Wage and Productivity Differentials in Japan. The role of Labor Market Mechanisms

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Abstract

Two stylized facts characterized Japan during the Lost Decade (1992-2005): rising wage inequalities and increasing productivity differentials at the firm level. Surprisingly, these two facts have never been connected in the literature. This paper tries to fill the gap by proposing an explanation, which focuses on labor market mechanisms. We first build an efficiency wage model with two types of firms that are distinguished by their job security scheme and associated incentive mechanisms. We show that a similar negative productivity shock at the aggregate level leads to different firms' reactions: the model predicts an increasing effort from the workers in the firms 1, which resort to efficiency wage mechanism. It leads to increasing productivity and wage differentials, and to a rise of the share of firms 1. Then, we test this model on Japanese micro data. For the first time, we match the Basic Survey on Wage Structure and the Employment Trend Survey for the year 2005. The matched worker-firm dataset we get allows us to confirm the existence of efficiency wages mechanisms on average. Second, we divide our sample of firms into two groups by using the unknown regime switching regression à la Dickens and Lang (1985), and we then find that the primary sector can be characterized by efficiency wage, whereas the secondary cannot. Then, we simulate the evolution of the share of the primary sector and find that it substantially increased between 1981 and 2005, in conformity with the predictions of our model.

JEL Classification: L23, J24, J31, J42

Key words: heterogeneity of firms, efficiency wages, job security, effort, productivity differentials, wage inequalities.

1 Introduction

For decades, wage inequality has substantially increased in the US, in UK and many other OECD countries. Japan is no exception. However, until recently,

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there was no consensus regarding whether income inequality widened during the 1990s and onward (OECD, 2006). For example, Tachibanaki (2005) claimed that income inequality widened during the 1980s and 1990s. On the contrary, Ohtake (2005) found that the increase in income inequality was partly due to the aging population. Focusing on the wage rate, Kambayashi et al. (2008) reconcile these two views; They apply the DiNardo, Fortin, and Lemieux (1996)'s decomposition technique and they get the following result: "although simple aggregate statistics may give the impression that wage inequality did not change during the period, the decomposition analysis reveals that the seemingly steady trend is a product of two opposing trends: 1) declining between-group (defined by education, experience, tenure and firm/establishment size) wage inequality; and 2) increasing within-group inequality among male workers."

The purpose of Kambayashi et al. (2008) is to assess the reality of increasing wage inequality. Moreover, in using DiNardo et al. (1996)'s methodology to decompose the change of the wage distribution into the contribution of the changes in the workers' skill distribution and the change in the factor prices, their results can be mobilized to add a piece of evidence to the debate between SBTC proponents and "revisionists" (Card & DiNardo, 2002). However, there is also another possible interpretation of their result. In the case of the UK, Faggio et al., (2007) have also found that rising inequalities primarily concern workers with equivalent observable characteristics. To explain these rising within-group inequalities, they analyze its counterpart, increasing productivity dispersion across firms, between and within sectors and show the link between the two phenomena.

This type of analysis has been conducted by other researchers, like Mortensen (2003). Although some papers (e.g. Kambayashi et al., 2008, or Tachibanaki, 2005) consider the wage differential between firms of different size in Japan, there have been no recent investigation of between-firms wage dispersion, in connection with productivity differentials. This is all the more surprising since that recent papers have established another stylized fact, increasing heterogeneity of performances of firms belonging to the same sectors and size categories (Fukao & Kwon, 2006; Ito & Lechevalier, 2008). One reason for the absence of this type of study is that a dominant concern has been the within-firm wage differential between regular and non-regular workers: the rising share of non-regular workers, which has more than doubled in 20 years to reach almost 1/3 of the workforce, has been a popular explanation of the rising inequalities in Japan (Ota, 2005). Another possible reason for having neglected the study of the link between increasing productivity dispersion and rising wage inequality is the fact that studies that have taken into account the firm-size differential have found that it does not explain the increasing wage gap (e.g. Kambayashi et al., 2008). The focus on wage differential between firms of different size is understandable in a country that has been (and still is to a certain extent) characterized by a dual structure according to the size of the firm. However, the fact that the cleavage along the firm-size is not a key determinant of increasing wage differential should not lead to the conclusion that between-firms wage differential is not important: as the US, Japan is characterized by a decentralized wage system (with some important differences between the two systems) that make crucial the analysis of inter-firms wage differential. If one aims at connecting the evolution of productivity differentials and of wage differentials, one has to take into account the fact that the increasing productivity differentials since the mid-1990s mainly occurred between firms of similar size and belonging to same narrowly defined sectors.

Our contribution is threefold. First, we study the evolution of wage and productivity differentials of firms by controlling for size and sector. Second, we propose a theoretical framework that focuses on labor market mechanisms, without referring to other factors such as the impacts of technical progress and internationalization. Third, we test our theoretical model by using a rich employer-employee dataset.

More precisely, in a first step, we build an efficiency wage model with one sector but two types of firms of similar size. The difference between the two types of firms is interpreted in terms of productive models like in Oï (1983), rather than in terms of monitoring technology like in Bulow and Summers (1986). More precisely, in one type of firms, the productivity is assumed to be endogenous and determined by workers' production effort, while in the other type of firms, it is exogenous. In solving the model, we determine the values of the employment in the primary sector (that is the number of firms), the hiring and separation rates, the effort and the wage in the primary sector. Finally, we find that a productivity slowdown at the aggregate level leads to rising productivity and wage differentials and increasing share of primary firms, all these results being inter-dependent.

In a second step, we test this model on micro data. For the first time, we merge two databases, the Basic Survey on Wage Structure and the Employment Trend Survey for the year 2005. It allows us to get information on (hourly) wages, accession and separation rates. We control also for firms characteristics (size, sector) and for workers characteristics such as age, gender and education. We first confirm the existence of efficiency wages in the Japanese market on average. Second, we divide our sample of firms into two groups by using the unknown regime switching regression *à la* Dickens and Lang (1985), and we then find that the primary sector can be characterized by efficiency wage, whereas the secondary cannot. Finally, we run a simulation for the years 1981-2005 and we find that the share of the primary sector has substantially increased, in conformity with the predictions of our model.

2 The model

We consider a simple dual labor market model. This dualism corresponds to two alternative labour organization structures. Firms, that are active on the primary labour market, need to implement a more productive (but more costly) organizational structure. The other firms implement a less costly and less productive organizational structure, and hire workers on the secondary labour market. We assume that one firm equals one job. Hence, employment levels in primary/secondary market stem from firms distribution across the two productive models.

