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Investigating the Heterogeneity of Downsizing Practices across Firms"

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How did the Japanese Employment System Change? Investigating the Heterogeneity of Downsizing Practices across Firms

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Abstract: Beyond the general issue of institutional change at the aggregate level, some studies have shown that the diversity of Japanese firms has increased since the late 1990s, both in terms of performance and organization. This paper contributes to this literature by investigating the evolving employment practices at the firm level. In mobilizing a database of listed manufacturing firms, we focus on the evolution of the speed of downsizing between the 1990s and the 2000s. A specificity of our paper is that we do not limit our analysis to the introduction of individual effects but we rather resort to a Bayesian estimation procedure, which yields to (firm-specific) individual forecasts of the parameters of the adjustment process modelled with random coefficients.

The first major result we get is a decreasing average speed of downsizing, contrary to what is found in a simple estimation with individual effects. Second, we confirm the increasing heterogeneity of Japanese firms between the 1990s and the 2000s, through a rising dispersion of the speed of downsizing. Third, we are able, from a descriptive viewpoint to identify some characteristics of firms with different speed of downsizing.

Keywords: Corporate Heterogeneity. Japanese Employment System. Speed pf Employment Adjustment. Downsizing. Panel. Random coefficient model. Bayesian estimation.

JEL classification: C23, G30, J23, L20, L63, L68

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1. Introduction

Until the mid-2000s, the academic debate about the Japanese economy has focused about the reality and the extent of institutional change, mostly in relation with its poor macro performance. Some authors have then emphasized the importance of the change – understood as a conditional convergence towards more "liberal" (i.e. more market based) forms of capitalism such as in Dore (2000), Hoshi & Kashyap (2001) or Schaede (2004) -, whereas others were denying any sign of change (Mulgan, 2002; Witt, 2006), to the point that Japan has even been defined as "arthritic" (Lincoln, 2001).

The absence of conclusion in this debate at that time may be explained by the focus on different criteria or on different time span: for example more historical perspectives were able to identify some signs of change, whereas studies, which focused on the most recent period, were not able to identify any break. However, to our view, the most important reason is that the question was not properly asked, as it was mainly focusing on the aggregate level. There are now a significant number of studies that have shown that institutional change in Japan from the mid-1990s should be mainly understood as a process of increasing heterogeneity of firms, both in terms of performance and organization.[2] As for performance, Ito & Lechevalier (2009, 2010), among others, have shown the increasing productivity dispersion for manufacturing and non-manufacturing firms since the late 1990s. Moreover, this heterogeneity is "discrete" in the sense it concerns firms of similar size and belonging to the same narrowly defined sectors (Nelson, 1991). As for the increasing diversity of organization at the firm level, if the empirical evidence is less precise, it is nonetheless unambiguous. For example, Aoki, Jackson & Miyajima (2007) link the reform of corporate governance to the increasing diversity of organization among Japanese firms and are able to distinguish three different models thanks to a cluster analysis. Other more qualitative studies such as Sako & Kotosaka (2012) have identified signs of increasing diversity on the labor and financial markets and link them to institutional change.

This trend is not proper to Japan and has been identified in other countries. For example Faggio, Salvanes & Van Reenen (2010) show increasing productivity dispersion among British firms, while Jackson (2003) show similar increasing organizational diversity in Germany. However, in both cases, the evolution is more significant in Japan.

There are various important issues at stake in this evolution. Let us emphasize two of them. First, it becomes much more difficult to characterize economic systems and to

[2] See Lechevalier (2014) for a review of this literature.

understand the direction of institutional change. It may explain why there is no agreement about the nature of the current evolution characterizing the Japanese economic system. Second, this increasing diversity of firms may be the background of rising inequalities, as shown for example by Kalantzis, Kambayashi & Lechevalier (2012), who link productivity dispersion to wage inequalities in the case of Japan.

What has been just said in general terms is particularly important in the case of the evaluation of changes on the Japanese labor market. From the mid-1990s, there have been several studies questioning the "end of the Japanese employment system" (Sako & Sato, 1997; Genda & Rebick, 2000; Kato, 2001; Rebick, 2005, among many others). To put briefly, in the past, this system has been viewed as relative homogenous for firms of similar size and belonging to the same sectors. It means that the recognition of the diversity of practices was not completely absent: the dualism of Japanese labor market has been a classical topic, and researchers emphasized differences across sectors (e.g. manufacturing vs. non-manufacturing) and between small and large firms. However, it has been characterized from the 1960s by the institutionalization of an inclusive wage labor nexus, in the sense that differences across firms have tended to vanish in a context of labor shortage (Minami, 1994; Lechevalier, 2012). Classically, the post-war Japanese employment system was thought as characterized by long term employment and seniority wage as an incentive (Koike, 1991). A rather complementary way of characterize it has been to focus on its major mode of adjustment: Dore (1986), among others, has shown the tendency of Japanese firms to resort to internal flexibility through various means (working hours, bonus cut, internal mobility within the firm or the group) rather than external flexibility (e.g. layoff). A reason that has been particularly emphasized in the literature refers to the greater investment in firm-specific human capital in Japan than in the US for example (Koike, 1991), which makes employment adjustments through dismissal and layoffs more costly there than in the US. As a result of this reticence towards downsizing, the speed of employment adjustment in Japan was apparently slower (Abraham and Houseman, 1989; Hashimoto, 1993). This is the way we will follow in this paper to study the evolution of the Japanese employment system. To put it differently, our approach to long-term employment in Japan and its changes is based on an ex-post method that focus on behavioral outcomes (Ono, 2010).

In a context characterized by slow growth if not economic stagnation, increasing pressures from globalization that force firms to reduce labor cost, but also public policies promoting more market mechanisms, the Japanese employment system has evolved. Key

features concern the rising number and share or non-regular workers, which represents more than 1/3 of the total workforce in the most recent period (Houseman and Osawa, 2003; Rebick, 2005; Coe, Johns, and Ward, 2011) and the declining job tenure (Kawaguchi & Ueno, 2013).[3] Although the turning point is relatively clear - end of the 1990s-early 2000s (see for example Sako & Kotosaka (2012) or Noda and Hirano (2013)) -, both the nature of the change and the definition of the emerging model are problematic (Lechevalier, 2014). In this paper, we argue that this is because previous studies have not enough drawn conclusions from the increasing diversity of firms. To take only one example, the rise of non-regular workers is concentrated in some establishments or firms as shown by an analysis of the *Diversification of Employment Form survey* (Lechevalier, 2014) or of a matching between the *Employment Trend Survey* and the *Basic Survey on Wage Structure* (Kalantzis, Kambayashi and Lechevalier, 2012). The purpose of this paper is to study the evolving diversity of employment practices at the firm level in focusing on downsizing employment adjustment.

This focus can be justified as follows. As recalled above, a typical behavior of Japanese firms facing a drop in their sales has been to reduce hiring rather than firing. Focusing on downsizing allows us looking, at least indirectly in the absence of gross flows data, at the exit side. Generally speaking, looking at the employment adjustment gives us the opportunity to empirically determine whether employment practices at the firm level have been stable or not (Bednarzik and Shiells, 1989; Chuma, 2002; Steinberg and Nakane, 2011). For example, one criterion is to check whether, for a given shock, the speed of employment adjustment has increased or not.[4] Many empirical works have already investigated this question. However, to our knowledge, no study has systematically investigated the evolving heterogeneity of downsizing employment adjustment at the firm level. For example, the fact that *some* firms are quickly restructuring should not be automatically interpreted as the sign of the end of long term employment practices in *general*. Non negligible differences in the mode of adjustment are observed across firms, in terms of speed of adjustment, factors at the origin of the employment adjustment or in qualitative instruments used to adjust employment.

Our main purpose is indeed to check how this diversity has evolved during the last two decades. We classically investigate how the average speed of adjustment has evolved but we

[3] Note that comparison with the US may lead to different conclusions regarding the significance of change. See for example Kambayashi & Kato (2011) or Farber (2007). Moreover, depending on the considered indicator (job tenure, separation rate, or ex-ante definition), the results may considerably vary(Ono, 2010)

[4] Other criteria may concern the volume of employment adjustment or the determinants of adjustment, as explained below (sub-section 2-1).

do not restrict our analysis to this question. We use an econometric estimation that allows us studying the evolution of the dispersion of the individual speed of employment adjustment. Moreover, as there is a potential asymmetry between upsizing and downsizing and the latter is a key to detect any change in employment adjustment practices (see Dore, 1986; Kang, J.-K. and A. Shivdasani, 1997; Ono, 2010; Noda and Hirano, 2013 among others), we focus on the speed of downsizing.

For this purpose, we use a micro database of 658 Japanese listed manufacturing firms taken from two databases, which compile the same data source, financial statements of listed firms: NEEDS (Nikkei Economic Electronic Databank System) and Japan Development Bank database.[5] In order to be able to identify some changes during the two last decades, we collect data from 1992 to 2011 on an annual basis and we make a comparison between the 1990s and the 2000s. This dataset allows us using a panel framework to test and analyze the evolution of heterogeneity of employment adjustment patterns across firms. Contrary to the majority of empirical studies, we do not limit our analysis to the introduction of individual effects. Rather, we resort to a Bayesian estimation procedure, which yields to (firm-specific) individual forecasts of the parameters of the adjustment process. More precisely we combine a random coefficient model *à la* Swamy (1970) and a Bayesian estimator of the individual parameters.

To summarize, conditionally to a specification of the dynamics of employment adjustment at the micro level, this paper aims at addressing three major questions. First, what has been the evolution of the average speed of downsizing? Second, how has the heterogeneity of firms from the viewpoint of their speed of downsizing evolved? Third, is it possible to identify different groups of firms on the basis of their speed of downsizing and to draw some conclusions from the viewpoint of the employment security of their workers?

Our results are as follows. The first major result is a decreasing average speed of downsizing, contrary to what is found in a simple estimation with individual effects. Second, we confirm the increasing heterogeneity of Japanese firms between the 1990s and the 2000s, through a rising dispersion of the speed of downsizing. Then, the question is to relate these differences of employment adjustment to fundamental characteristics of the firms. This is our third result: we are able, from a descriptive viewpoint, to identify some characteristics of firms with different speed of downsizing and to conclude that regular workers are experiencing diverse employment security conditions that depend on the firm they work for.

