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Flexible labor, innovation regimes and the erosion of the Japanese model: Evidence from the Basic Survey on Wage Structure

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ABSTRACT

Due to labor market reforms around 2003–4, Japan has a growing group of 'non-regular' workers who are easy to fire, and have poor carrier perspectives. This marks a break with the traditional Japanese model of life-time employment that allowed for intensive in-company training and commitment of personnel. Drawing from a national wage structure survey, we find indications that employment of non-regular workers has a negative impact on productivity (proxied by wages), this negative impact being largest under innovation regimes that require a high cumulativeness of knowledge. Our findings are consistent with neo-Schumpeterian research in Europe which concluded that certain labor market rigidities, while being *un*desirable from a neoclassical perspective, can be useful to innovation. Our paper confirms the impression from earlier research that structural reforms of labor markets along supply-side lines are likely to be one of the reasons for a substantial decline of productivity growth in major OECD countries since about 2004/05.

1. Introduction

Since the late 1970s, supply-side economists advocated rigorous structural reforms of labor markets. While these reforms were mainly motived by allegedly beneficial effects on job growth, the question of how structural reforms of labor markets would influence innovation or productivity has long been neglected. Meanwhile, a few studies suggest that flexible labor has a neutral or perhaps even a positive impact on innovation (e.g., Arvanitis, 2005; Van Schaik and Van de Klundert, 2013; Bartelsman et al., 2016). But there is also a growing neo--Schumpeterian literature that tells a different story: deregulation and 'flexibilization' of labor markets might have, through various channels, a *negative* impact on the functioning of the Schumpeter-II innovation model (Schumpeter, 1942).

This paper contributes to the latter line of research. We agree that deregulation of labor markets enhances the efficient use of scarce resources in a static neoclassical framework; but in a dynamic Schumpeterian framework it may harm both, innovation and the diffusion of innovations and thus result in lower productivity gains.

Neo-Schumpeterian contributions show that the effects of labor market flexibility depend on the innovation model that is dominant in an industry (Kleinknecht et al., 2014; Wachsen and Blind, 2016; Cetrulo et al. 2019, Hoxha and Kleinknecht, 2020, 2023). Using a Japanese wage structure survey, this paper addresses the effect of non-regular work on wages (as a proxy for productivity) and its dependence on the innovation regime. We examine how non-regular employment affects wages and how this differs according to the innovation regime dominant in an industry.

In the past, Japan was known for having lifetime employment and seniority-based systems (wage and promotion), various mechanisms to enhance employee involvement and voice, elaborate pay systems including employee ownership and profit sharing, extensive training and multiskilling, and corporate welfare programs (Kambayashi and Kato, 2017). The latter have been regarded as a major source of Japan's impressive postwar economic performance (e.g., Aoki, 1990).

The Japanese economy, however, has been stagnant over a long period since the collapse of real estate and stock exchange bubbles around 1990. Under the cabinet of prime minister Koizumi around 2003–4, Japan implemented labor market reforms intending to increase labor market flexibility, non-regular employment, and overall economic efficiency. One of the key initiatives during this period was the revision of the Labor Standards Act in July 2003, which came into effect in April

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2004, aiming at an overall improved functioning of the labor market.

Among others, the reforms allowed for the easier hiring of 'non-regular' workers with little job security and poor carrier perspectives. This is a break with the Japanese tradition of life-long employment that made it attractive to invest in intensive firm-specific training that many considered crucial to Japan's emergence as an industrial power (e.g., Mincer and Higuchi, 1988). In this respect, Japan is an interesting case for research on the role of labor flexibility.[1]

The contribution of this paper is twofold. First, we shed light on the effects of labor market flexibility on wages. Second, we examine how far the effects of labor market flexibility depend on innovation regimes. Previous studies in Western countries have analyzed the effects of flexible work on direct measures of innovation and productivity. We use wages as a proxy for productivity and present evidence on how the effect of employment status on wages varies across innovation regimes and over time.