The model's timeline is the following:

- $t = 0$, firms are matched with a given productive model, employment in primary and secondary market is derived;
- $t = 1$, wages and tenure are determined for primary and secondary jobs;
- $t = 2$, workers effort in primary jobs is determined.

Primary jobs require workers' implication and effort. An incentive mechanism is at play yielding real wage growth in line with effort. Secondary jobs are perfectly competitive. No incentive is required, so workers' utility is equal to unemployed workers'. Unemployment benefits depend on taxes raised on wages. To ensure progressive taxation, only primary market workers are taxed:

$$w_u = \frac{t \cdot w_1 \cdot L_1}{U} \tag{1}$$

with $U = N - L_1 - L_2$, N being total labour force. Tax rate t is exogenous.

2.1 Incentives and effort

We solve the model by backward induction, starting by stage 2.[1] We consider two types of firms: $type1-$firms are active on primary market, while $type2-$firms hire workers only on secondary market. The endogenous number of firms will be determined at stage 0 (see section 2.3 below).

Hereafter we display dynamic equations for utilities of shirker (V_1^S) and non-shirker workers (V_1^{NS}) employed on primary market jobs, as well as utilities of unemployed (V^U) and workers employed on secondary market jobs (V_2):

$$r \cdot V_1^{NS} = w_1 \cdot (1-t) - e + s_1 \cdot (V^U - V_1^{NS}) \tag{2}$$
$$r \cdot V_1^{S} = w_1 \cdot (1-t) + (s_1 + q) \cdot (V^U - V_1^{S}) \tag{3}$$
$$r \cdot V^{U} = w_u + a_1 \cdot (V_1^{NS} - V^U) \tag{4}$$
$$r \cdot V_2 = w_2 \tag{5}$$

We assume that there is no hiring and firing on secondary labor market.

From the no-shirking condition ($V_1^{NS} = V_1^S$) one gets the standard incentive compatible real wage schedule (efficiency wage) that applies to workers on primary jobs:

$$w_1^e = \frac{e \cdot [a_1 + s_1 + r + q \cdot w_u]}{q \cdot (1-t)} \tag{6}$$

[1] We have to determine values of seven endogenous variables: w_1, w_2, e, a_1, s_1, L_1, L_2. Seven equations are needed to ensure that all our endogenous variables are determined at equilibrium.

Given this condition, $type1-$firms endogenously generate an effort's function by maximizing job's value. Values of jobs on primary / secondary markets (respectively J_1 and J_2) are given by the following equations:

$$J_1 = \frac{m_1 - w_1}{r + s_1} \tag{7}$$

$$J_2 = \frac{m_2 - w_2}{r} \tag{8}$$

with:

$$m_1(e) = A \cdot \sqrt{e} \tag{9}$$

Hence, productivity of primary market jobs is endogenous and determined by workers' productive effort. The more intense the effort gets, the higher is productivity (other things being equal). However, there is a drawback to more intense effort as it also yields higher disutility for workers: the utility cost of effort increases.

This is a crucial aspect of the model. Unlike standard Shapiro and Stiglitz [1984] kind of models, we consider that effort is endogenous. Firms have an interest in trying and improve effort. In fact, given equation (9), one can see that increasing effort allows firms to increase their productivity. On the other hand, it is clear from equation (2) that increasing efforts yields a higher utility cost for workers. However, workers get paid back for their effort because real wages are set according to an incentive compatible efficiency wage mechanism. Hence, subject to the efficiency wage constraint, workers are indeed willing to increase their effort. Concerning firms, equation (6) clearly says that they are forced to pay higher wages, when effort increases, in order to prevent shirking. Profits' maximization yields an endogenous effort's function:

$$\frac{dJ_1}{de} = 0 \Rightarrow \frac{\partial m_1}{\partial e} - \frac{\partial w_1^e}{\partial e} = 0$$

$$e = \left[\frac{A \cdot q \cdot (1-t)}{2 \cdot (a_1 + s_1 + r + q)}\right]^2 \tag{10}$$

2.2 Wages and tenure

We now turn to stage 1 of the model. As in standard labour market models, firms compete to attract workers. In our framework, firms can compete on both wages and work condition. In particular, $type1-$firms can offer various degrees of job tenure (measured by s_1). Higher job security rises workers' utility and effort, and lowers the incentive wage. Hence, there is a trade-off for firms: either proposing workers higher wages or better tenure.

Because of (perfect) competition across firms, wages and tenure are set so as to ensure that jobs values are driven down to zero:

$$
\begin{aligned}
J_2 &= 0 \Rightarrow m_1(e) = w_1 && (11)\\
J_1 &= 0 \Rightarrow m_2 = w_2 && (12)
\end{aligned}
$$

This implies that w_2 is simply set equal to exogenous productivity m_2. Regarding condition (11), one should recall that m_1 is determined according to equation (9). Substituting (9) in condition (11) yields the following zero-profit wage schedule:

$$
w_1^{zp} = \frac{A^2 \cdot q \cdot (1-t)}{2 \cdot (a_1 + s_1 + r + q)} \tag{13}
$$

In our model (as in other standard dual labor market models) secondary market jobs provide no extra-rent for workers. Hence, for workers employed in $type2-$firms, utility is set equal to V^U:

$$
V^U = V_2 \tag{14}
$$

Substituting equations (4) and (5) for V^U and V_2 in condition (14), one gets an additional relation between w_1 and w_2. We will call this a "no-migration" condition as it prevents flows from (to) secondary market to (from) unemployment:

$$
w_2^{nm} = \frac{a_1 \cdot [(1-t)\, w_1 - e] + (r + s_1) \cdot w_u}{a_1 + r + s_1} \tag{15}
$$

with w_u being determined according to equation (1).

Finally, we need to ensure that flows on the labor market are at equilibrium. Hence, a flow equilibrium condition is considered, ensuring that hiring always matches firing:

$$
a_1 \cdot U = s_1 \cdot L_1 \tag{16}
$$

Recall that $U = N - L_1 - L_2$, and that employment is determined by the number of firms on primary/secondary market.