[5] The size of the sample we use in most of estimations will be reduced because of some missing values and technical conditions in the estimation of the speed of downsizing.

This paper is built as follows. In the next part, we present some stylized facts on the employment adjustment and downsizing of the Japanese firms based on a literature review. In a third part, we describe the different specifications to be estimated in order to capture of the evolution of the heterogeneity of downsizing. In the fourth part, we introduce our database and some stylized facts. In the fifth part, we present the results of the estimations. A last part is devoted to concluding remarks.

2. Employment adjustment and downsizing: framework and stylized facts characterizing the Japanese case

2.1 Framework

Before surveying the empirical literature on employment adjustment and downsizing in Japan and introducing the issue of heterogeneity in the next section, it is worth briefly recalling the basic model. The estimation of employment adjustment is based on dynamic labor demand functions such as the ones introduced in Hamermesh (1993). The form of the dynamic labor demand depends on the specification of the adjustment costs. A first way to specify them is to consider a quadratic and symmetric function defined as:

$$C(\Delta L_t) = \frac{c}{2}(L_t - L_{t-1})\ c > 0$$

where L_t denotes labor and $\Delta L_t = L_t - L_{t-1}$. This far from perfect specification allows us to easily derive the analytical form of labor demand. Indeed, assuming a quadratic form for the production function,

$$F(X_t, L_t) = X_t L_t - \frac{b}{2} L_t^2 \quad b > 2$$

where X_t denotes a vector of inputs, we can show that in an uncertain environment, under the assumption of rational expectations, the maximization of an expected stream of discounted profits leads to the following form of employment dynamics:

$$L_t = \mu L_{t-1} + \sum_{i=0}^{\infty} \gamma_i E_t \left(X_{t+i} - w_{t+i}\right) \quad (1)$$

where w_t is the real wage at time t and where the autoregressive parameter μ is a non-linear combination of the structural parameters.

$$\mu = \left[\frac{c + (1+r)(b+c)}{2c}\right] - \frac{1}{2c}\{[c + (1+r)(b+c)]^2 - (1+r)c^2\}^{\frac{1}{2}}$$

Adding the assumption of a first-order autoregressive form for the exogenous factors and for the real wage, the conditional expectations of these variables are then proportional to the current observed level. We can deduce a labor dynamic demand shown by:

$$L_t = \mu L_{t-1} + \beta X_t + \rho w_t \quad (2)$$

Where the parameters β and ρ are non-linear combinations of the autoregressive parameters of exogenous processes and the parameters γ_i in equation (1). In this case, we get the same specification as Hamermesh (1993):

$$L_t = \mu L_{t-1} + \beta Z_t + \varepsilon_t$$

Where ε_t is an i.i.d. process and Z_t designs a vector of variables influencing the long-run labor demand including the real wage. In such a specification, all the explanatory variables are observable; moreover, the estimation of the parameters gives a measure of the speed of employment adjustment, through the median lag defined by $-\log(2)/\log(\mu)$.[6] Then we can show that the speed of employment adjustment is inversely proportional to the level of adjustment costs represented by the parameter c. From this general specification, it is possible to derive several models based on alternative assumptions on the adjustment cost structure, the nature of expectations and the form of the production function. Here, we adopt a framework with one production factor, labor, which is not split into workforce and work hours, because of a lack of data. Finally, we use a log linear approximation of the model:

[6] From this, it can be understood that the "optimal speed" is to be understood by reference to a long term target. See Hamermesh (1993) for a more precise explanation.

$$\Delta \log(L_t) = a_0 + a_1 \log(Q_t) + a_2 \log(w_t) + a_3 \log(L_{t-1}) + \theta_t \qquad (3)$$

where Q_t and w_t denote respectively the level of production and the real wage.

In this log-linear model, we can define clearly what we mean by "speed of adjustment": it corresponds to the opposite value of the autoregressive parameter a_3 as it can be shown quickly. Let us assume that the labor dynamics is given by:

$$L_t = a_0 + a_1 \log(Q_t) + a_2 \log(w_t) + \vartheta \log(L_{t-1}) + \epsilon_t$$

where ϑ, with $|\vartheta| < 1$, denotes the autoregressive parameter. The so-called "adjustment speed of labor" is defined by the quantity $1 - \vartheta$ and denotes the persistence of the shocks in the labor dynamics. This adjustment speed corresponds to the opposite of the parameter a_3, since we have $a_3 = \vartheta - 1$.

From this, we can easily derive the speed of downsizing. It is still the opposite value of the autoregressive parameter a_3 in the following equation

$$\Delta \log(L_t) = a_0 + a_1 \log(Q_t) + a_2 \log(w_t) + a_3 \log(L_{t-1}) + \theta_t \;\; if \; \Delta \log(L_t) < 0 \qquad (3')$$

The next question is how to interpret the speed of downsizing. As recalled above, the reluctance to downsize among Japanese firms by comparison to their American counterparts, which leads to a relatively slow downsizing speed, may come from a greater investment in firm-specific human capital, which makes employment adjustments through dismissal and layoffs more costly (Hashimoto, 1993; Koike, 1991). For this reason, labor may be treated to some point as a “quasi-fixed factor” (Oï, 1962). There may also more institutional reasons for this relatively slow downsizing speed: as recalled by Noda and Hirano (2013), from a historical perspective, firms’ emphasis on long term employment stems not only from their strategy to accumulate firm-specific human capital, but also from their desire to maintain cooperative relationships in avoiding struggles with the enterprise union. In this context, the bargaining power of this last actor comes from the link that it contributes to establish between job security for regular workers and prosperity of the firm, especially productivity increases. It means that the practice of downsizing (and in particular its speed) says something deep about HRM in Japanese firms, and that any increase of the average speed of downsizing in the 2000s, if confirmed, would indicate a change in the Japanese employment system. Focusing

on the downsizing speed has indeed several advantages from the viewpoint of the study of HRM and its evolution. First, this is obviously a synthetic indicator for HRM. Second, this is an objective outcome, contrary to the answers we can get from qualitative surveys on HRM practices (see for example Bloom and Van Reenen, 2007). Third, it allows capturing some important characteristics of employees' (micro) job security.[7]

However, at the same time, analyzing the evolution of employment practices through the speed of downsizing implies a certain number of limitations, which should be taken into account in order to be cautious in interpreting the results. First, it is not a comprehensive indicator of mobility, as it focuses on its external dimension. Second, in interpreting the results, we should pay attention to the macro and sectoral contexts: downsizing has not the same meaning in declining, mature or growing industries. Third, we have to be careful about the choice of the sample and/or the control of performance indicators: the dispersion of downsizing speed captures both the dispersion of performance and of adjustments to comparable shocks. Fourth, as it will be explained in sub-section 4-1, with our dataset and our methodology, we are not able to distinguish between different types of workers (regular vs. non regular), different types of downsizing (attrition versus firing), and we cannot control for hour adjustment. Finally, it is worth emphasizing that this paper focuses on the speed of downsizing but that other characteristics matter such as, for example, the volume of downsizing (i.e. the size of the adjustment), which are not taken into account in the present discussion.[8]

2.2 The Japanese case: literature review and stylized facts

Studies on employment adjustment in Japan that used dynamic labor demand function constitute a substantial literature, which can be classified into two categories that will be reviewed below: some of them focus on the evolution of the speed of employment adjustment, eventually in international comparison (mostly by reference to the US); others study the determinants of the adjustment and the characteristics of the firms, in analyzing in particular the role of financial constraints and of corporate governance. Besides these two streams of

[7] Another advantage, not related to HRM issues, is that studying the downsizing speed allows analyzing how firms do adapt to shocks such as globalization or crisis such as the Lehman shock (Farber, 2007; Steinberg and Nakane, 2011).

[8] As downsizing in Japan is characterized by strong non-linearities (for example because of the two consecutive-years loss practices), it is difficult to identify any change in HRM practices based an important volume of downsizing during a given year. From this viewpoint, both speed and timing of downsizing are more accurate characteristics of the long-term employment practices in Japan.

research, there have been various attempts to discuss the very process of adjustment, either in taking into account its discrete nature at the micro level (Hildreth and Ohtake, 1998), in analyzing the asymmetric nature of adjustment in decreasing/increasing regimes (Matsumoto, Hara, and Nawata, 2009), or in estimating jointly employment and wage adjustment (Tachibanaki and Morikawa, 2000; Ariga and Kambayashi, 2009). However, as far as we know, surprisingly enough, there has been no systematic effort to deal with the heterogeneity of employment adjustment at the firm level, despite some attempts at the industry level (Abe, 2002).

There is no general agreement about the evolution of employment adjustment in Japan from the 1990s onwards. For example, Higuchi (2001) estimates dynamic labor demand functions with macro data and finds an increasing speed of adjustment. In the same spirit, other studies such as the one summarized in Ministry of Labor (1999) find that the employment adjustment is more sensitive to economic cycles and to operating losses in the 1990s than previously (e.g. in the 1970). On the contrary, Boyer and Juillard (2000), who estimates dynamic labor demand functions with industry level data of regular employees, find a stability of the employment adjustment speed. They explain this result by the fact that Japanese firms in the 1990s still resort to other tools of adjustment than employment adjustment, such as reduction of working hours, wage cuts, transfers of employees within the group. An interesting complement is provided by Chuma (2002), who confirms the finding of Boyer & Juillard (2000) regarding the apparent soft adjustment at the macro level but shows that it may be in reality harsher at the firm level. Moreover, Steinberg and Nakane (2011) confirm the low employment responsiveness in Japan after the Lehman shock by looking at macro and industry levels data. However, they note that it has risen over time, especially through the increasing importance of the non-regular force. This finding makes particularly interesting a comparison between the adjustment to two different shocks, during the 'Lost Decade' (especially in the late 1990s and early 2000s) and after the Lehman shock.

It is worth noting here that we find a similar inconstancy in more recent studies using micro data and looking at the evolution until the 2000s. For example, Nakata (2007) studies the evolution of the employment adjustment speed at ten large firms in the manufacturing and wholesale and retail and finds that it has accelerated around 2000s. This result is not confirmed by Kumasako (2010), who studies a larger panel of firms for a longer period with a

similar GMM estimation method.[9] A part of the explanation of the absence of converging results regarding the answer to such a basic question as the evolution of employment adjustment speed certainly lies in the differences of data (for example macro vs. micro as shown by Chuma, 2002), of samples of firms and period or of modelling of the process (continuous vs. discrete). However, to our view, a key reason, as we will try to show it in our own result, refers to an inappropriate modelling of the heterogeneity, which more deeply correspond to an insufficient attention to the increasing heterogeneity of the Japanese human resources management models from the 1990s, despite isolated and not enough systematic attempts (see for example Suruga, 1998; Chuma, 2002; Abe, 2002; Noda, 2002).