This paper is organized as follows. Section 2 provides background information and reviews related literature. In Section 3 we provide descriptive data. We then estimate Mincerian wage equations in Section 4. We estimate the impact of non-regular work on hourly wages (after the usual controls). Theoretically, we expect that firms in highly cumulative innovation regimes will, due to their dependency on internal learning and on worker embodied knowledge from experience, hire non-regular labor market outsiders with some hesitation. In low-cumulative innovation regimes, however, firms are less dependent on internal knowledge accumulation and will therefore more frequently choose the advantage of lower wage costs of labor market outsiders. Besides, as our labor market data cover 13 years (2007–2019), we can run our wage equation for all 13 years separately and observe whether certain coefficients shift over time. We expect that, given the typical disadvantages of outsider positions (no training, no job rotation, etc.), their productivity (proxied by their wages) is substantially lower than insider wages, and, in the course of time, we expect this difference to become larger. Moreover, we expect the wage penalty of non-regular workers towards regular workers to be larger under highly cumulative innovation regimes. Besides, our regressions produce information about the impact of education on wages or on (large) gender wage gaps. The conclusions section addresses some broader meanings of our findings.

2. Background and related literature

From the late 1970s onwards, the supply-side economics plea for removing 'rigidities' in labor markets got momentum. In the early 1980s, countries like the UK, the US, Canada, New Zealand, or Australia were praised for having deregulated their labor markets to make them work as true markets. Deregulation included the reduction of minimum wages, easier firing, decentralization of wage bargaining, or sobering of unemployment benefits. Moreover, the Keynesian aim of full employment was replaced by the concept of 'natural' unemployment (or NAIRU), understanding that 'natural' (or NAIRU) unemployment should be high enough to keep workers disciplined and prevent inflation-enhancing wage claims (Shapiro and Stiglitz, 1984).

In the 1980s, supply-side economists complained that 'Old-Europe' and Japan were lagging in the reform process. This has meanwhile changed. For example, Italy had substantial labor market reforms along supply-side lines in the second half of the 1990s, which enhanced employment growth but strongly reduced productivity growth (Lucidi and Kleinknecht, 2010). Moreover, German labor market reforms (the so-called Hartz packages) took place between 2002 and 2005 with similar effects: favorable for employment but negative for innovation and productivity growth (Hoxha and Kleinknecht, 2020, 2023).

Besides emphasizing the role of training, the neo-Schumpeterian literature addresses the positive role for innovation of long job durations in well-protected insider jobs. Among others, it is argued that removing 'rigidities' in labor markets, together with high 'natural' unemployment, weakens the bargaining position of labor, resulting in weak wage growth. Weak real wage growth, in turn, reduces productivity growth through channels like capital-labor substitution (Hicks, 1932), induced innovation (Samuelson, 1965) or through a slower speed of replacement of older vintages of capital stock by new and more productive ones (Tjan and Hartog, 1980); in other words, it leads to a slower diffusion of advanced process technologies that are embodied in new capital goods. Moreover, low wage growth protects weak entrepreneurs and technological laggards against being competed away in the process of Schumpeterian 'creative destruction'. In the long run, this will result in a weaker average quality of entrepreneurs. The empirical relevance of the above four arguments is demonstrated by Vergeer & Kleinknecht (2014). They estimate that, over the medium term, a one-percentage point lower (higher) growth of real wages results in an 0.35 – 0.46 percentage points lower (higher) growth of GDP per working hour.

A second group of arguments relates to easier firing and a larger labor turnover reducing trust and loyalty. This creates unfavorable conditions for the management of firm-specific knowledge, especially if such knowledge is 'tacit' and embodied in people (Polanyi, 1966). For example, Lorenz (1999) argues that, for the successful implementation of automation technology, engineers often need access to the tacit knowledge of the people who still do the work that is to be automated. If these people cannot trust on having safe insider positions, they will refuse to collaborate. Expanding the argument by Lorenz, one could even argue that people that are easy to fire (and who fear for their jobs) have motives for hiding inefficient work practices, exploiting information asymmetries between management and shopfloor.

Moreover, shorter job tenures can weaken the historical memories of firms, turning them into *un*learning organizations that repeat past mistakes. More frequent job changes can also reduce gains from learning-by-doing; or they can diminish the loyalty of personnel. Lower loyalty eases the leaking of precious knowledge and trade secrets to competitors, thus increasing Pigouvian externalities that discourage investments in new knowledge. Kleinknecht et al. (2016) observed that the rise of flexible labor correlates with the growth of management bureaucracies for monitoring and control. Thicker management layers can threaten the professional autonomy of creative people, besides driving up overhead costs.

Another argument (to be empirically tested in this paper) relates to the innovation regime that is dominant in an industry. In the past, we distinguished a Schumpeter-I innovation regime (i.e., garage businesses and startups; Schumpeter, 1912) and a Schumpeter-II innovation regime in which innovations primarily emerge from professional R&D labs in larger corporations (Schumpeter, 1942; see also Breschi et al., 2000).