At the equilibrium, the efficiency wage and the zero-profit wage schedules should cross. By substituting equations (10), (1) and (16) for e, w_u and a_1 in equation (6), and then equating (11) and (6), allows us to determine the separation rate as a function of hiring conditions:

$$
s_1(a_1) = \frac{2 \cdot t \cdot a_1}{1+t} \tag{17}
$$

We now turn to the no-migration condition. At the equilibrium, workers should be indifferent between secondary jobs and unemployment. We substitute equations (10), (1) and (16) for e, w_u and a_1 in equation (15), and then impose (12). This allows us to determine the equilibrium hiring rate:[2]

[2] We actually have two roots for a_1^*. However, we can proove that there is a unique positive root.

$$a_1^* = \frac{\left[\begin{array}{c} A^2 \cdot q \cdot (1-t)^2 - 4 \cdot (q+r) \cdot (1+t) \cdot m_2 + \\ A \cdot \sqrt{q} \cdot (1-t)^{3/2} \cdot \sqrt{A^2 \cdot q \cdot (1-t) - 4 \cdot (q+r) \cdot (1+t) \cdot m_2} \end{array}\right]}{4 \cdot (1+t) \cdot m_2} \tag{18}$$

We can now solve the model recursively. From (17), one easily gets the equilibrium separation rate:

$$s_1^* = \frac{2 \cdot t \cdot a_1^*}{1+t} \tag{19}$$

From equation (10), one has:

$$e^* = \left[\frac{A \cdot q \cdot (1-t)}{2 \cdot (a_1^* + s_1^* + r + q)}\right]^2 \tag{20}$$

Finally, equation (13) yields:

$$w_1^* = m_1^* = \frac{A^2 \cdot q \cdot (1-t)}{2 \cdot (a_1^* + s_1^* + r + q)} \tag{21}$$

2.3 Productive model and employment

At stage 0, firms are distributed across the two existing productive models. We simply assume that adopting *type*1 productive model is costly. This cost depends on the specificity of such a productive model (tbc). Moreover, the cost is likely to be higher under bad macroeconomic conditions.

Let us take the simple situation where the cost of adopting *type*1 productive model is equal to:

$$c(U) = \alpha + \beta \cdot U \tag{22}$$

Hence, if firms want to adopt the more productive organizational model, they will only become indifferent between *type*1− and *type*2−model when the following condition is satisfied:

$$m_1^* - c(U) = m_2 \tag{23}$$

From (16) and (19) we know that $U = \frac{s_1 \cdot L_1}{a_1} = \frac{2 \cdot t \cdot L_1}{1+t}$. Condition above thus yields:

$$L_1^* = (1+t) \cdot \frac{m_1^* - m_2 - \alpha}{\beta \cdot 2 \cdot t} = \frac{1+t}{\beta \cdot 2 \cdot t} \cdot (m_1^* - m_2) - \alpha \tag{24}$$

This allows us to determine the number of firms adopting *type*1−productive model. It is important to notice that this number is a linear combination of the productivity differential between *type*1−firms and *type*2−firms (or equivalently of the wage differential between the two types of firms). Given the assumption of a "one worker-one firm" match, the number of $type1-$firms equals the employment level on primary market (L_1^*). We can then easily derive unemployment $U = \frac{2 \cdot t \cdot L_1^*}{1+t}$.

2.4 Consequences of lower A

We can now turn to analyze the consequences of exogenous changes in given parameters of the model onto the equilibrium values of relevant endogenous variables. We are particularly interested in assessing the consequences of economic crisis. As the Japanese economy during the Lost Decade (1992-2005) has been characterized by a slowdown of the productivity growth at the aggregate level (Yoshikawa, 2008), the relevant parameter in our model is therefore A, the exogenous productivity component of primary market jobs. Crisis in our model can be thought of as yielding a once and for all drop of A. In this section we asses the consequences of such a drop on the macroeconomic equilibrium of the model.

One can show that:

$$\frac{\partial s_1^*}{\partial A} > 0$$

A decrease in A yields a lower s_1^*. Hence, one consequence of the crisis is higher tenure for employed workers, and greater job security.

From equations (20) and (21), one sees that increased tenure (i.e. lower s_1^*) yields higher effort and wages for primary market workers. As a direct consequence, the share of primary firms also increases: this result will be used in the empirical part. One can show that these results hold in spite of the direct offsetting effect of lower A:

$$\begin{aligned}
\frac{\partial e^*}{\partial A} &< 0 \\
\frac{\partial w_1^*}{\partial A} &= \frac{\partial m_1^*}{\partial A} < 0 \\
\frac{\partial L_1^*}{\partial A} &= \frac{1+t}{\beta \cdot 2 \cdot t} \cdot \frac{\partial m_1^*}{\partial A} < 0
\end{aligned}$$

One should note that overall productivity of firms proposing primary market jobs increases following the crisis. This is entirely due to the increase in productive effort, i.e. to the endogenous intensification of work in primary jobs. As a consequence, productivity differentials across firms proposing primary versus secondary market jobs increase due to the crisis.

To summarize, let us assume that crisis brings about a drop of the exogenous component of productivity (being this due to a drop in technological capabilities and/or to other demand-driven factors). As a consequence, firms seek an intensification of productive effort to compensate for the drop in productivity. However, work intensification yields higher utility costs for workers. Hence, firms have to compensate for that in order to avoid shirking. To ensure higher effort firms act on two distinct grounds. First, real wages w_1 associated with primary market jobs increase to offset growing utility cost of effort. This is indeed a standard result. However, in our model job security is also endogenous. Hence, firms can provide higher job security to primary market workers in order to favor an increase in effort, as indicated in equation (20). This is what happens at the equilibrium: primary market workers get higher job security and wages as a consequence of the exogenous productivity drop.

Moreover, as a consequence of increased m_1^*, the productivity differential across the two types of firms increases. This pushes firms to adopt $type1-$productive model up to the point where condition (23) is again satisfied. According to (24) this yields a higher proportion of $type1-$firms as well as higher unemployment at the equilibrium.

One should note that all results above can be derived under more general assumptions concerning productivity of $type2-$firms. In particular, one can assume that m_2 also depends on A. Hence, a lower A yields a drop in $type2-$firms productivity. Our main results still hold under this assumption, but are more contigent to specific parametric restrictions.

2.5 Comments

The result we get deserve some comments, especially before turning to the empirical part of the paper. The first comment concerns the nature of the differences between the two types of firms. In our model, thes difference are interpreted in terms of productive models, like in Oï (1983), rather than in terms of monitoring technology used in different sectors, like in Bulow and Summers (1986). More precisely, in one type of firms, the productivity is assumed to be endogenous and determined by workers' production effort, while in the other type of firms, it is exogenous. The main novelty of the model by comparison to previous formalization is that the $type1-$firms endogenously generate an effort function. To put it differently, in this case, the adjustment is made through the effort. The difference between these two types of firms does not concern the ability of some of them to restructure or to downsize while the others are rigid. The key mechanism that we emphasize is the job security and the associated incentive scheme (efficiency wages): firms may decide to adopt this organization or to prefer a competitive scheme.[3]

The second remark concerns the causes of the evolution of wage and productivity differentials. Layard, Lickell and Jackman (2005) show how the link between workers wages and employer productivity can be modeled in a variety of ways (union bargaining, efficiency wage, rent-sharing and search-based). The fact that efficiency wage applies to Japan is a matter of empirical investigation and we provide a new test for it. However, the most important for us in the