While, as we have just seen, there is no systematic analysis of the heterogeneity of employment adjustment at the firm level, attempts to identify the *determinants* of employment adjustment are numerous. As recalled above (sub-section 2.1), this is of high interest for our own purpose as it may give some insights regarding of the evolution of the heterogeneity of human resource management at the firm level. For example, this heterogeneity may be connected to the absence/presence of unions (Noda, 2002). More generally, as soon as we are able to identify coherent sets of characteristics, it may be possible to propose an interpretation in terms of heterogeneous productive models (Oï, 1983). More precisely, different strategies regarding the accumulation of firm-specific human capital may be connected to the characteristics of different groups of firms defined by their speed of downsizing, as it will be argued in sub-section 5-3.[10]

However, it is worth recalling that the general difficulty with these studies is that there is no behavioral or structural model that may justify the direct introduction of corporate characteristics in the dynamic labor demand functions presented above. Because of this lack of theoretical foundation, our purpose here will be limited to survey papers that have identified a certain number of variables that may explain why some firms adjust slowly or rapidly in apparently similar circumstances (i.e. under a similar shock).

A first question concerns the correlation between the speed of adjustment and other characteristics of the HRM at the firm level, such as the job tenure for example. Although the relationship between the two is non-trivial, we expect a positive correlation as a slow speed of downsizing may correspond to a reluctance to fire in case of downturn and leads to longer

[9] Beyond the evolution of downsizing speed, changing behavior may also matters as emphasized by Noda and Hirano (2013), who study the impact of the changing attitude of union towards downsizing on its practice by firms at the end of the 1990s.

[10] Our purpose is therefore here much less ambitious than in Ito and Lechevalier (2010), who try to identify the endogenous sources of heterogeneity in investigating the complementarity between export and innovation strategies.

tenure in the case there are some restraints on the hiring rate, as observed in Japan since the 1990s. As a result, one should observe a higher average age of the employees.[11]

Among the other variables that have been the most commonly acknowledged for their correlation with the speed of downsizing are the industry and the size, which are often used as control variables. Many studies have already found significant differences of speed of employment adjustment across industries (Abe, 2002). Regarding the size, it tends to slow down the speed of adjustment for the following reason (Suruga, 1998): the bigger a firm is, the more it can resort to internal transfers of a part of the workforce, which is not accounted in studies focusing on external mobility.

Other non-financial firms' characteristics seem to be correlated to the mode of employment adjustment. First of all, the *share of exports in total sales* captures the impact of the globalization of product markets on the employment from the point of view of the firms. It is expected to contribute to a more rapid adjustment as a more competitive environment may require more responsiveness (Dore, 1986; Farber, 2007, among others). Second, the *innovation effort* (as captured by the ratio of R&D expenses for example) and the capital intensity should have a negative impact on the speed. This is the main result of a "labor as a quasi-fixed factor" type of analysis (Oï, 1962): the more the firm is oriented toward innovation and is capital intensive, the more the human capital is integrated to the physical capital and is the object of specific investments. As for *the age of the firm*, it is most often thought as negatively correlated with the speed of adjustment.[12] Various argument may justify this, such as the institutionalization of the wage labor nexus (Lechevalier, 2012, 2014) or the fact that smaller firm are more fragile and may have to react quickly, for example in a context of financial distress (Ogawa, 2003).

In addition to the above mentioned non-financial factors, many studies have focused on various financial factors mostly interpreted in term of corporate governance. We may distinguish various reasons to explain the popularity of this type of argument. One is due to the success of the so-called negative profit adjustment model (Suruga, 1998; Noda, 2013).[13] Another reason, related to the previous one, is the importance of financial constraints. For example Ogawa (2003) finds that they are stronger for smaller than for larger firms and that it induces a more rapid speed of adjustment in the former ones. Although this mechanism is not

[11] Another important HRM related variable concerns the role played by unions (Noda, 2002; Noda and Hirano, 2013). However, we could not include it in the present study because of lack of appropriate data.
[12] In this paper we use the variable *Date of creation of the firm* and we therefore expect a positive correlation.
[13] This model has been tested more recently by Matsumoto, Hara and Nawata (2011), who basically confirm its pertinence, except during the period of the Bubble and the most recent period (from the late 1990s to the mid-2000s in their studies), when firms seem to restructure independently of the existence of negative profit.

proper to Japan, it may have been a source of increasing heterogeneity across Japanese firms after the Bubble period (1986-1991) that lead to over-investment and over-debt behaviors for some firms. After the burst of the Bubble, the consequences of such strategies were dramatic, especially in a deflationary context, which increased the debt burden. In fact, according to a study realized by the Development Bank of Japan (2000), increases of the debt equity ratio (DER) significantly accelerated the process of job destructions in Japan between 1978 and 1998. This study concludes that the influence of the debt on the employment adjustment decisions had certainly increased between the 1970s and the 1990s.

Last but not least, a final reason of the popularity of this approach refers to "classical" theories of the Japanese firm such as the one proposed by Masahiko Aoki (see for example Aoki, 1990), which lead to investigate the complementarity between employment practices and corporate governance variables (Abe, 2002; Noda, 2013). We do not consider here the impact of the Main Bank or of the financial structure (e.g. market vs. bank-led finance) for the following reasons: besides the fact that the importance of the Main Bank as an organizational feature has decreased from the 1990s (Noda, 2013), the reality of their correlation with HRM practices in general and with employment adjustment in particular is dubious. According to various studies (such as Abe, 2002) a more important characteristic concerns the *stockholding structure*. For example, the importance of *cross-shareholding* is expected to have a negative influence on the speed of the employment adjustment, as firms with higher cross-shareholding ratio feel less pressure. Another example is the share of the *foreign shareholders*: the bigger it is, the stronger may be the pressure of international financial markets to reach certain levels of profitability, and the more rapid may be the speed of adjustment.

Finally, let us mention an important corporate characteristic that may be correlated to the downsizing speed, corporate performance, which can be captured through various indicators, such as productivity or profitability.[14] A classical debate in the U.S. has concerned the relationship between downsizing and productivity and the least we can say is it has been little conclusive (Baily, Bartelsman and Haltiwanger, 1994). Some studies such as Suruga (1998) nonetheless seem to indicate that good performances (measured by various indicators of profitability) go hand in hand with a slow employment adjustment. However, this result is fragile as there is obviously a problem of causality.[15] Table 1 summarizes the variables

[14] This is worth noting that the correlation between corporate performance and downsizing speed is particularly difficult to interpret, because of causality issues.

[15] Moreover, the relationship between performance and downsizing speed seems to be characterized by a non-linear relation, as indirectly shown by Noda and Hirano (2013) in their study in which they look at the interaction term between union and ROA.

considered in this paper and the expected sign of their correlation with the speed of downsizing.

3. How to study the evolution of the heterogeneity of the employment adjustment: introducing alternative specifications

In this section, we focus on the modelling of the *heterogeneity* of downsizing. For the sake of simplicity, in the discussion below, we do not distinguish the direction of employment adjustment, that is, we do not consider any threshold, as in equation (3'). What is explained below in general holds of course for downsizing, which is a specific case.

The choice of the specification of employment adjustment previously introduced is determined by the answers given to two problems: the form of the employment adjustment (continuous versus discrete) and the modelling of the heterogeneity. Our contribution focuses on the second problem.[16]

From now, let us consider the preceding specifications introduced in sub-section 2-1 in a panel framework including *N* firms observed on *T* periods. For firm *i* and year *t*, the simplest model is the following:

$$\Delta \log(L_{i,t}) = a_0 + a_1 \log(Q_{i,t}) + a_2 \log(w_{i,t}) + a_3 \log(L_{i,t-1}) + \theta_{i,t} \qquad (4)$$

In this specification, we assume that the dynamics of employment is strictly identical for all the firms of the sample. Implicitly, it is equivalent to assume the homogeneity of the production structure and of the adjustment costs function (*b* and *c* parameters in the above specifications). In this case, the average median lag is identical for all firms. Such an assumption is in fact very restrictive and has to be tested (Hsiao, 1986). On the contrary, we can assume that the structure of production and the functions of adjustment costs vary across firms, so that there is nothing common between them, except the general specification of the functions. In that case, the model is:

[16] Here we do not enter into the details of the origin of the heterogeneity but it is worth recalling that it related to the adjustment costs and it can have two basic sources. One is legal or institutional and may explain the inter-countries differences (Houseman & Abraham, 1994). The other one is productive and explains the within country heterogeneity, which is our object in this paper.

$$\Delta \log(L_{i,t}) = a_{0,i} + a_{1,i} \log(Q_{i,t}) + a_{2,i} \log(w_{i,t}) + a_{3,i} \log(L_{i,t-1}) + \theta_{i,t} \quad (5)$$

where the parameters $a_{j,i}, (j = 0, 1, 2, 3)$ are *a priori* different across firms and residuals $\theta_{i,t}$ are independently distributed across firms. As a result, these parameters have to be estimated firm by firm.