In the following, we use a refined measure of innovation regimes, drawing from work by Peneder (2010) on a large set of *Community Innovation Survey* (*CIS*) data. Peneder distinguishes between industries with a high versus a low 'cumulativeness of knowledge'. Firms in industries with a *low* cumulativeness of knowledge rely primarily on acquisition of more *general* knowledge from *external* sources. Highly cumulative innovators rely in their innovation process more on *internal* sources of knowledge, having a strong focus on the accumulation of firm-specific knowledge from the experience acquired in a process of continuous improvement of products, processes, or systems. Such knowledge tends to be poorly documented and comes close to what Polanyi (1966) called 'tacit' knowledge from practical experience that is embodied in people. If such knowledge is important, longer job tenures in well-protected insider positions are attractive to employers.

3. A first look at the data

Our labor market data come from the *Basic Survey on Wage Structures*

[1] Japan is also known for having a relatively large wage gender gap. Although the gap has been slightly narrowing in recent years, it still is one of the largest among highly developed countries (Hara, 2018).

compiled by the Japanese Ministry of Health, Labor, and Welfare. The survey has been held since 1948. Our data cover 2007–2019, covering almost all industries, except Agriculture, Forestry and Fishing; the cut-off point is at establishments that have at least 5 employees. For our analysis, we exclude non-business activities such as education, health care, or social work. As the survey is each year again randomly sampled, there is no panel data. The 2019 survey sampled 78.181 establishments (drawn from a population of 1,513,867 establishments), of which 53.867 (69 %) responded. The survey is addressed to the personnel department of each establishment, asking them to fill in the survey for a certain number of specified employees. The survey covers, over the entire 13 years, a total of 10,677,121 employees and produces information that allow estimation of person-level wage equations.

Table 1 details the workers by type of contract. On average over 2007–2019, most Japanese workers (82.6 %) were still well-protected insiders: full-time[2] and permanent. A second group (2.3 % of all workers) consists of partly flexible workers ('full-time, regular, fixed term'). They have almost the same status in terms of the labor law as the first group. A major deviation is their fixed-term contract; often they are hired for 5 years and can be prolonged another 5 years. Anecdotical evidence suggests that, in the course of time, many of them succeed to get promoted into the first group. In our further statistical exercises, we shall merge groups 1 and 2 into one 'regular workers' group. The non-regular workers are in groups 3 and 4. People in group 4 are hired for a maximum of 5 years. If the firm employs them longer than 5 years, they can claim a permanent position. Table 1 shows that a small group (3.9 %) succeeded to get a permanent position (group 3), while 11.1 % is temporary (group 4). Women are more strongly represented in the non-regular workers groups.

Table 2 gives an overview of industries that were classified by Peneder (2010) in high, medium, and low cumulativeness industries. The classification is derived from European *Community Innovation Survey* data. Applying a classification from Europe to Japan alleviates concerns about endogeneity. Manufacturing industries that are dependent for their innovations on accumulation of an internal knowledge base correlate strongly with industries that have high innovation performance. In service industries, this correlation is less strong (see Peneder 2010, Table 1).

It is obvious from Table 2 that medium- and low-cumulativeness industries are, in an historical perspective, somewhat 'older' industries. In these industries, it is likely that much of the knowledge for technological renewal tends to be somehow standardized and codified, which makes it more easily tradable on external markets. In such mature industries, risks and uncertainties are lower, but so are the innovation rents when compared to highly cumulative innovation regimes that can more easily monopolize the internal and firm-specific knowledge behind their innovations.

The descriptive data in Table 3 show that wages are highest in the industries that depend on highly cumulative (internal sources of) knowledge. This is not surprising, given the high innovation intensity of these industries and their dependency on highly qualified personnel. The latter is visible in the high share of personnel with university education (last row). Moreover, as expected, highly cumulative industries employ somewhat higher shares of tenured insiders than industries with a medium and low cumulative knowledge base.

4. Mincerian wage regressions

4.1. Model

Our dependent variable is hourly wages. The latter is the monthly income divided by monthly working hours. Monthly income is the scheduled salary plus allowances and bonuses (per month). Monthly working hours are the scheduled working hours plus overtime hours.

For the sake of simplicity, we merge the two groups of *regular* workers (i.e., group 1 + 2 in Table 1: regular workers with permanent plus fixed-term contracts). This seems to be justified by their almost identical (strong) protection by the labor law, except for the fixed-term contracts in the second group. Moreover, in regressions that treat both categories separately (not documented), we obtained quite similar coefficients. Moreover, again for simplicity, we merge the two groups of *non*-regular workers (i.e., group 3 + 4 in Table 1). Here again, tentative estimates for both groups separately gave similar coefficients.