[3] Our interpretative framework should be also distinguished from other explanations focusing on labor market mechanisms, such as the role of labor unions (Freeman & Medoff, 1983), the role of size and/or human capital (Haltiwanger et alii, 1999), or the difference in capital / labor ratio (Leonardo, 2007), for example.

choice of the model is that we are in a non competitive environment and that difference in the productive organization is the essence of productivity differential. After having characterized the two types of productive models, we interpret the increasing wage and productivity differentials as the result of the differenciated reactions of the two types of firms to a similar shock at the aggregate level. The question of the nature of this shock is completely open. The most important is that we are able to study the evolution of the differential without introducing any assumption regarding technical progress or internationalization. The origin of the growing differential lies in the initial difference of productive models and in the differentiated response to the productive shock. It means that we focus on labor market mechanisms, without refereeing to any technological story, like in Faggio et al. (2007) for example.[4]

3 An empirical test on Japanese micro data

3.1 Empirical Strategy

According to the model of the previous section, we should find a negative relationship between flow behaviors and wage level in the primary sector (as in equation (21)), whereas there should be no correlation between them in the secondary sector. The goal of this empirical part is to explain the actual differentials of productivity and wage by applying the above dichotomy to the Japanese economy.

Ideally, testing our model would require a micro panel dataset including data on wages, accession and separation rates. Moreover, the sample period should correspond more or less to the so-called Lost Decade (1992-2005), during which the Japanese economy has been characterized by a long stagnation and the question of increasing differentials has particularly attracted attention. Unfortunately, to our knowledge, this database does not exist publicly in Japan. However, we could get access to the Basic Survey on Wage Structure (BSWS) and the Employment Trend Survey (ETS) for the year 2005. Thanks to the first survey, we get information on wages and thanks to the second one we get accession and separation rates data. Then, using an identification key provided by the Ministry of Health, Labor and Welfare (MHLW), we are able to match these two datasets at establishment level. In doing so, we build an employer-employee dataset. The interest of such database to study the type of question we are interested is well-known (Abowd and Kramarz, 2001; Abowd et al., 1999).

By using this one-shot cross-sectional data, we first detect the existence of efficiency wage mechanism through the criterion described above, the existence of a negative correlation between flow structure and wage. To do this, we

[4] Faggio et alii (2007) provide a test for the Caselli (1999)'s model, according to which the increasing dispersion of productivity (and thus of average wages among firms) can be explained by the differentiated rate of introduction of new technologies.

estimate a Mincerian equation for male regular workers, in which the dependent variable is the logarithm of scheduled hourly wage rates and the explanatory variables are workers characteristics such as sex, education, tenure and dummies of prefectures (Kambayashi et al, 2008). The mean of residual of this equation for each establishment can be interpreted as establishment specific components. Under the model, when an establishment belongs to the primary sector, the mean residual of the establishment should be negatively correlated with the magnitude of outflow.

In the next step, we use the unknown regime switching technique (Dickens & Lang, 1985; Ishikawa & Dejima, 1994) to decompose the economy into two types of establishments, because we do not have any explicit ex-ante criteria to define which establishment belongs to which sector. After, having done this decomposition, we check whether we observe in both sectors a similar relation between the mean residual and the flow structure or not. Finally, we are able to simulate the evolution of productivity and wage differentials induced by our model by extending the decomposition into two sectors to the Lost Decade.

3.2 The dataset

In this part, we match two databases, the Basic Survey on Wage Structure (BSWS) and the Employment Trend Survey (ETS) for the year 2005. As the BSWS is an individual survey and the ETS an establishment survey, we get a matched worker–establishment database. The key issue is the size of the sample after matching.

3.2.1 The BSWS individual survey and the ETS establishment survey

The BSWS individual survey is a sample survey conducted by MHLW, once a year, at the end of June. It covers private establishment over 5 employees and public establishment over 10 employees. All industries other than agriculture are surveyed. Workers are re-sampled within an establishment. The sample size is about 78000 establishments and 1.6 million workers per year. It is a rich set of information on establishment and individual characteristics. The most important feature for us is rich data on wages.

As for the ETS, it is an establishment survey conducted by MHLW, twice a year, at the end of June and December. It covers public and private establishments with more than 5 employees in all industries, except agriculture. Newly separated and newly hired workers (within the sampling period) are re-sampled within an establishment. The sample size is about 10000 establishments, 80,000 inflow workers and 90,000 outflow workers per year. It gives information on the numbers of new entrants and of separations.

3.2.2 Matching the two surveys

Regarding the BSWS, data is collected at the end of June 2005. Sample is restricted to regular fulltime employees. As for the ETS, inflow/outflow is the number of acquisition/leave for regular fulltime workers between July and December 2005 (during half a year after the BSWS data point). The ratio is based on the stock number of regular fulltime employee at the beginning of July 2005.

We match these two surveys by using a key provided by the MHLW. Although the size of matched sample is 2733, we found some possible inconsistencies in data. The data point of BSWS is the end of June 2005, and that of the second ETS is the beginning of July 2005 (next day of the BSWS data point). We proceed to a sample restriction as follows:

- 4 establishments are excluded due to the negative employment stock at the beginning of July;

- 250 establishments are excluded due to the inconsistency of industry classification between BSWS and the second ETS;

- 435 establishments are excluded due to the inconsistency of firm size and establishment size classifications between BSWS and the second ETS.

As a result, the final size of the match sample is 2044 establishments. For the BSWS, the matching rate is only 5% but from the point of view of ETS, it is 30%, which is quite acceptable. Finally, please note that this restriction is pretty conservative in that there is a possibility for an establishment and/or firm to move to another classification at the beginning of July.

3.3 Detecting the existence of efficiency wage schemes

The fact that efficiency wage is a satisfying model for the Japanese labor market is a matter of empirical investigation. However, depending on the exact nature of the efficiency wage model, the empirical strategy may drastically vary. Moreover, the results may be ambiguous, as it is sometimes difficult to empirically distinguish between the predictions of different models (Manning, 2003). For example, Abe and Ohashi (2004) confirm the existence of efficiency wage model in Japan by analyzing the wage profiles. In our case, in order to detect the existence of efficiency wage on average, we proceed as follows.