Between these two extreme assumptions, some specifications provide a better and more general modelling of the heterogeneity of employment adjustment paths. First of all, we shall consider that the introduction of individual effects is sufficient to take into account the heterogeneity of the dynamics:

$$\Delta \log(L_{i,t}) = a_{0,i} + a_1 \log(Q_{i,t}) + a_2 \log(w_{i,t}) + a_3 \log(L_{i,t-1}) + \theta_{i,t} \quad (6)$$

In this case, we assume the heterogeneity across firms of the structural rate of growth of employment $a_{0,i}$, under the restrictive assumption that the speeds of adjustment and the long term parameters are homogenous. In this case, the specification, fixed or random, of individual effects has to be tested by a usual Hausman's test. However, such assumption is *ad hoc* because we have seen above that the constants and the coefficients of this specification are non-linear combinations of the same structural parameters, if we assume the existence of quadratic adjustment costs and rational expectations. Under these last two assumptions, it is difficult or even impossible to identify any heterogeneity concerning the average levels, without this heterogeneity affecting the autoregressive parameter of the conditioning variables. In the former example, with quadratic production and adjustment costs functions, the constant and the autoregressive parameter are functions of the parameters *b* and *c* (see equation 1): if one of these two structural parameters varies across firms, we cannot derive a specific constant for each firm, while keeping the assumption of the same adjustment speed $-a_3$

In these conditions, a panel specification providing an effective capture of the heterogeneity of the employment dynamics (coming either from the production structure or from the adjustment costs) consists in assuming the existence of random coefficients, as in Swamy (1970):

$$\Delta \log(L_{i,t}) = a_{0,i} + a_{1,i} \log(Q_{i,t}) + a_{2,i} \log(w_{i,t}) + a_{3,i} \log(L_{i,t-1}) + \theta_{i,t} \quad (7)$$

$$a_{i=}\ (a_{0,i}, a_{1,i}, a_{2,i}, a_{3,i})\ i.i.d.\ (\bar{a},\ \Omega) \tag{8}$$

where the parameters $a_{j,i}$ and in particular the adjustment speed $-\ a_{3,i}$ are assumed to be real random variables with $cov\left(a_{j,i}\theta_{i,t}\right) = 0, \forall\ i, j, t.$ Since this specification is not restricted by assuming the equality of the parameters, it allows taking into account the heterogeneity of the adjustment dynamics. However, we assume that these variables have a common distribution, or, at least, two identical first moments. We then have to estimate the expected value and the second order moments associated to these distributions. Here the second advantage of this approach appears: it gives the possibility to make the estimation on the basis of a distribution of adjustment speeds. For example, it is possible to evaluate the mean and the variance of the distribution from the sample. Doing so, we can precisely measure the increasing or decreasing trends of the heterogeneity of the adjustment median lag across firms.

Nevertheless, this specification with random coefficients raises several problems. First of all, it is necessary to justify the stochastic nature of the parameters of the reduced form. If we come back to the initial model, this hypothesis is equivalent to the *ad hoc* assumption of adjustment costs or production functions with stochastic parameters. However, it is important to note that the general solution for such kinds of functions is no longer defined by the equation (1). The second issue with this specification is that we do not have an *a priori* forecast of the adjustment speed for one particular firm. We can just estimate the first two moments of its distribution. We will solve this problem in proposing a Bayesian estimator of the individual parameters (Hsiao, 1996). We will *a priori* assume a distribution on these parameters, by using the GLS estimators of the two first moments. The Bayesian predictor we then obtain is a combination of the information specific to each firm *i* (time series information) and of the prior information on the first two moments $\bar{a}$ and Ω of a distribution, which is assumed to be homogenous for the set of *N* firms. These moments are estimated by using the Swamy (1970) GLS two steps procedure.

Thus, for a given firm, the less precise the individual information on the adjustment speed is (that is the higher the variance of the individual estimator is), the closer the individual predictor will be to the mean of the common distribution, estimated by GLS, given the whole sample. On the contrary, in the case of a firm, on whose adjustment speed we have precise

individual information, the individual predictor will give a small weight to the information given *a priori* on the expected value of the distribution common to the firms. More formally, if we note $\widehat{a_i}$the Bayesian individual predictor of the vector of parameters a_i for the i^{th} firm we have:

$$\widehat{a_i} = (\widehat{\Omega}^{-1} + \frac{1}{\widehat{\sigma}_i^2} X_i' X_i)^{-1} (\widehat{\Omega}^{-1} \hat{a} + \frac{1}{\widehat{\sigma}_i^2} X_i' Y_i) \quad (9)$$

In this definition, $\hat{a}$ corresponds to the GLS estimate of the mean of the distribution of parameters a_i, and $\widehat{\sigma_i}$ denotes the estimate of the variance of residuals for the firm *i*. The Swamy's estimate of the matrix of variance covariance of the parameters a_i, denoted $\widehat{\Omega}$, is defined as:

$$\widehat{\Omega} = \frac{1}{N} \sum_{i=1}^{N} (\tilde{a_i} - \tilde{a})'(\tilde{a_i} - \tilde{a}) \quad (10)$$

where $\tilde{a_i}$ is the OLS estimate of individual parametersa_i and $\tilde{a} = (1/N) \sum_{i=1}^{N} \tilde{a_i}$.

At this stage, we should mention an issue, for which we cannot propose any solution. Exogeneity may not hold for the output variable, since output depends on employment and may be therefore correlated with the residual in the labor demand equation. However, as far as we know, there is no way to solve this problem in a random coefficient model (Hsiao and Pesaran, 2004). In order to try to deal nonetheless with this endogeneity issue, we have proceeded as follows: we have considered the pooled specification, in which the coefficient are supposed to be identical for all firms and we have transformed the equation (4) into the equation (4'):

$$\log(L_{i,t}) = a_0 + a_1 \log(Q_{i,t}) + a_2 \log(w_{i,t}) + (a_3 + 1) \log(L_{i,t-1}) + \theta_{i,t} \quad (4')$$

Then, we have estimated the equation (4') by using the method of Arellano and Bond (1991) and taking the first difference of $\log(L_{i,t})$ as instruments. Once this equation is estimated, it is easy to deduce the adjustment speed.

Finally, let us mention an alternative empirical strategy in order to answer to the second question we address in this paper, namely the emerging differentiation between groups of firms. Instead of resorting to a pure descriptive approach as it will be done below or to a clsuter analysis as in Aoki, Jackson and Miyajima (2007),[17] we may think to a non-dynamic panel transition regression model (PTR) with fixed individual effects.[18] The major interest of this type of model is to be able to identify thresholds in the time dimension (e.g. historical turning point) and in the cross-section dimension (e.g. identification of different groups of firms). This strategy is not followed here because we focus on the estimation of individual speeds of adjustment.

4. Dataset and descriptive statistics

4.1 Dataset

In this paper we primarily use a balanced panel of 658 manufacturing firms observed over the period 1992-2011. For reasons explained below, mainly because of conditions related to the number of downsizing experiences, this balanced sample will be restricted to 410 for most of the estimations presented in this paper. This sample is obtained from the NEEDS and Japan Development Bank databases, which are both built from the annual reports of firms listed at the Tokyo Stock Exchange.[19] Although NEEDS and Japan Development bank databases are financial oriented databases, without precise information about the workforce, except the number of regular employees in the mother-firm, they are often used to study the patterns of employment adjustment and the characteristics of the corporate governance in a context of still restrictive access to administrative surveys (Suruga, 1998; Abe, 2002; Nakata, 2007; Matsumoto, Hara and Nawata, 2009; Kumasako, 2010, among others).

[17] If a cluster analysis allows defining groups without *ex ante* criteria such as the size class or the sector, it raised two problems. First, it is characterized by an inherent fragility because of the lack of strong statistical criteria and the instability of grouping depending on the chosen parameters. Second, and even more importantly, cluster analysis is very weak if not unable to deal with dynamic issues such as the evolution of dispersion.

[18] For a general introduction to this type of model, see Hansen (1999); for an application to Japanese price dynamics, see Canry, Fouquau and Lechevalier (2011).

[19] As the data source is the same, both databases should contain the same information. However, we found significant differences, especially regarding missing values for some variables, and we combined both of them after having checked that the matching is coherent.

Our sample does not include firms listed before 2011, and which are no longer listed in 2011. Consequently we face a classical problem of survival bias. As a consequence, we do not consider the job creations and destructions through the birth and death of firms.

An explication must be given regarding the choice of the period. In this paper, we focus on the period from 1992 to 2011, which we divide into two sub-periods, 1992-2001 and 2002-2011. This choice can be justified as follows. First, we start our study at the beginning of the so-called Lost Decade and we end it at the most recent year for which data are available. Second, our purpose is to compare the "1990s" and the "2000s" in investigating the reality of the turning point in the behavior and performance of Japanese firms, which has been identified between the end of the 1990s and the early 2000s (Aoki, Jackson, Miyajima, 2007; Ito & Lechevalier, 2009). Finally, both sub-periods include the same number of years (10).

The definition of the variables is specified in table 1. We use non-consolidated annual data, which are better than the consolidated ones to study a mid-term evolution (such as between 1992 and 2011) and more generally historical evolutions (Suruga, 1998; Abe, 2002; Chuma, 2002; Matsumoto, Hara & Nawata, 2011). In doing so, we are able to capture job mobility within a group as a form of external mobility from the viewpoint of a single firm. We are also able to better control for mergers and acquisitions. However, there is still one remaining problem, with which we were not able to deal: during this period, a law was passed in 1997, which lifted the ban for the holding structure. Adopting such a structure for a firm implies that employment on an unconsolidated basis will be apparently reduced for organizational reasons, which does not correspond to a case of downsizing.[20]

The database does not contain any information about the number of non-regular employees, nor about the worked hours, which are however two important features of the Japanese mode of employment adjustment. Consequently, our results concern uniquely the number of regular employees. This point deserves several comments that will focus on the issue of non-regular workers. We are aware that our sales data correspond to the production of both regular and non-regular workers, whereas employment and wages are only those of regular workers. Therefore, ideally, we should include the adjustment of non-regular workers. This is particularly important if they act a buffer for regular workers: if it is the case, a low speed for regular workers may come from a high speed for non-regular workers. It means that we should be very cautious in the interpretation of our results: different speeds of downsizing

[20] We are grateful to Katsuyuki Kubo for having attracted our attention on this point. Although we are aware of the bias this problem may introduce, we did not deal with it, in the absence of data on the firms, which adopted the holding structure, or of clear statistical criterion to identify them *ex post*.

for two firms say less about their different "essence" than about the different conditions (e.g. micro employment security) of their regular workers (see also sub-section 5.3). [21][22]

A sectoral price index, taken from the Bank of Japan database, has been chosen to value production, understood as sales per annum rather than the value added. Finally, we use the real average wage, constructed by dividing the payroll (not including the wages of non-regular employees) by the number of employees and deflating by the same price index as the one used for production. Most variables are taken from the NEEDS and Japan Development Bank databases, except the date of creation of the firm, which is taken from the Japan Company Handbook (JCH).

As the industrial classification, we refer to the usual classification made by the Tokyo Stock Exchange. As seen in Table A1, the distribution by sub-manufacturing sectors is very unbalanced, which correspond however more or less to the structure of manufacturing in Japan, dominated by large and international companies in the machinery, electrical machinery or chemicals sectors.