Our regressions include the usual controls. First, we control for a worker's highest educational attainment, distinguishing university degrees, junior college degrees, high school and junior high school degrees, the latter serving as the reference group. Second, we control for the gender wage gap. We further control for age and for duration of service in the same firm. For both we expect positive coefficients. We also control for a worker's position in the firm, including positions such as manager, section chief, unit chief etc. We expect a hierarchy of salaries depending on the position. We also control for firm size classes, the smallest class (5–9 workers) serving as the reference group. A large literature finds that larger firms pay higher wages (Brown and Medoff 1989). We further include dummies for 47 regions ('prefectures'), as well as year-dummies and a constant term. Our regressions are summarized in Table 4.

Table 1
Shares of workers by degree of flexibility: Full sample, 2007–2019.

		Males + Females:			
Group:	*Type of worker:*	*Absolute numbers:*	*Ratio:*	*of which males:*	*of which females:*
1	Tenured regular, full-time	8,821,479	82.6 %	87.1 %	71.4 %
2	Fixed-term regular, full-time	249,161	2.3 %	2.3 %	2.4 %
3	Tenured *non*-regular	419,850	3.9 %	2.5 %	7.5 %
4	Fixed-term *non*-regular	1,186,631	11.1 %	8.1 %	18.7 %
	Totals:	10,677,121	100 %	100 %	100 %

4.2. Results

Table 4 shows that larger firms pay higher wages than smaller firms, which confirms a well-documented (but poorly understood) finding in the literature (Brown and Medoff, 1989). Coefficients on a worker's position in the hierarchy of the firm show a corresponding hierarchy in wages. As expected, coefficients of educational variables rise as we move up from the lowest to the highest level of education. In other words, we move from the lowest level (junior high school; 9 years of education) via high school (12 years) to junior colleges (14 years) to universities (16 years). Using the years of education as a continuous variable, we find that one year of extra education increases the hourly wage by 4.2 % in the total sample.

It is interesting to note that in industries with a highly cumulative innovation regime, the latter effect is larger: 4.6 %; correspondingly, it is lower in the medium + low cumulative innovation regimes (3.8 %). This highlights the crucial role of educational attainment in determining individual wages, as has been found in earlier studies (see the survey by Card, 1999). We can add to this literature that innovation regimes also matter for wages: if innovation depends primarily on internal and often worker-embodied knowledge from experience (rather than on external sources), workers earn a premium compared to a low-cumulativeness innovation regime.

Finally, it comes as no surprise that a worker's age and the duration

[2] One should note that 'full-time' stands in many countries for 'good' jobs, while 'part-time' signals precarious jobs. One of the exceptions is the Netherlands, where part-timers have the same rights as full-timers.

Table 2
Industries according to degree of cumulativeness of knowledge according to Peneder (2010: 331).

*Industries with a **high** cumulativeness of knowledge:*
Chemicals; basic metals; machinery, nec.; electrical equipment, nec.; communication technology; precision instruments; motor vehicles, parts; financial intermediation; insurance, pension funding; computer services; research and development; other business services.
*Industries with a **medium** cumulativeness of knowledge:*
Mining (petroleum, gas); textiles; pulp/paper, products; ref. petroleum, nuclear fuel; rubber and plastics; mineral products; computers, office machinery; other transportation equipment; manufacturing nec.; post, telecommunications.
*Industries with a **low** cumulativeness of knowledge:*
Mining (coal, peat, other); food & beverages; tobacco products; wearing apparel, fur; leather, leather products, footwear; wood, wood products, cork; publishing, reproduction; fabricated metal products; recycling; electricity and gas; water supply; wholesale trade; land transport, pipelines; water transport; air transport; auxiliary transport services; auxiliary financial services.

Table 3
Descriptive information on interesting variables across categories of cumulativeness.

Variable:	*All industries:*	*Highly cumulative industries:*	*Medium cumulative industries:*	*Low cumulative industries:*
Mean hourly wage (rounded to full Yen)	2,300	2,700	2,222	2,136
Employment status:				
Tenured regular, full-time	82.6 %	88,5 %	85.6 %	79.5 %
Regular, full-time, but fixed-term contracts	2.3 %	2.1 %	2.0 %	2.5 %
Non-regular, permanent contracts	3.9 %	1.7 %	3.2 %	5.0 %
Non-regular, fixed-term contracts	11.1 %	7.7 %	9.2 %	13.0 %
Highest education: university degrees	31.3 %	40.3 %	28.8 %	27.7 %

of service in the same firm have positive signs, and women experience a substantial gender wage gap.