First, according to a conventional procedure in the usage of the BSWS, we calculate the scheduled hourly wage as the monthly salary (excluding various allowances) per scheduled working hour ($w_{i,2005}$). Secondly we limit the sample to regular male in private and over 30 employee firms except for construction industry to keep the comparability to public data. Thirdly we regress the log of scheduled hourly wage on dummies for educational level, age, age squared divided by 100, tenure, tenure squared divided by 100, and prefecture dummies ($X_{i,2005}$) according to the standard Mincerian equation (see Kambayashi et al., 2008) as follows:

$$w_{i,2005} = \alpha + X_{i,2005}\beta + u_{i,2005} \tag{25}$$

Here $u_{i,2005}$ is, given $X_{i,2005}$, normally distributed unobservable term with mean zero. By using the estimated coefficients in equation (25), we can produce the residual for each individual. If the human capital markets are perfect, the residual of (25) can be interpreted as unobserved matching rent (or establishment-individual specific components) which a certain worker can enjoy just because one belongs to a specific establishment. The summary statistics of the residual is reported in Figure 1.

Figure 1: Summary Statistics for Residual of Mincerian Equation at Individual Level

	Obs	Mean	Std. Dev.	Min.	Max.
Residual	48,681	0.000	0.323	-3.978	3.819

We take the mean of residual for each establishment to produce the establishment fixed effect. The summary statistics of the mean residual for each establishment is reported in Figure 2.

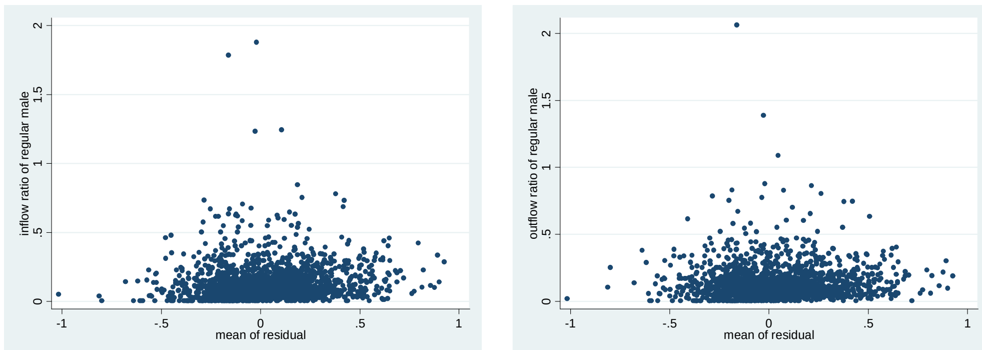
Figure 2: Summary Statistics for Residual of Mincerian Equation at Establishment Level

	Obs	Mean	Std. Dev.	Min.	Max.
Residual	31,852	-0.039	0.249	-1.673	1.934

The next step is to see the nature of wage premium from a view point of flow structure. According to equation (21), the wage premium should be negatively correlated with separation rate as well as accession rate in the primary sector. The next figure (Figure 3) is the scatter plots for the mean residual and flow ratios at establishment level. There seems to be a slight negative relationship, which means that the turnover decreases as the average residual increases as implied in equation (21).

These negative relationships can be confirmed in the following simple regression reported in Figure 4. After controlling industries, firm size and overtime ratio, we can find slightly significant negative correlation between outflow ratio

Figure 3: The Mean Residual and Flow Structure



and mean of residuals. Therefore, we find empirical evidence to support the predictions of (21). It implies the existence of efficiency wage mechanism in the Japanese labor market on average.

Although we can confirm the efficiency wage on average, the negative correlation does not seem to be universal when we look at Figure 3. This leads us to further investigations to divide the matched sample into the two categories, primary and secondary sectors.

3.4 Identifying two types of firms: a switching regression approach

To empirically test our model, the ideal would be to get simultaneously the two following results: 1) identification of two types of firms; 2) detection of efficiency wages for one type and of competitive wage setting for the other one according to same criterion used in the former step (negative correlation between the mean residual and the outflows). Unfortunately, to our knowledge, there is not such procedure. Therefore, we proceed in two steps, first in identifying two types of firms and, second, in checking whether there is a significant difference between these two types for firms regarding the correlation between wages and flows.

To divide the sample of firms into two tiers, criteria such as firm size or industry can offer the key of identification. However, in adopting such *a priori* classification, the problem is not only to misclassify some firms. More deeply, it hinders to consider the possibility of within-groups heterogeneity: for example, two firms with similar size or belonging to the same sectors may choose different wage and productive systems. This is why we adopt the unknown regime switching regression *à la* Dickens and Lang (1985).[5] With this methodology,

[5] A well-known limit of this methodology, which has been already applied to the Japanese

Figure 4: OLS Estimates of the Effect of Flow Structure on Mean Residual (Sample: 2005 BSWS and ETS matched sample)

	(1)	(2)	(3)	(4)
Dependent Variables	Mean of Residual			
Inflow Ratio	0.010 (0.036)			
Outflow Ratio		-0.067 (0.039)*		
Gross Flow Ratio			-0.016 (0.021)	
Excess Flow Ratio				-0.012 (0.024)
Observations	1899			
R-squared	0.28	0.28	0.28	0.28

Note: Standard errors in parentheses, and *** p<0.01, ** p<0.05, * p<0.1. Other explanatory variable includes average overtime ratio, 4 firm size dummies, 9 industry dummies and constant. Gross flow ratio means inflow ratio plus outflow ratio. Excess flow ratio means gross flow ratio minus the absolute value of employment growth rate.

sample separation is *a priori* unknown and the segmental choice between two sectors is explicitly endogenized (Sousa-Poza, 2004). The system of estimation is as follows:

$$\left\{ \begin{array}{c} R_{j,p} = \lambda_p + Y_{j,p}\gamma_p + Z_{j,p}\delta_p + V_p \\ R_{j,s} = \lambda_s + Y_{j,s}\gamma_s + Z_{j,s}\delta_s + V_s \\ z = \lambda_3 + V_j\gamma_3 + Z_j\delta_3 + V_3 \end{array} \right\} and \left\{ \begin{array}{lll} R_j = R_{j,p} & if & z \geq 0 \\ R_j = R_{j,s} & if & z < 0 \end{array} \right\} \quad (26)$$

where

$R_{j,k}$ is the mean residual of establishment j of sector k (p: primary, s: secondary);

Y_j is the separation ratio of establishment j;

Z_j are control variables;

z is a latent variable which splits the sample into two kinds of sectors;

V_j provided the key to identify the division of sectors.

Because $R_{j,k}$ is the mean residual and can be interpreted as a quasi-rent, industry and firm size should matter. Therefore, we include 9 industry dummies

labor market by Ishikawa and Dejima (1994), is that it provides a test for dual labor markets and does not recognized the possibility of three segments. However, from the point of view of the question we address in this paper, it is not a problem as we explicitly focus on the cleavage between two types of productive models.

and 4 firm size dummies as controls. $R_{j,k}$ may also be affected by unobserved temporary demand shock, causing omitted variable bias. To cope with the potential bias, we firstly limit the hourly wage as scheduled wage, which is not likely to be affected by temporary demand shock. Secondly we introduce the average overtime ratio within establishment to directly control the temporary demand shock.