4.2 Descriptive statistics

The basic features of our data are summarized in table 2. It is possible to highlight the following points. First of all, our sample of listed manufacturing firms include on average very large firms (between 2,000 and 3,000 employees during the period). This is not a problem for our purpose, which is to show an increasing heterogeneity within a same sector for firms of similar size.[23] They are also characterized by a high capital ratio (between 20 and 30%), a high R&D ratio (between 2% and 3%), relatively highly internationalized by comparison to other firms if one looks at the export ratio (between 12% and 17% of sales against less than 10% for the average of manufacturing firms according to Cabinet office (2006)) or the foreign ownership (more than 5%). They were also created in the mid-1930s

[21] A technical assumption to justify our approach despite the absence of data on non-regular workers is to assume that the cost function has an additive form as follows: $C(\Delta L_t) = \frac{c_1}{2}(R_t - R_{t-1}) + \frac{c_2}{2}(N_t - N_{t-1})$, where L, R, and N are respectively the total number of employees, the number of regular workers, and the number of non-regular workers.

[22] Let us also mention that we are aware that data on non-regular workers are available in the *Monthly labor survey*. Although, in principle, it is possible to get access to micro data, there are at least two problems. First, monthly labor survey is an establishment based survey while our dataset is at the firm level; it is in principle possible to connect them but there is a very high probability that the matched dataset will be incomplete (for each firms some establishments will be missing). Second, this procedure is conditioned to the permission by the MHLW in charge of the *Monthly labor survey* to make public the names of the establishments that are in principle anonymous. Therefore, despite the very promising outcome of a matching between administrative surveys such the Monthly labor survey and listed firms' dataset, we decided to give up this procedure and to leave it for further research.

[23] Moreover, it is well-known that the smaller are the firms, the higher is the heterogeneity.

and are therefore old on average. As for the employees, they are also aged (around 40 years old).

It is also interesting to see the evolution between the two sub-periods. During this period the tenure has slightly increased, up to 17.8 years, the average age of employees has significantly risen from 39.8 years to 41.2, which may indicate a decrease in the hiring (which cannot be captured with our data). The R&D ratio has slightly increased while a sharper increase (+50%) of the capital/labor ratio is observed. On average, firms of our sample have better performance in the 2000s, especially if one looks at the productivity or the ordinary profit (including in a ratio to sales, as in *perfo2* indicator), less according to other indicators. Firms have become more internationalized, both in terms of export ratio and share of foreign shareholders. They have also experienced a decay of their cross-shareholding (from 25.9 to 24.6), while the evolution of their debt is more ambiguous: the debt equity ratio has decreased (from 52.7% to 47.3%) while the ratio between debts and sales has increased (from 0.705 to 0.896).

We now specify the evolution of employment. The average size of the firms (*employees*) has decreased from 2,882 employees in the 1990s to 1,996 in the 2000s. It means that our sample of 410 covers on average 1.1 million employees in the 1990s and almost 820,000 in the 2000s.

If we consider the evolution of employment year by year, the profile is even clearer from an average size of 3,200 in 1992 to 1,898 in 2011 (Figure 1a). It is all the more impressive that the background is a slight decrease of sales. This evolution of employment is the result of a sharp decrease in the 1990s (up to 2002) and a slight decrease in the 2000s. If we put this evolution in more historical perspective (Figure 1b), in looking at the evolution from the mid-1970s, it appears that the decrease of manufacturing employment in the 1990s is exceptional in any respect. It means that we have to be cautious in analyzing the evolution of downsizing, which partly corresponds to an overall trend of de-industrialization. Back to the evolution from the 1990s, if we consider the growth rates, it is possible to see more clearly what is related to the trend of de-industrialization and to what is related to adjustments to negative shocks affecting sales (Figure 1c). For example, it is possible to clearly identify the impact of the Lehman shock in terms of sales and employment adjustment.

Moreover, two typical patterns of employment adjustment at the sectoral level, in the case of electrical machinery and pharmaceuticals are reproduced in figures A1. The following comments can be made. The overall profile is relatively similar to the one observed at the

aggregate level, with especially a sharp decrease in the 1990s. However, employment has increased again in the 2000s in the case of pharmaceuticals, whereas it has continued to decrease in the case of the electrical machinery, with a lower slope though.

A final question concerns the frequency of the episodes of downsizing. An overall decrease of the manufacturing employment does not mean that all the firms are concerned. In Tables A2, we calculate the frequency of downsizing over each sub-period and distinguish 11 cases (from no downsizing over the sub-period to downsizing every year, i.e. 11 downsizing episodes during a given sub-period). The surprising fact is that downsizing has been frequent or very frequent among a majority of firms between these two periods. During the two periods, a large majority of firms have downsized five or more than five times. If, without surprise, the experiences of downsizing are less numerous in the 2000s in a better economic context - the share of the firms with less than 5 experiences of downsizing by sub-period is a little more than 5% in the 1990s and more than 30% in the 2000s – the frequency is nonetheless surprising high in the 2000s. As it will be seen later, for technical reasons, we are forced to limit our sample to firms with more than 5 downsizing experiences by sub-period and in order to keep a balanced sample between the two period, we end with a number of 410 firms for our estimation, which is 62% of the initial sample.

5. Results

5.1 A decrease of the average speed of downsizing in the 2000s by comparison to the 1990s

The first hypothesis to be tested - conditionally to our specifications of the dynamics of employment adjustment at the micro level - concerns the increase of the average speed of downsizing in the 2000s, which would indicate a change in the Japanese employment system.

The results are reported in table 3. We propose five estimates of the autoregressive parameter of employment that captures the speed of downsizing - for the whole period (1992-2011) and two sub-periods, 1992-2001 and 2002-2011 – in order to point out the importance of the heterogeneity specification. As a benchmark, we propose a comparison between two extreme assumptions: the *pooled* specification (same model for all the firms) and the mean of the estimates obtained from individual data, firm by firm (*Indi*). In this last case, we report the average of the N individual OLS estimated autoregressive parameters and the corresponding variance. Between these two extreme assumptions regarding the modelling of heterogeneity

(*Pooled* versus *Indi*), we consider *OLS* estimates in a homogenous model with individual fixed effects (*Within*)[24] and *GLS* estimates in a heterogeneous model with random coefficients (Swamy, 1970). Finally, in order to deal of the issue of endogeneity, we have also considered a dynamic panel framework and computed the *GMM* estimator in following the method proposed by Arellano and Bond (1991). This is done through a transformation of the *pooled* specification as explained in section 3.

As explained above, having robust GLS estimates of the downsizing speed requires that the firms considered have experienced at least five downsizing. In these conditions, the initial sample is reduced to 410 and we apply the same criterion to other estimates for the sake of comparison.

Depending on the assumption made on the homogeneity of the underlying data generating process, we get very different results regarding the evolution of the downsizing speed ($-\ a_3$), which is a decreasing function of the parameter a_3. Basically, an increase of the speed is observed in the cases of the *Pooled*, *Within* and *GMM* estimates, whereas we can conclude to a decrease of the speed in the case of *Indiv* and *GLS* estimates. It is worth noting that we get a negative value for the speed during the first sub-period, which is difficult to interpret. If we leave aside at this stage the two extreme hypothesis (homogeneity of all coefficients in the *Pooled* and *GMM* estimations vs. heterogeneity of all coefficients in the *Indiv* estimation) and we concentrate on the *Within* and *GLS* estimates, the results are not less striking. The *Within* estimates is the most common way to treat the heterogeneity of the process and leads to the conclusion that the speed of downsizing has significantly increased from 0.291 in the 1990s to 0.503 in the 2000s, which is similar to the levels observed in the US with similar data.[25] On the contrary, we get the reverse results with the *GLS* estimates of the mean of the distribution of individual parameters $a_{3,i}$ in the random coefficient specification, which decreases significantly from is 0.245 in the 1990s to 0.220 in the 2000s. This last result does not confirm the standard view of the end of the "Japanese employment system". It seems that, on average, firms responded to macroeconomic and institutional changes at a slower speed in the 2000s than in the 1990s.

The next question is then to identify which is the “best” estimate. There is no simple answer to this question, as the different estimators are not comparable. However, we may adopt two criteria. One is logical and concerns the modelling of the heterogeneity: it has been

[24] It is well known that, the introduction of fixed individual effects in a dynamic specification induces a small sample bias (Nickell 1981). However, these estimates are presented here only for the sake of comparison.
[25] See for example Appended table 2-3 in Cabinet office (2006).

presented already in section 3. The second one is empirical and can be explained as follows. Basically, one confirms that the labor dynamics is heterogeneous across firms in our micro database. In the case one considers the whole period (1992-2011), as in the case the study is done by sub-periods, the standard homogeneity tests (Hsiao, 1986) largely reject the homogeneity hypothesis, even if individual effects are introduced (table 4). For instance, the value of the Fisher test associated to the central hypothesis that all parameters a_i are equal for all firms (under the assumption of fixed individual effect) is 21.16. Then, at a 5% risk level, the null hypothesis of homogeneity of the parameters a_i given fixed individual effects is strongly rejected. The same result is obtained in the case of the two sub-periods used in our study. It means that, with panel data, a heterogeneous specification of the labor dynamics is essential to evaluate the speed of downsizing. We can go even one step further in order to compare the *Within* and the *GLS* estimates. The test for homogeneity of the constants leads to a strong rejection of the null hypothesis, which may lead to use the *Within* estimate. However, the test for homogeneity of the coefficients also leads to a strong rejection of the null hypothesis (with for example a Fisher of 14.71 for the whole period), which means that the modelling of heterogeneity in the *Within* estimator is not appropriate and we should, from this viewpoint, prefer the *GLS* estimate. Finally, also the *GMM* estimator is the only one among the estimator we consider that provides a solution to the endogeneity issue, it can be hardly preferred to the *GLS* estimator for the same reason: it does not provide a proper modelling of heterogeneity.