Our variable of interest is the wage gap of non-regular workers. Compared to the reference group of regular workers, *non*-regular workers suffer substantial wage penalties. Against the background of the above-sketched neo-Schumpeterian arguments, it is interesting to note that, in industries with a highly cumulative knowledge base, the wage penalty for non-regular workers is bigger than in the low-cumulativeness industries. In Table 3 above, we saw that firms in industries with a highly cumulative innovation regime hire *lower* shares of non-regular workers. We now see in Table 4 that, if they do hire non-regular workers, these workers seemingly are relatively less productive than the insiders (as far as wages reflect productivity). Both findings seem to reflect a downside of non-regular jobs in an innovative environment: non-regular workers receive little training, hardly participate in job rotation, have little firing protection, and are expected to leave the firm after some years. Hence, they cannot be expected to participate in a process of permanent learning or to develop a strong commitment to the firm, making improvement suggestions etc. We conclude that the advantage of lower wage costs when hiring non-regular workers has a downside: it reduces the share of workers that can contribute to knowledge accumulation and permanent improvements, let alone to innovation. And this reduces the growth of productivity and wages.

The estimates in Table 4 cover all data from 2007 to 2019. Additional insights come from estimating the same equation for each of the thirteen years separately. We refrain from a detailed documentation of the 13 regressions. Table 5 is confined to changes of two interesting coefficients over our observation period: the wage penalty of non-regular workers and the penalty for being a woman. It shows that, in the total sample as well as under the three innovation regimes, the (substantial) wage penalty for being 'non-regular' is slightly, but steadily growing during our observation period. The highest wage penalty for non-regular workers persistently holds for the innovation regime that is based on highly cumulative knowledge, i.e., for industries in which accumulation of internal and firm-specific knowledge is important for the innovation process. Correspondingly, somewhat lower but still high wage penalties hold for industries in which internal knowledge is less important for innovation and in which knowledge is mainly acquired via external sources. Besides, the last column shows that the gender wage gap of women is still high and slowly shrinking, probably due women's shares in the non-regular jobs being higher than males' shares (Table 1).

5. Conclusions: the broader meaning of the findings

Since the late 1970s, supply-side economists advocated a rigorous deregulation of labor markets to make them work as real markets. While countries like New Zealand, Australia, the UK, or the US reformed their labor markets in the early 1980s, 'Old Europe' and Japan hesitated for a long time. Meanwhile, countries like Italy (in the late 1990s), Germany (during 2002–5) and Japan (around 2003/04) have undertaken reforms of various kinds. Their reforms have in common that they made the hiring of non-regular or flexible personnel easier. Research shows that Italian and German labor market reforms were favorable for growth of employment (often in low-pay jobs), but had a negative impact on productivity growth and innovation, and, this negative impact is strongest in highly innovative sectors with a high 'cumulativeness' of knowledge (e.g., Wachsen and Blind, 2016; Cetrulo et al., 2019; Kleinknecht et al., 2014; or Hoxha and Kleinknecht, 2020, 2023).

This paper fits into the latter strand of literature in that we find that non-regular jobs in Japan are related to substantially lower wages, the wage gap rising over time and being larger in industries that have a highly cumulative innovation regime. Evaluating our findings, we meet the problem that interpreting the causal link between wage growth and productivity growth is no trivial task. For neoclassical economists, life is simple: they see a one-directional causal link from productivity to wages and tend to assume productivity as exogenous. Recent neo-Schumpeterian research finds that there must also be a link from wage growth to productivity growth along the four channels mentioned above: (1) capital-labor substitution (Hicks, 1932), (2) induced innovation along Von Weizsäcker & Kennedy lines (Samuelson, 1965), (3) Vintage effects (Tjan and Hartog, 1980), and (4) Schumpeterian creative destruction (Kleinknecht, 2020).

All four arguments can explain that rising (declining) wages will lead to higher (lower) productivity growth. And, as mentioned above, there is empirical support for the link from wage growth to productivity growth (e.g., Vergeer and Kleinknecht, 2014).

In the Japanese case, a plausible interpretation of our findings seems to be that the introduction of non-regular jobs allowed firms paying lower wages, which, in turn reduced productivity growth through the four channels just mentioned. In addition, the fact that non-regular workers in Japan receive hardly any training, do not participate in job rotation, have fixed-term contracts and limited carrier perspectives is likely to de-motivate such workers and excludes them from contributing

Table 4
Summary of wage regressions (Dependent variable: log of hourly wages in Yen; all observations from 2007 to 2019).