The next issue, before estimating the system of equations (26) is to define the key to identify the two sectors, V_j. Our strategy is to use the difference of gross job flow between male and female as the identifier.[6] This idea refers to a stylized fact characterizing the Japanese labor market, discrimination of female workers (Wakisaka, 1997). It is well documented that the average wage of female workers is almost 30% below that of male, after having controlled for human capital characteristics. Several economists ran the so-called 'market test' for female discrimination and found empirical evidence, which do not contradict the existence of discrimination. More deeply, it has been shown that this wage differential between male and female workers comes from various differences regarding the job stability: in particular, female workers tend to be adjusted as a buffer upon temporary shocks. This fact is confirmed with our data set: in calculating the turnover rate by gender, we find an apparent difference of gross flow rates between two regular workers (figure 5). More precisely, the gross flow rate is higher and more volatile for female regular workers than for male. As a result these two turnover rates are not so strongly correlated.[7] Therefore, this is quite consistent if we assume, upon conventional wisdom in this field, female workers are usually treated as more flexible inputs in many Japanese firms.

Figure 5: Summary Statistics for Separation Rate by Gender

	Obs	Mean	Std. Dev.	Min.	Median	Max.
Male	1,933	0.249	0.232	0	0.19	3.84
Female	1,908	0.304	0.551	0	0.21	16.00

Our basic hypothesis to differentiate between a primary group of firms (characterized by efficiency wage mechanism) and a secondary group of firms (where competitive mechanisms apply) is as follows. At first, we assume female workers never join in the primary sector, therefore the exogenous demand shock directly affect the flow ratio of female workers. If the turnover rate of male employee is no more than female workers within the same firm, the male workers in this establishment are more or less to be shielded from the exogenous demand shock. We interpret such male workers are likely to belong to the primary sector.

[6] Because BSWS individual survey does not contain educational levels for part-time workers, we can not compare full-time workers and part-time workers under the above Mincerian specification.

[7] Actually, the simple correlation coefficient is statistically significant but up to 0.30

Therefore, if the turnover rate of male regular workers is smaller than of female, the male workers in such establishments may belong to the efficiency wage sector. On the other hand, if the turnover rate of male regular workers is bigger than or equal to that of female, they may belong to the competitive sector. After having chosen this identifyier, we run the estimation based on equation (26).

Figure 6: Estimated Results of Switching Regression: Effect of Flow Structure on Mean Residual (2005 BSWS and ETS matched sample)

	(5)	(6)	(7)	(8)
	Full Sample OLS	Secondary Sector	Primary Sector	Switch
Dependent Variables		Mean of Residual		(latent)
Outflow Ratio	-0.067 (0.039)*	0.030 (0.031)	-0.215 (0.069) ***	
Gross Flow Ratio Difference between Male and Female				-0.868 (0.015)***
Observations			1875	
R-squared	0.28	0.46	0.13	0.94

Note: Standard errors in parentheses, and *** p<0.01, ** p<0.05, * p<0.1. Other explanatory variable includes average overtime ratio, 4 firm size dummies, 9 industry dummies and constant. Gross flow ratio means inflow ratio plus outflow ratio. Full estimates are found in the appendix.

The full results are reported in appendix (figure 9). We focus here on the key relations between mean of residual and outflow ratio, reported in figure 6. The estimation (5) is the same result as the estimation (2) in figure 4, in which we can find weakly negative correlation between separation rate and mean residual. When we divide the sample into two parts, according to the switching equation (8) (in figure 6), this negative relation is exhibited more strongly and significantly in the primary sector (7), whereas it is rather small and statistically insignificant in the secondary sector (6). As a whole, these results imply that firms in the primary sector resort to efficiency wages, whereas firms in the secondary sector do not.

Finally, after having decomposed the firms into two groups and checked that firms of primary group resort to efficiency wages whereas firms of the secondary do not, it may be interesting to check *ex post* the characteristics of the firms belonging to each sector, especially in terms of size and industries. The summary statistics and estimated coefficients of the switching regression are reported in appendix (figures 8 and 9). A first conclusion is that, compared with larger firms, smaller firms are not likely to belong to the primary sector significantly; as for service industries, they are more likely to belong to the primary sector than manufacturing firms or electric and utilities. Moreover, as the switching regression (8) in figure 9 is a Probit type, it is necessary to simulate the *ex post* probabilities to evaluate the effect of firm characteristics. For this purpose, we divide the sample into three groups by *ex post* probability to belong to the primary sector and provide summary statistics for each group in order to compare the firm characteristics between likely-primary sector firms (figure 8). Four basic conclusions can be drawn from this exercise. First, the average quasi-rent is larger in the most-likely-primary-sector-firms. Second, the difference of gross flows between male and female workers is much less in the most-likely-primary-sector-firms than the least. Third, the group whose probability to belong to the primary sector is higher does less contains smaller firms. For example, in the case of most-likely-primary-sector firms the smaller firms (under 299 employees) occupies 26.2% whereas it is up to 36.4% in least-likely-primary sector firms. Fourth, as for the industries, manufacturing industries are found in the lowest probability whereas high probability firms are characterized by high share of service industry. This analysis therefore provides another justification to use the unknown switching regression methodology *à la* Dickens and Lang.

3.5 Simulation

Ideally, the purpose of this section is to simulate the evolution of productivity and wage differential on the basis of the previous relationships observed for the year 2005. In doing so, we are able to check whether our model can replicate the stylized facts that have been emphasized in the introduction. More precisely, from our model, we expect that a negative productivity shock at the aggregate level (similar to what has been observed in Japan during the Lost Decade) should lead to increasing productivity and wage differentials.

However, because of a lack of data, we are not able to directly confirm (or not) the predictions of our model regarding the evolution of wage and productivity differential. Instead, we focus on another relation, given by equation (24), which describes the share of primary firms as a linear combination of the productivity (respectiv. wage) differential between the two sectors. As seen in the section 2.4, the rise of the productivity and wage differentials coming from a negative productivity shock at the aggregate level goes hand in hand with a rise of the share of the primary sector. Moreover, we are able to calculate the respective impact of two mechanisms at the origin of the evolution of the primary sector: the efficiency wage mechanism and structural effects regarding industry and firm size changes.