5.2 An increasing heterogeneity of the individual speeds of downsizing in the 2000s

Then, we consider the second question, relative to the evolution of the variance of the firms' adjustment speeds. To put it differently, the issue is to test if this heterogeneity, and particularly the heterogeneity of the autoregressive parameters $a_{3,i}$, has increased. For that purpose, we can consider individual estimates firm by firm. However, it raises unsolvable problems for estimations by sub-periods, because of a lack of observations. This is the main reason to justify the choice of a panel frame with random coefficients, which is the less restrictive assumption from the point of view of the heterogeneity.[26] In the table 3, we

[26] Concretely, the parameters of the random coefficients specifications (mean and variance-covariance matrix of the distribution of the coefficients) are estimated by following the method proposed by Swamy (1970). An estimator of the variance-covariance matrix of the coefficients is first built based on *N* individual estimators of the parameters obtained equation by equation. Then, by using this estimator of the variance-covariance matrix of

calculate the variance of the distribution of the individual parameters $a_{3,i}$ in the case of the estimation with random coefficients. It has increased between the 1990s and the 2000s from 0.354 to 0.386.[27] A simple Harthley test of the homogeneity of the variances confirms that the two variances are different from each other (F-ratio of 1.091 larger than 1). From this, we can conclude that the heterogeneity of the downsizing speed has increased in the 2000s, by comparison with the 1990s.

This basic result can be complemented and confirmed by more precise analysis of the evolution of the distribution by making histograms for the two sub-periods (Figures 2). In limiting the samples to firms with non-negative speeds and inferior to 1, we end with 362 firms for the sub-period and 354 in the second sub-period. What is obvious through the comparison of the two histograms is that the values are more concentrated around the mean (0.24-0.25) in the first sub-period whereas there are more extreme values in the second sub-period.

5.3 A preliminary descriptive analysis of the characteristics of firms with different speed of downsizing

We then turn to our next question: it is possible to identify groups of firms with significantly different characteristics, on the basis of their speed of downsizing.[28] Given our empirical strategy to get individual estimates of the speed of downsizing, it is not possible to do better than a descriptive approach at this stage.[29] Moreover, as recalled in the sub-section 4.1, we should be very careful in the interpretation of our results, as they say less about the overall human resource management of firms (as non-regular workers, who may act as buffer, are not included) than about the employment security of regular workers.

The results are reported in table 5. We divide our sample of 410 firms into 3 groups defined by their speed of downsizing: low (137 firms), medium (136) and high (137). In the first sub-period, the average speeds for each group are respectively: 0.024, 0.229, and 0.482.

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the parameters, we build a variance-covariance matrix of the residuals, thanks to which we construct a *GLS* estimator of the expectation of the distribution of the parameters.

[27] These numbers are the variance of the common distribution of the parameters in a random panel model.

[28] Let us recall that our purpose is not so much to capture the essence of the firms with high or low speed of downsizing but rather to evaluate the diverse degree of (micro) job security for regular workers belonging to different firms (see our discussion on the impact of the absence of data on non-regular workers in sub-section 4-1). This could have even better been achieved with linked employer-employee data (McKinney, K. L. and L. Vilhuber, 2006).

[29] As mentioned earlier, an alternative would be to estimate a PTR model to get more clear-cut and rigorous results in the identification of various groups of firms depending on their speed of downsizing.

These figures are respectively 0.002, 0.169, and 0.490 in the second sub-period. The very low values for the low-speed group are due to a large number of negative speeds and should therefore not be over-interpreted. What is striking however are the decrease of the speed for the medium-speed group (from 0.229 to 0.169) and the increase of the speed of the high-speed group.

The question is then double here: for each sub-period, which corporate characteristics take significantly different values in groups with different speed? Do we observe any change over time?[30] A first interesting result concerns the size of the firms, for which the observed differences are significant: whereas, as expected, low-speed firms were the largest in the 1990s, they are the smallest in the 2000s. This change may be connected to another change, related to the performance of firms by speed-group. Whatever the criterion we consider – productivity, different types of profit - eventually relative to assets (ROA) or sales (perfo2) - the low-speed firms were the best performing in the 1990s. A good performance may have acted at that time as a factor that has reduced the pressure for downsizing. It is possible to consider that the situation is reversed in the 2000s, although it is less clear as it depends on the considered indicator.[31] In any case, the relationship between performance and downsizing speed is no more linear and sometimes less significant. For example, whatever the profit one considers (operating, gross, or ordinary), the high-speed firms are the most profitable. This is also true when one looks at the ratio to sales (perfo2) but not when one looks at ROA. As for the medium speed firms, they were the least productive in the 1990s and are the most productive in the 2000s.

A similar evolution is observed for the capital intensity and the R&D ratio: although the differences across firms for these indicators were non-significant in the 1990s, it is found that higher speed firms are characterized by higher ratio for all these indicators in the 2000s. As for the debt, it is possible to say that higher speed firms are characterized by higher debt, as expected, which is particularly true in the 2000s, whatever the indicator we consider (DER or DHK). Another interesting evolution concerns the structure of shareholding: whereas there was no significant differences among different groups of firms regarding the share of foreign shareholders in the 1990s, higher speed firms (medium and high) have a significant higher share of foreign shareholders; the evolution is the reverse for cross-shareholding, which was

[30] The whole discussion below is based on ANOVA tests, which compares the means of three populations (high, medium and low speed in our case). These results, which are available upon requests to the authors, are not reported here in order to make easier the reading of this essentially descriptive analysis.

[31] Although, our data does not allow us to draw any conclusion related to the role of unions, our results may interestingly be compared to the finding by Noda and Hirano (2013) regarding the changing sign of the impact on the downsizing speed of the interaction term between ROA and union before and after 1997.

significantly higher for slow speed firms in the 1990s and is no more significant in the 2000s. Finally, there is no significant difference across the groups of firms in the two sub-periods for the following characteristics: average age of employees, tenure, age of the firms, and export ratio.

To summarize, what is striking is the changes of the average characteristics of the groups of firms defined by their speed. In the 1990s, the high-speed firms were the smallest, the least performing, the most indebted. In the 2000s, they are the largest, the most profitable, still the most indebted, but also with the highest capital and R&D ratio and the highest share of foreign shareholders.

6. Conclusion

The present study, based on the NEEDS and Japan Development bank databases, questions what has been called "the end of the Japanese style lifetime employment system", through an analysis of the downsizing employment adjustment at the firm level during the period 1992-2011 in a panel framework. We obtained two major findings: an increasing heterogeneity across firms is observed in the 2000s, while the average speed of downsizing has decreased. Thus, there is no sign of the end of the Japanese employment system, but rather a differentiation among firms. To put it differently, the idea of the uniqueness of the human resources management model in Japan, which was already problematic in the past, may have become even more questionable during the last two decades. Thus, our contribution is complementary to previous researches that have discussed the “end of Japanese employment system” (see for example Ono, 2010; Kambayashi & Kato, 2010, among others) in focusing on one aspect that have been neglected until now, the evolving diversity of HRM practices in Japan.

Basically, from a more technical viewpoint, our message is twofold. First, in order to have a proper understanding of the evolution of the Japanese employment system, it is important to study the evolving heterogeneity of firms. Second, it is essential to properly model this heterogeneity. In our view, properly modelling the heterogeneity is at least as much important as the discussion on the discrete / continuous nature of the adjustment process, for which we did not propose any improvement in the present paper. The wishful originality of these results comes mainly from the adoption of a panel framework and above all from the choice of the estimation method. The method used in this paper – random coefficient model

combined with a Bayesian estimator of the individual parameters - produces individual coefficients. It is the same than for a firm by firm estimation but it is improved by correcting abnormal values in using the entirely available information. It allowed rigorously analyzing the deformation of these coefficients distribution and the determinants of the individual speeds.

At this stage, we should mention important issues at stake. First, the increasing heterogeneity of the firms' employment policies may have an impact in term of (employment security and wages) inequalities from the point of view of workers. It may be an explanation of the increasing inequalities for regular workers, which are observed on the Japanese labor market since at least the beginning of the 1990s (Kalantzis *et al*., 2012). This point should be carefully studied. Second, what has been assessed here in the case of the manufacturing industries needs to be applied to non-manufacturing industries. Third, it may be interesting to connect more precisely this increasing heterogeneity employment adjustment to the rising productivity dispersion. In doing so, we may also be able to propose some explanations to the increasing heterogeneity of HRM at the corporate level in Japan, as done in previous studies on productivity dispersion (such as in Ito & Lechevalier, 2009).

Finally, the limits of this empirical study of the employment adjustment also provide several routes for further research. This study is first limited by an important survival bias, because we focused on firms in activity between 1992 and 2011. This is all the more acutely a problem since that these two decades were characterized by an increasing number of bankruptcies, and it has important consequences for the employment security of workers. In fact, this bias probably very certainly leads to an underestimation of the firms' actual heterogeneity. In addition, we took into account only one aspect of the firms' employment policies, i.e. the management of regular employees, and, due to a lack of data, were not able to analyze practices related to non-regular workers -- which are also probably another source of heterogeneity. [32]

7. References

[32] Linked employer-employee data would also allow us confirming or not the hypothesis proposed by Kambayashi and Kato (2010) regarding the different fate of “traditional” and expanded (such as women) regular workers in the 2000s in terms of downsizing. On the usefulness of linked employer-employee data for this type of study, see McKinney, K. L. and L. Vilhuber (2006).