Variable	*Total sample: (i) Coef.*	*High-cum industries: (ii) Coef.*	*Med.+Low-cum ind.: (iii) Coef.*
Non-regular workers (reference group: regular workers)	−0.333	−0.352	−0.319
	(0.000)	(0.001)	(0.000)
Females (reference group: males)	−0.214	−0.223	−0.218
	(0.000)	(0.000)	(0.000)
Age	0.002	0.006	0.001
	(0.000)	(0.000)	(0.000)
Duration of service	0.015	0.012	0.016
	(0.000)	(0.000)	(0.000)
Education level (reference group: Junior High School):			
Education: High School	0.102	0.111	0.097
	(0.001)	(0.001)	(0.001)
Education: Junior College	0.173	0.201	0.160
	(0.001)	(0.001)	(0.001)
Education: University	0.278	0.300	0.255
	(0.001)	(0.001)	(0.001)
Position in the firm (reference group: none) #			
Manager	0.462	0.511	0.437
	(0.001)	(0.002)	(0.001)
Section Chief	0.342	0.393	0.312
	(0.001)	(0.001)	(0.001)
Unit Chief	0.159	0.178	0.156
	(0.000)	(0.001)	(0.001)
Foreman	0.115	0.117	0.094
	(0.001)	(0.001)	(0.001)
Other	0.225	0.299	0.183
	(0.001)	(0.001)	(0.001)
Occupation (reference group: none) #			
Professional worker	0.066	0.088	0.051
	(0.001)	(0.001)	(0.001)
Clerical worker	−0.037	−0.028	−0.039
	(0.001)	(0.002)	(0.001)
Seller	−0.127	−0.143	−0.134
	(0.001)	(0.001)	(0.001)
Service worker	−0.136	−0.038	−0.127
	(0.000)	(0.008)	(0.000)
Security	−0.343	−0.137	−0.327
	(0.001)	(0.008)	(0.001)
Driver	−0.143	−0.074	−0.128
	(0.001)	(0.005)	(0.001)
Factory worker	−0.067	−0.050	−0.082
	(0.000)	(0.001)	(0.000)
Firm size classes (reference group: 5–9 workers):			
5,000 and more	0.376	0.378	0.355
	(0.001)	(0.001)	(0.001)
1,000 - 4,999	0.284	0.293	0.264
	(0.001)	(0.001)	(0.001)
500 – 999	0.208	0.215	0.204
	(0.001)	(0.001)	(0.001)
300 – 499	0.170	0.181	0.163
	(0.001)	(0.001)	(0.001)
100 – 299	0.110	0.094	0.116
	(0.001)	(0.001)	(0.001)
30 – 99	0.100	0.089	0.104*
	(0.001)	(0.001)	(0.001)
10 – 29	0.053	0.037	0.059
	(0.001)	(0.001)	(0.001)
Constant term	0.695	6.892	6.986
	(0.001)	(0.003)	(0.001)
Dummies for regions ('Prefectures')	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Numbers of observations:	10,677,121	2,923,966	7,753,155
Adjusted R-Squares	0.617	0.622	0.606

Note: Robust standard errors in parentheses.
1.*= significant at 10 % level. **= significant at 5 % level. ***= significant at 1 % level.
2. # = 'none' indicates lower ranking ('hirashain') workers; in firms with less than 10 workers, all employees fall into the 'none' category, except for the CEO.
3. We conducted a Chow test to verify equality of coefficients between coefficients of the variables for non-regular workers between high cumulativeness and medium-low cumulativeness industries. The results (Chow test statistics/ chi^2: 1356.58***) show that the coefficient of the variable for non-regular workers is significantly higher in the high cumulativeness industries than that in medium-low cumulativeness industries.

Table 5
Estimated wage penalties for selected groups: non-regular workers and females.