As the switching regression is conducted at establishment level, following (12) in figure 6, we can deduce the probability that establishment j belongs to the primary sector as:

$$F\left(\hat{\lambda_3} + V_j\hat{\gamma_3} + Z_j\hat{\delta_3}\right) \tag{27}$$

Here F is the c.d.f. of standard normal distribution, V_j is the difference of gross worker flow between male and female, and Z_j are dummies for industry and firm size. Among 1875 establishments in the sample, the mean of imputed probability of belonging to the primary sector is 0.27.

To evaluate the share of the primary sector in the economy, it is necessary to summarize the probabilities with some weights. The number of male regular workers may be an available and consistent weight. In this case the weighted average of probabilities will be equivalent to the share of regular male workers under the efficiency mechanism; calculated as 0.21. Assuming that female regular workers are under marginal mechanism to keep the consistency through this article, the share of primary sector is about 0.16 within whole of regular workers.

In the next step, our concern is to determine of the evolution of the share of the primary sector. As the published ETS provides the aggregated worker flows by gender, firm size, and industry since 1981, we are able to put in perspective the evolution during the Lost Decade by taking into account the evolution in the 1980s. If we assume the switch equation has been stable over time, we can impute the probability for the average firm to belong to primary sector in a certain industry, firm size and year. By using the imputed probability, we can deduce the average share of primary sector upon assuming female workers are always in the secondary sector. Let define S_t as the share of primary sector, E_t as the number of regular workers and M_{kt} as the number of male regular workers of industry-firm size k in year t. V_{kt} is the difference of aggregated gross worker flow between male and female, and Z_{kt} are dummies for industry and firm size classification. S_t should be defined as follows:

$$S_t = \frac{\sum_k F\left(\hat{\lambda_3} + V_{kt}\hat{\gamma_3} + Z_{kt}\hat{\delta_3}\right).M_{kt}}{E_t} \tag{28}$$

In figure 7 we depict the transition of imputed shares of primary sector among regular workers between 1981 and 2005.[8] We show another computed shares as if we fix the worker flow in each industry and firm size as in 1981 ($\overline{V}_{k1981}$).

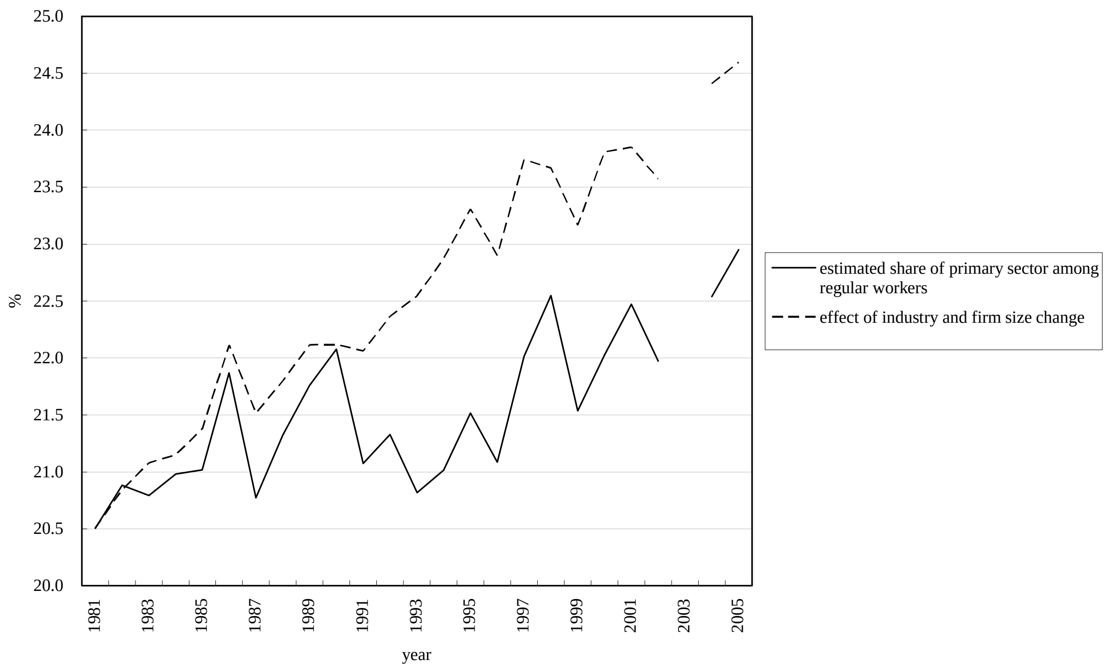
$$\overline{S}_t = \frac{\sum_k F\left(\hat{\lambda_3} + \overline{V}_{k1981}\hat{\gamma_3} + Z_{kt}\hat{\delta_3}\right).M_{kt}}{E_t} \tag{29}$$

The difference of two lines is produced by the effect of the change of worker flow.

As for 2005 in figure 7, the estimated share of primary sector is 0.23 among whole regular workers. Perhaps due to aggregation, these figures are

[8] Data for 2003 are missing.

Figure 7: Transition of Share of Primary Sector



much higher than micro data-based mean probability, that is 0.16. Therefore we should be cautious when interpreting the simulated probability based on aggregated data.

Putting aside the level of shares, a more interesting fact in the figure 7 is the upward trend of primary sector through decades. We can distinguish 2 steps in the rise of this share, between 1981 and 1991 (increase of 0.6) and between 1992 and 2005 (increase of 1.9): it is possible to say that this trend has accelerated from the early 1990s even if it is characterized by fluctuations.

Moreover, a second conclusion is that this upward trend largely comes from the shift of industry and firm size. As shown in the full estimates of switching regression in the appendix (figure 9), male regular workers in larger firms or in service industries are more likely to be in the primary sector than those in smaller firms or manufacturing. Thus, the mean probability will change when the distribution of industries and firm size shifts. During decades it is well known structural changes in the Japanese economy have been characterized by a rising share of non-manufacturing industries. It may be the underlying mechanisms at the roots of the increasing share of primary sector in Japan, which is depicted in figure 7. Furthermore, this trend would have been more rapid if the difference of gross flows between male and female had kept his level of 1981. In other words the effect of the change of outflow – that is, here, a proxy for the strength of efficiency wage mechanism - has been somewhat negative. It means that, especially between 1990 and 1993 when the trends of two lines are apparently reversed, Japanese firms have weakened the mechanism of efficiency wage by relatively using more male outflow rather than female outflow.

As a whole, the simulated evolution of the share of the primary sector confirms a prediction of our model. However, the specific and relative impact of the efficiency wage mechanism in the rising share of the primary sector has declined from the 1990s.