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8. Figures and Tables

Figure 1a: Evolution of employment and real sales in the balanced sample of 410 firms (1992-2011)

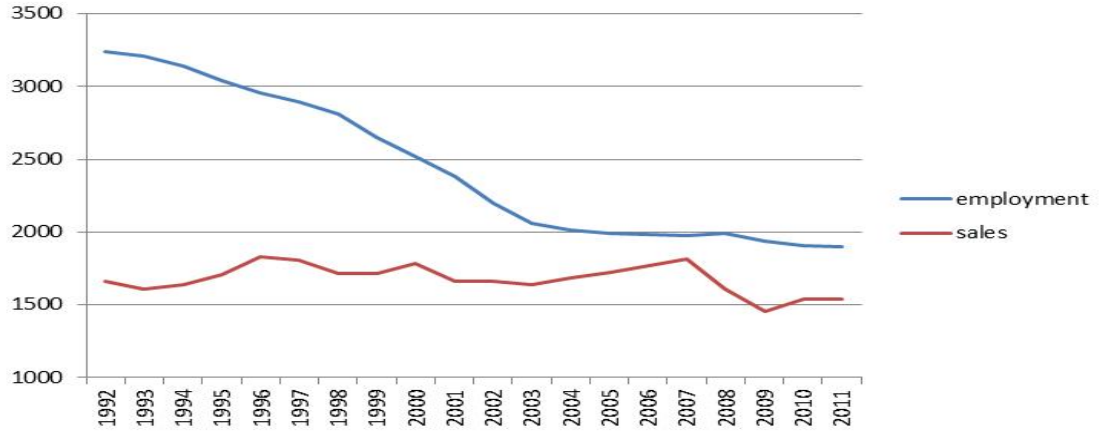
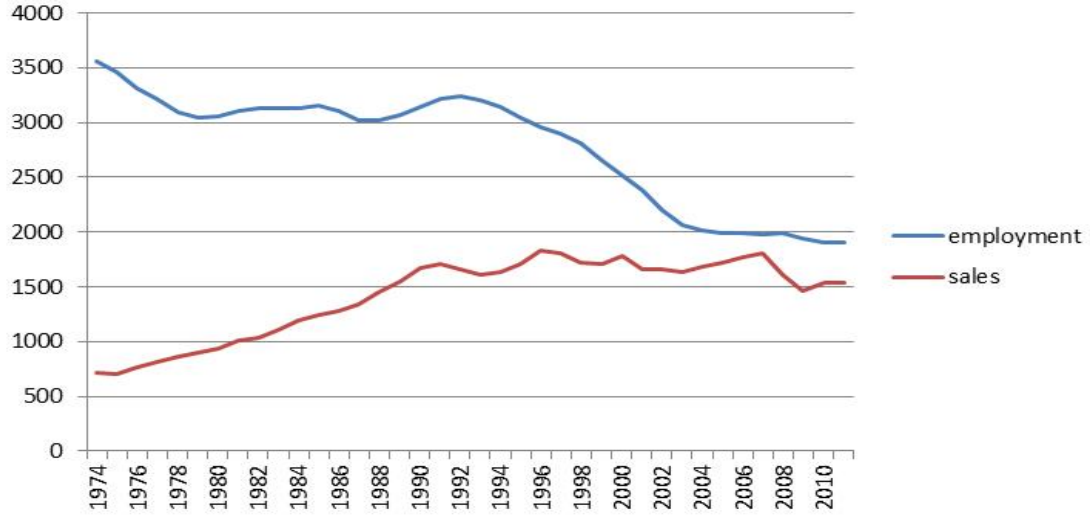
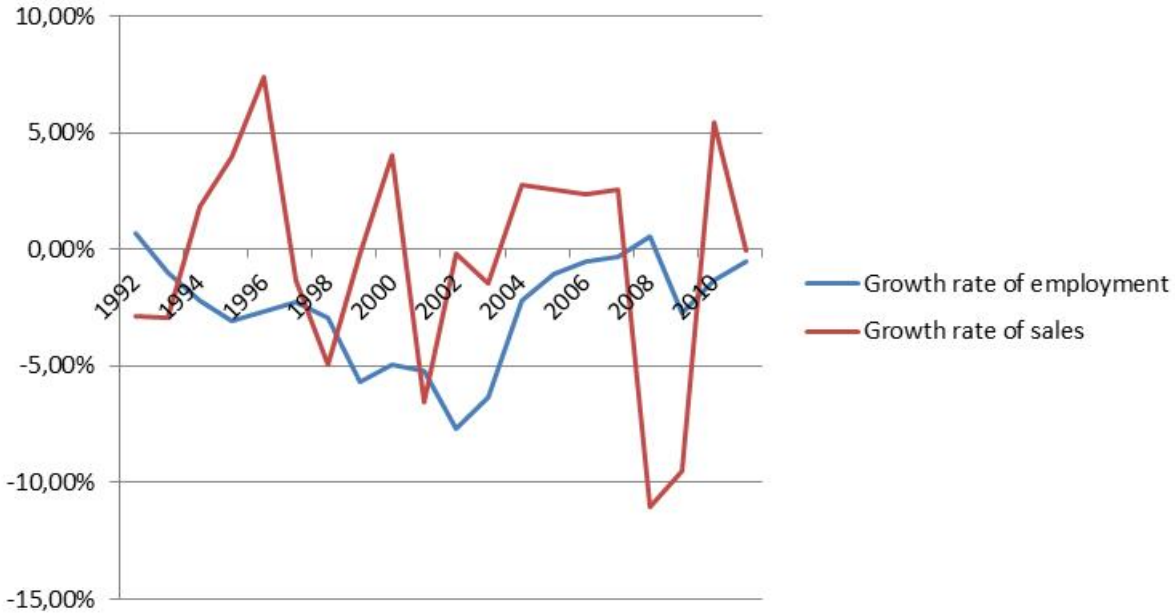


Figure 1b: Evolution of employment and sales in the balance sample of 410 firms (1974-2011)

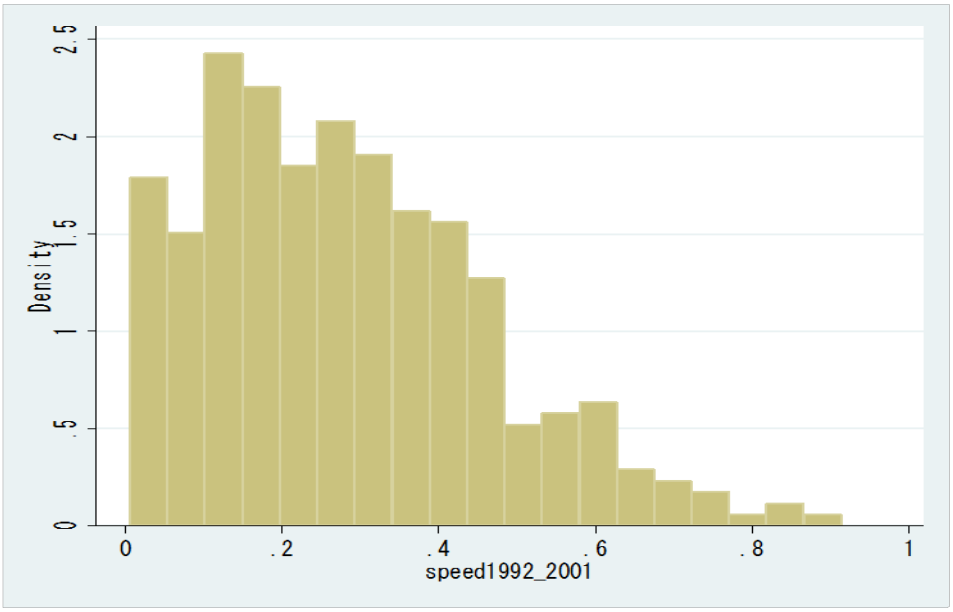


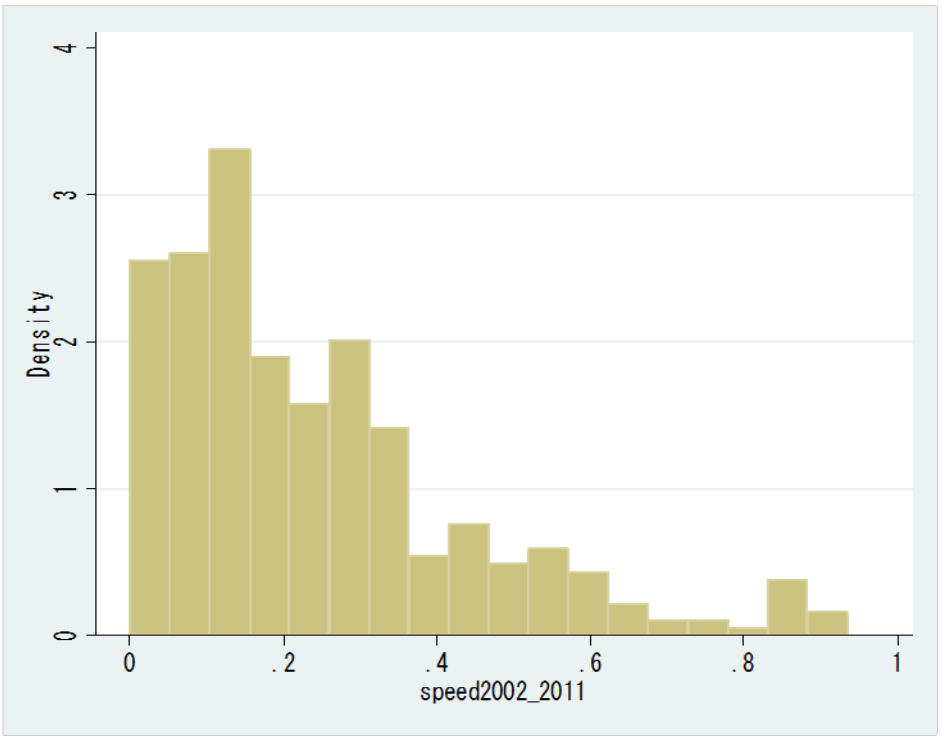
Notes: The employment figures correspond to the average size of firms, the sales figures to the average sales. The unit of real sales is 100 million yen.

Figure 1c: Evolution of the growth rate of employment and real sales in the balanced sample of 410 firms (1992-2011)



Figures 2: Distribution of the individual speed of downsizing by sub-periods (1992-2001) and (2002-2011)





Notes: in these two histograms, we limit the samples to the firms with speed superior to 0 and inferior to 1. Therefore, the samples are limited to 362 firms in the first sub-period and to 354 firms in the second sub-period.