Year:	*Total sample:*	*Non-regular workers under different innovation regimes:*			*Gender wage gap*
		Industries with a highly cumulative knowledge base	*Industries with a medium cumulative knowledge base*	*Industries with a low cumulative knowledge base*	
2007	−0.308***	−0.324***	−0.264***	−0.311***	−0.257***
2008	−0.300***	−0.327***	−0.287***	−0.293***	−0.251***
2009	−0.298***	−0.318***	−0.295***	−0.291***	−0.236***
2010	−0.310***	−0.333***	−0.295***	−0.301***	−0.221***
2011	−0.320***	−0.335***	−0.314***	−0.310***	−0.227***
2012	−0.324***	−0.339***	−0.312***	−0.310***	−0.219***
2013	−0.341***	−0.353***	−0.325***	−0.325***	−0.211***
2014	−0.343***	−0.365***	−0.335***	−0.323***	−0.208***
2015	−0.343***	−0.366***	−0.353***	−0.322***	−0.202***
2016	−0.342***	−0.372***	−0.332***	−0.322***	−0.199***
2017	−0.350***	−0.366***	−0.326***	−0.335***	−0.197***
2018	−0.364***	−0.385***	−0.344***	−0.340***	−0.188***
2019	−0.321***	−0.346***	−0.314***	−0.306***	−0.169***

Note: The above coefficients are obtained by estimating the equation from Table 4 separately for each year from 2007 to 2019.

to a learning organization. Table A1 (Appendix) shows that meanwhile (i.e., in 2019), 15.8 % of all workers in Japan are non-regular and their share has slightly increased during 2007–19. The non-use of their talents is a loss for a dynamic and innovative economy. In this context, one should note that textbooks of innovation management emphasize that successful innovation requires the mobilization of knowledge from *all* corners of the organization, including low-ranking people (e.g., Tidd and Bessant, 2020).

It comes as no surprise that people on non-regular jobs earn substantially lower wages than regular workers. In a neoclassical view, they earn lower wages as they are less productive. The crucial question that deserves further research is of course: are the workers or are their jobs low-productive? In any case, we can conclude that non-regular workers do not receive training, do not participate in job-rotation etc. and this makes them gradually less productive compared to the labor market insiders: Table 5 shows a gradually rising wage penalty for non-regular towards regular workers in our estimates over 2007–19.

Moreover, we find that firms in highly cumulative innovation regimes hire lower numbers of non-regular workers; but if they hire them, it turns out that their wage penalty towards regular workers is larger than in industries with low-cumulativeness innovation regimes. These findings indicate two important things: First, non-regular workers are seemingly judged by employers to be less productive in highly innovative environments and hence they are less frequently hired than under low-cumulativeness innovation regimes; and second, given that they are hired, the high (and rising) wage penalty of non-regular workers indicates that, in a highly cumulative innovation regime, they negatively contribute to productivity. All this confirms the neo-Schumpeterian argument that the creation of precarious or non-regular jobs has important downsides in highly cumulative innovation regimes.

Such results are at odds with what supply-side economists would have expected from their reforms: if markets (in this case: the labor market) work better, we should see a more efficient and dynamic

economy. After more than 40 years of supply-side dominance in economics departments and after labor market reforms in various important countries, the OECD-wide slowdown of productivity (see OECD, 2015; Bailey and Montalbano, 2016; Cardarelli and Lusinyan, 2015) does not fit into the vision of supply-siders.

Certainly, the slowdown has more reasons. An important one is the exhaustion of the Sillicon Valley boom in IT (Gordon, 2016) and a strongly diminishing contribution of IT to productivity growth in major OECD countries after 2004 (Cette et al., 2015). Another reason may be a long-run decline of investments in basic R&D (OECD, 2015; Soete et al., 2019). Our above story suggests that the removal of labor market rigidities through structural reforms is another important factor behind the productivity slowdown. And this has a broader meaning for economic theory.

Neoclassical economists have always believed that a state of *Perfect Competition* is the best of all Worlds. The better the assumptions behind *Perfect Competition* are fulfilled (i.e., large numbers of suppliers and buyers, no entry barriers, market participants are perfectly informed, etc.), the easier the market can clear and the better we can allocate scarce resources efficiently. However, as Schumpeter already indicated as early as 1942, *Perfect Competition* is an *un*favorable milieu for innovation:

'Perfect competition … is a condition for optimal allocation of resources … But … introduction of new methods of production and new commodities is hardly conceivable with perfect … competition … And this means that the bulk of … economic progress is incompatible with it. As a matter of fact, perfect competition is and always has been temporarily suspended whenever anything new is being introduced …' (Schumpeter, 1942).

Economists, being used to the comfortable assumption that innovation is exogenous, most likely did not pick up the meaning of the above Schumpeter quote: it is a fierce attack on widespread neoclassical thinking. What is 'good' for the efficient allocation of scarce resources can be 'bad' for innovation that makes resources less scarce. We argue that, for successful innovation, *im*perfect markets and labor market rigidities are often helpful.