4 Conclusion

In this paper, we have proposed a framework aiming at connecting two stylized facts that characterized the Japanese economy during the Lost Decade (1992-2005): rising wage inequalities and increasing productivity differentials. First, we have build an efficiency wage model with two types of firms: firms of the primary sector adopt efficiency wage scheme, whereas the labor market of the secondary sector is competitive. A key feature of this model is that the first type of firms endogenously generate an effort function. In this model, a negative productivity shock at the aggregate level produces increasing productivity and wage differentials, as well as rising share of the primary sectors.

Second, we test this model on Japanese micro data. For the first time, we match the Basic Survey on Wage Structure and the Employment Trend Survey. The matched worker-firm cross-section dataset we get allows us to establish that there is a negative correlation between the mean of the residual and ouflows and, thus, to confirm the existence of efficiency wages mechanisms on average. Moreover, by using the unknown regime switching regression methodology à la Dickens and Lang (1985), we are able to distinguish between two sectors and, in a second step, to show that one can be characterized by efficiency wage and the other one not, by using the same criterion. Finally, we study the evolution of the share of primary sector by simulation. The fact that it substantially increased between 1981 and 2005 is conformed to the predictions of our model. However, the relative importance of the efficiency wage mechanism by comparison to structural evolutions of industry and firm size changes has to be nuanced.

Important issues are related to this work. First of all, it is confirmed that rise wages inequality is related to increasing productivity dispersion among Japanese firms. Second, the rising share of primary sector and its associated increasing wages and tenure is rather counter-intuitive if one considers the state of the debate on the end of the so-called "Japanese employment system". Third, this focus on labor market mechanisms and choices regarding the productive model at the level of the firm shows that it is possible to generate a similar trend of rising wage inequalities to the one that has been observed in Japan during the Lost Decade, without resorting to hypotheses regarding SBTC or globalization. At the same time, we are conscious that our work has important limitations and that we should be about our conclusions. We can think about at least two extensions of this work. First, it is desirable to study directly the evolution of inter-firms wage and productivity differential rather than indirectly through the share of primary firms. Second, it would be necessary in the future to decompose precisely the overall wage differentials into within-firms and between-firms differentials.

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Appendix

Figure 8: Appendix 1 - Summary Statistics of Switching Regression Sample

		Full Sample Used in the Regression				least: 0.1> Prob. of Primary Sector		more or less: 0.5> Prob. of Primary Sector >0.1		most: Prob. of Primary Sector >0.5	
Variable		Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mean of Residual		0,043	0,237	-1,015	0,928	0,025	0,210	0,024	0,215	0,104	0,297
Outflow Ratio		0,126	0,126	0,000	2,058	0,111	0,112	0,132	0,124	0,150	0,150
Gross Flow Ratio Difference between Male and F		-0,046	0,384	-7,058	2,615	0,059	0,178	-0,183	0,306	-0,125	0,634
Overtime Ratio		0,083	0,057	0,000	0,298	0,091	0,055	0,080	0,057	0,068	0,057
Firm Size Dummies	(over 1000)	0,498	0,500	0	1	0,486	0,500	0,553	0,498	0,468	0,500
	(300-999)	0,196	0,397	0	1	0,150	0,358	0,220	0,415	0,269	0,444
	(100-299)	0,187	0,390	0	1	0,211	0,408	0,152	0,359	0,171	0,377
	(30-99)	0,118	0,323	0	1	0,153	0,360	0,075	0,263	0,091	0,288
Industry Dummies	(Mining)	0,014	0,117	0	1	0,027	0,163	0,000	0,000	0,000	0,000
	(Manufacturing)	0,605	0,489	0	1	0,910	0,286	0,551	0,498	0,011	0,105
	(Electric and Utilities)	0,026	0,160	0	1	0,046	0,210	0,011	0,103	0,000	0,000
	(Transportation and Communication)	0,070	0,255	0	1	0,000	0,000	0,006	0,080	0,285	0,452
	(Retail, Wholesales and Restaurants)	0,077	0,266	0	1	0,017	0,128	0,269	0,444	0,004	0,067
	(Finance and Insurance)	0,029	0,169	0	1	0,000	0,000	0,115	0,320	0,002	0,047
	(Real Estates)	0,017	0,130	0	1	0,000	0,000	0,047	0,212	0,022	0,148
	(Service)	0,162	0,368	0	1	0,000	0,000	0,000	0,000	0,675	0,469
Observation		1874				957		468		449	

Figure 9: Appendix 2 - Full Results of Switching Regression: Effect of Flow Structure on Mean Residual (2005 BSWS and ETS matched sample)

	(5)	(6)	(7)	(8)
Dependent Variables	Full Sample OLS	Secondary Sector Mean of Residual	Primary Sector	Switch (latent)
Outflow Ratio	-0.067 (0.039)*	0.030 (0.031)	-0.215 (0.069) ***	
Gross Flow Ratio Difference between Male and Female				-0.868 (0.015)***
Overtime Ratio	0.970 (0.090)***	1.253 (0.070)***	0.179 (0.240)	
Firm Size Dummies (over 1000)		BASE		
(300-999)	-0.070 (0.013)***	-0.069 (0.010)***	-0.081 (0.033)**	0.037 (0.016)**
(100-299)	-0.170 (0.013)***	-0.161 (0.010)***	-0.206 (0.032)***	-0.071 (0.016)***
(30-99)	-0.218 (0.016)***	-0.215 (0.011)***	-0.219 (0.0395)***	-0.273 (0.019)***
Industry Dummies (Mining)	0.176 (0.039)***	0.203 (0.027)***	0.421 (0.094)***	-1.100 (0.051)***
(Manufacturing)		BASE		
(Electric and Utilities)	0.260 (0.029)***	0.260 (0.022)***	0.107 (0.067)	-0.304 (0.037)***
(Transportation and Communication)	0.073 (0.019)***	0.015 (0.013)	0.131 (0.038)***	1.870 (0.023)***
(Retail, Wholesales and Restaurants)	-0.051 (0.019)***	-0.064 (0.014)***	0.027 (0.045)	0.314 (0.022)***
(Finance and Insurance)	0.165 (0.029)***	0.166 (0.019)***	0.164 (0.061)***	1.050 (0.035)***
(Real Estates)	0.143 (0.037)***	0.185 (0.025)***	0.083 (0.077)	1.230 (0.045)***
(Service)	0.127 (0.014)***	-0.003 (0.010)	0.165 (0.032)***	2.238 (0.016)***
Constant	0.004 (0.013)***	-0.033 (0.010)***	0.080 (0.037)**	-1.362 (0.010)***
Observations		1874		
R-squared	0.28	0.46	0.13	0.94

Note: Standard errors in parentheses, and *** p<0.01, ** p<0.05, * p<0.1. Gross flow ratio means inflow ratio plus outflow ratio.