Table 1: Definition of variables

Name	Source	Definition	Calculation	Expected sign of correlation with downsizing speed
employees	NEEDS	Number of employees (SIZE1)		**Negative**
AGEMOY	JDB	Average age of employees		**Negative**
tenure	JDB	Average tenure of employees		**Negative**
ROA	NEEDS	Operating profit plus interest and dividend received divised by total assets	(Operating_Profit)/(Total_Assets)	**Negative**
PERFO2	NEEDS	Ordinary profit divised by sales	(Ordinary profit)/(SALES)	**Negative**
DER	NEEDS	Total fixed liabilities / (total capital + total reserve)	(Fixed_liabilities)/(Total_Capital+Total_Reserve)	**Positive**
DHK	NEEDS	Total debt as a percentage of sales defined as total fixed liability and total current liability divised by	(Current_Liability+Fixed_Liabilities)/(SALES)	**Positive**
CROSSHAR	JDB	% of shares owned by other firms		**Negative**
FORE1	JDB	% of shares owned by foreign firms		**Positive**
SECTOR	NEEDS	NEEDS sector code		
XPROD	NEEDS	Exports as a percentage of total sales		**Positive**
RDRATIO	JDB	R&D expenses divised by sales		**Negative**
PRODUCTI	NEEDS	Real average sales per employee	(SALES)/(employees)	**Negative**
INTENSK1	NEEDS	Tangible fixed assets total plus intangible fixed asset divised by the number of employees	(Tangible_Fixed_Assets+Intangible_Fixed_Assets)/(employees)	**Negative**
INTENSK2	NEEDS	Tangible fixed assets total divised by the number of employees	(Tangible_Fixed_Assets)/(employees)	**Negative**
SINCE	JDB	Date of creation of the firm		**Positive**

Table 2: Basic Descriptive Statistics

1992-2001	employees	agemoy	tenure	intensk1	intensk2	xprod	rdratio	crosshar	fore1
	2882,50	39,806	17,454	20,280	20,023	0,126	0,024	25,986	5,520
	producti	ordinary_profit	gross_profit	operating_profit	roa	perfo2	der	dhk	since
	56,51	5052,103	34744,497	5061,925	0,023	0,026	52,785	0,705	1934,168
2002-2011	employees	agemoy	tenure	intensk1	intensk2	xprod	rdratio	crosshar	fore1
	1996,03	41,23	17,86	32,59	31,58	0,17	0,03	24,58	9,86
	producti	ordinary_profit	gross_profit	operating_profit	roa	perfo2	der	dhk	since
	76,691	7358,149	34349,460	5505,063	0,027	0,049	47,330	0,896	1934,174

Table 3: Estimated Speed of Downsizing (N=410 firms; balanced panel)

	Pooled	Within	Indiv	GLS	GMM
1992-2001	0,023	0,291	0,291	0,245	-0,054005
tstat/std for GLS	5,732	27,633	11,678	0,354	9,650
2002-2011	0,109	0,503	0,262	0,22	0,237552
tstat/std for GLS	13,854	34,408	9,859	0,386	7,670
1992-2011	0,083	0,28	0,229	0,174	0,138205
tstat/std for GLS	18,332	39,598	18,666	0,257	26,710

Note: For all the estimated models, we report the speed of downsizing. *Indiv* denotes the average of individual OLS estimates. The t-stats are in parenthesis except for GLS for which the estimators of the mean and of the variance of the coefficients distribution are reported.

Table 4: Homogeneity tests

		Period 1992-2011		Sub-Period: 1992-2001		Sub-Period: 2002-2011	
	Null Hypothesis	Fisher	P-value	Fisher	P-value	Fisher	P-value
Test for global homogeneity	H0:αi=α βi=β	21.159455	<0.001	6.3205424	<0.001	20.84909	<0.001
Homogeneity test for coefficients beta i	H0:βi=β	14.71212	<0.001	2.8678593	<0.001	11.064259	<0.001
Homogeneity test for constants alpha i	H0:αi=α	12.345366	<0.001	9.8145459	<0.001	11.542939	<0.001

Note: This table reports the results of the standard homogeneity tests proposed by Hsiao (1986).

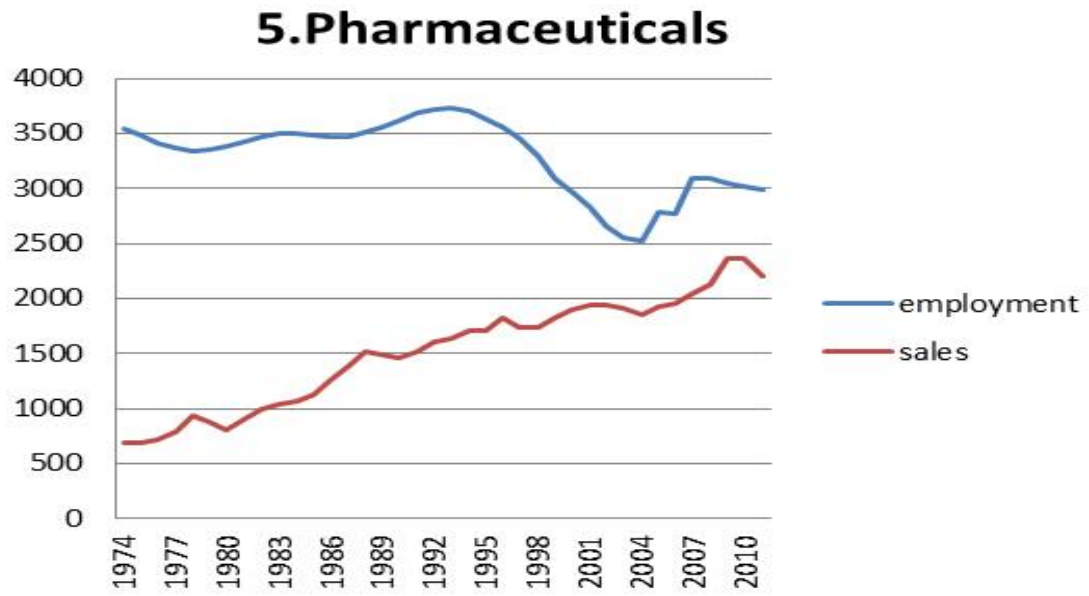
Table 5: Average characteristics of groups of firms distinguished by their speed of downsizing

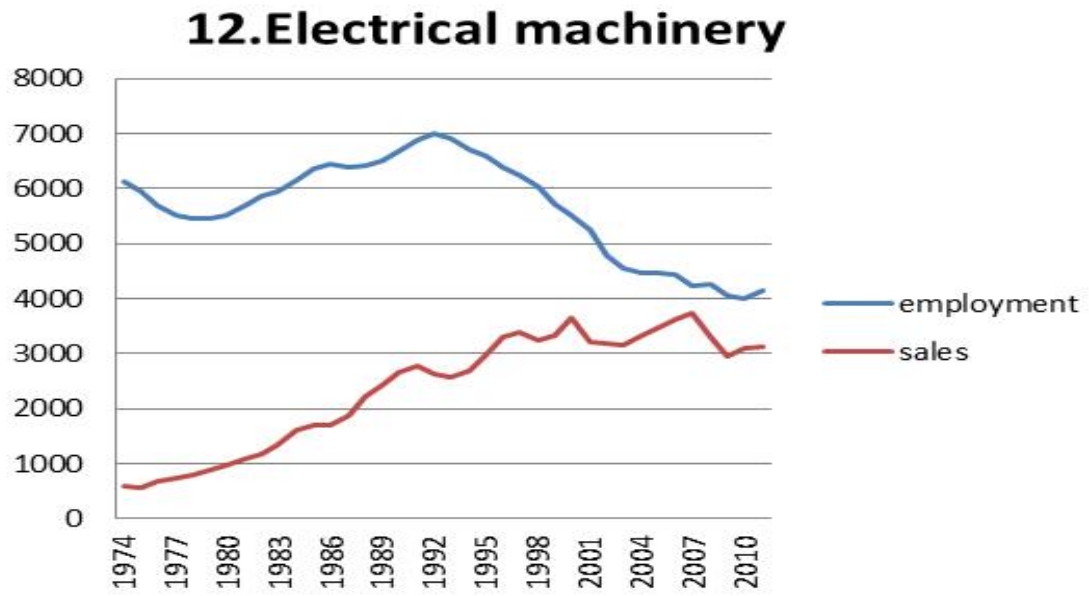
	number	speed	average speed	employees	agemoy	tenure	intensk1	intensk2	xprod	rdratio	crosshar	fore1
1992-2001	137	low	0,0245	3505,38	40,098	17,635	20,977	20,768	0,116	0,027	27,252	5,485
	136	medium	0,2288	2826,71	39,786	17,435	19,665	19,419	0,142	0,022	25,157	5,176
	137	high	0,4822	2315,39	39,535	17,291	20,198	19,881	0,122	0,024	25,549	5,899
2002-2011	137	low	0,0002	1752,85	41,012	17,774	28,038	27,428	0,176	0,030	25,355	9,348
	136	medium	0,1689	1806,39	41,196	17,796	34,988	33,568	0,164	0,030	25,549	10,089
	137	high	0,4902	2428,83	41,470	18,002	34,745	33,752	0,177	0,035	22,846	10,158

	number	speed	average speed	producti	ordinary_profit	gross_profit	operating_profit	roa	perfo2	der	dhk	since
1992-2001	137	low	0,0245	62,006	6650,30	41500,87	6710,20	0,029	0,035	44,812	0,649	1935,91
	136	medium	0,2288	51,564	4967,76	35731,09	4732,11	0,020	0,020	50,968	0,760	1933,07
	137	high	0,4822	55,958	3538,25	27001,53	3743,47	0,021	0,023	62,574	0,705	1933,53
2002-2011	137	low	0,0002	77,171	7015,03	29154,37	5242,33	0,032	0,044	45,329	0,702	1935,00
	136	medium	0,1689	78,965	6103,95	29815,80	4771,79	0,029	0,049	43,945	0,821	1935,45
	137	high	0,4902	73,938	8955,47	44078,21	6501,07	0,020	0,055	52,715	1,165	1932,07

9. Appendix

Figures A1: Evolution of employment and real sales in pharmaceuticals and in electrical machinery





Notes: The employment figures correspond to the average size of firms, the sales figures to the average sales. The unit of real sales is 100 million yen.

Table A1: Distribution of firms by sectors

	sector	number of firms
1	Food products	45
2	Textiles	28
3	Pulp	8
4	Chemicals	96
5	Pharmaceuticals	18
6	Petroleum products	3
7	Rubber products	11
8	Ceramic	29
9	Iron and steel	32
10	Non-ferrous metal	49

	sector	number of firms
11	General Machinery	104
12	Electrical machinery	100
13	Shipbuilding	5
14	Motor vehicles	40
15	Other transport machinery	6
16	Precision instrument	18
17	Other manufacturing	25

Tables A2: Frequency of downsizing in 1992-2001 and in 2002-2011

1992-2001		
Occurrences	Frequency	%
0	0	0
1	7	1.06
2	11	1.67
3	15	2.28
4	42	6.38
5	69	10.49
6	68	10.33
7	121	18.39
8	149	22.64
9	114	17.33
10	62	9.42
Total	658	

2002-2011		
Occurrences	Frequency	%
0	1	0.15
1	15	2.28
2	35	5.32
3	60	9.12
4	98	14.89
5	101	15.35
6	129	19.60
7	83	12.61
8	64	9.73
9	49	7.45
10	23	3.50
Total	658	