For example, supply-siders heavily attacked centralized bargaining as a labor market rigidity, notably if results of union bargaining were imposed by government on the entire sector, as it often happens under a 'Rhineland' system (Hall and Soskice, 2001). From a neo-Schumpeterian view, such a rigidity is helpful for a rapid diffusion of advanced process technology. If rising wages are imposed on all firms in an industry, technological laggards are forced to modernize the firm or to leave the market. Under decentralized bargaining they could have asked their workers sacrificing wages to rescue their jobs rather than modernizing equipment. In doing so, laggards can rely that, if 'natural' or 'NAIRU' unemployment is high enough, workers will accept lower wages.

Another issue are the risks and uncertainties of (radical) innovations. Given large probabilities of failure, innovators need to have (the expectation of) effective entry barriers that allow for high innovation rents in the case of success. Under perfect competition, entry barriers are absent; firms earn a 'normal profit', meaning that there is no compensation for losses suffered from failed innovations.

Fortunately, innovation not only prospers under *im*perfect markets; successful innovation also creates market *im*perfections. The typical cost structure of innovative projects involves high fixed (and often sunk) costs for the development of the first prototype. But once the product is on the market, the innovator enjoys rapidly declining marginal costs. This enhances strong economies of scale that favor creation of large market shares by dominant suppliers. It is not by accident that successful innovators, earlier or later, end up as oligopolists, if not monopolists.

Moreover, the mere fact that large conglomerates are large can also enhance innovation as giant firms often have a broader portfolio of innovative projects that ran in parallel. Such diversification encourages innovation as it reduces innovation risks.

Of course, besides having large market shares, it also helps that innovators often can exploit network externalities, information asymmetries, patent protection, copyright laws, or other entry barriers that prevent an efficient allocation of scarce resources and allow reaping somehow durable monopoly profits. And the bigger are the profits from innovation, the higher is the incentive to accept the risks and uncertainties of innovative projects.

Another problem with perfect competition is the assumption of efficient protection of property rights. This assumption conflicts with the fact that knowledge behind innovation has strong public goods properties and this makes it hard to protect such knowledge against imitators. We could interpret the creation of safe insider jobs with long job tenures (a labor market rigidity!) as a way of 'buying' loyalty of workers, thus curbing Pigouvian externalities. The latter is important as legal ways of protecting intellectual property (patents, trademarks or copyrights) only help to some degree, but are far from perfect.[3]

We conclude that the 'rigid' Japanese labor market in the past, offering life-time employment, not only hampered the efficient allocation of scarce resources in a static neoclassical view; it also helped the innovative process that makes resources less scarce: it supported Schumpeterian dynamic efficiency.

JEL-codes

J08; J31; J41; J53; M54.

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CRediT authorship contribution statement

Yuya Ikeda: Data curation, Formal analysis, Resources, Validation, Visualization, Writing – review & editing. **Masatoshi Kato:** Conceptualization, Funding acquisition, Project administration, Resources, Writing – review & editing. **Alfred Kleinknecht:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

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[3] The importance of loyalty of personnel for innovation is underlined by *Community Innovation Survey* data in the Netherlands. Brouwer & Kleinknecht (1999) found that among the mechanisms for protecting monopoly rents from innovation against imitators, 'time lead on competitors' and 'secrecy' ranked first and second. 'Keeping qualified people in the firm' ranked third and 'patent protection' only fourth. One should note that the second and third ranked factors depend on loyalty and commitment of workers that will erode under flexible hire and fire practices (see also Svensson, 2011)

Data availability

The authors do not have permission to share data.

Appendix

Table A1
Development of shares of regular and non-regular workers, 2007–2019.

Year:	*Regular permanent:*	*Regular fixed-term:*	*Non-regular permanent:*	*Non-regular fixed-term:*	*Total:*
2007	83.7	2.0	4.9	9.3	100
2008	83.7	2.2	4.6	9.5	100
2009	83.9	2.3	4.0	9.8	100
2010	83.5	2.3	4.0	10.2	100
2011	82.2	2.4	3.9	11.6	100
2012	81.0	2.5	3.9	12.6	100
2013	82.3	2.4	3.4	11.9	100
2014	82.4	2.4	3.2	12.0	100
2015	82.3	2.3	3.0	12.4	100
2016	82.4	2.4	3.1	12.1	100
2017	82.7	2.3	3.6	11.5	100
2018	82.5	2.2	4.4	10.9	100
2019	81.7	2.5	5.3	10.5	100
Total:	100	100	100	100	100

Note: Number of observations is 10,655,121.

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