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ABSTRACT

Labour Market Institutions, Technology and Rent Sharing

In this paper we analyse how labour market institutions and technology affect wage determination through rent sharing. To this aim we first extend the theoretical framework of Estevao and Tevlin (2003) to account for heterogeneity of labour (regular and non-regular workers). The predictions of the model are then tested with detailed industry-level data over four decades (1970-2012) for Japan, where the functioning of labour markets changed significantly along directions (de-unionisation, decline in standard employment and in the role of seniority) similar to the majority of advanced OECD countries. Our results indicate that such labour market evolutions weaken the capacity of regular workers to appropriate rents and might have contributed shaping the long-run wage stagnation observed in Japan. However, more advanced technologies help regular workers to appropriate higher rents.

JEL Classification: J30, J41, C23

Keywords: rent-sharing, non-regular work, bargaining power, Japan

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1. Introduction

The increasing concerns about a defective inclusive growth have recently led to a resurgence of studies on functional income inequality across developed countries. A first strand of investigations has concentrated on potential country- and industry-level determinants of a falling labour share, such as trade, technology and labour market institutions (Acemoglu, 2003a; 2003b; Autor et al., 2014; 2016; Karabarbounis and Neiman, 2014, Fukao and Perugini, 2020). Other studies have identified the micro-mechanisms underlying workers' remunerations in the presence of rents. This new line of research builds upon the literature initially focused on the United States (Blanchflower et al., 1996; Estevao and Tevlin, 2003) and emphasises that changes in the rent sharing across firms and over time may significantly contribute shaping overall levels of wage and income inequality. Card et al. (2018), for example, focused on rent sharing as one important determinant of the aggregate wage dispersion among Portuguese workers with the same skills/characteristics and employed in the same industry. Their interest is on how the remarkable across-firms productivity differentials spill-over into wages when monopsonistic firms unilaterally exert the power to set wages. Bell et al. (2018) investigated the co-movements of wages and profits per employees in a sample of large companies in the UK; more specifically, they studied whether increasing market power of firms and weakening bargaining power of workers negatively affected the portion of rents accruing to the latter. In more general terms, rent sharing as one of the main drivers of the divergence between productivity and wage patterns (Standsbury and Summers, 2017) has been frequently researched in the US, Canada and many European Union countries in recent years (for an exhaustive review see Card et al., 2018). To the best of our knowledge, however, there are no studies on Japan, the third-largest economy in the World. Our paper aims at filling this gap and at shedding light on this under-explored side of the extensive and long-lasting debate on wage trends, income inequality and secular changes in the Japanese labour market (Hattori and Maeda, 2000; Kalantzis et al., 2012; IMF, 2016; Aoyagi and Ganelli, 2013; Aoyagi et al., 2016, Izumi et al., 2016; Kawaguchi and Mori; 2019). To this aim, we build on the theoretical and empirical approaches proposed by Estevao and Tevlin (2003) to identify a set of possible factors able to affect the capacity of regular (i.e., full time, permanent dependent) workers to appropriate rents. We focus in particular on domains that identify major evolutions in the Japanese economy in the last decades: technology and IT capital intensity on one side and on some labour market features (non-regular employment, unions, seniority) on the other. Consistent with the predictions of our theoretical framework, our fine industry-level empirical analysis over the period 1970-2012 shows that such factors are able to shape regimes to which heterogeneous levels of rent sharing are associated.

The paper is structured as follows. In the next section we describe the background, motivations and scope of our research. Section 3 provides a review of the recent literature and presents our theoretical framework. Data and variables used in the empirical analysis, as well as some basic descriptive evidence, are discussed in section 4. Section 5 illustrates the empirical model and methods and section 6 our outcomes. Section 7 concludes.

2. Background, Motivations and Scope of the Research

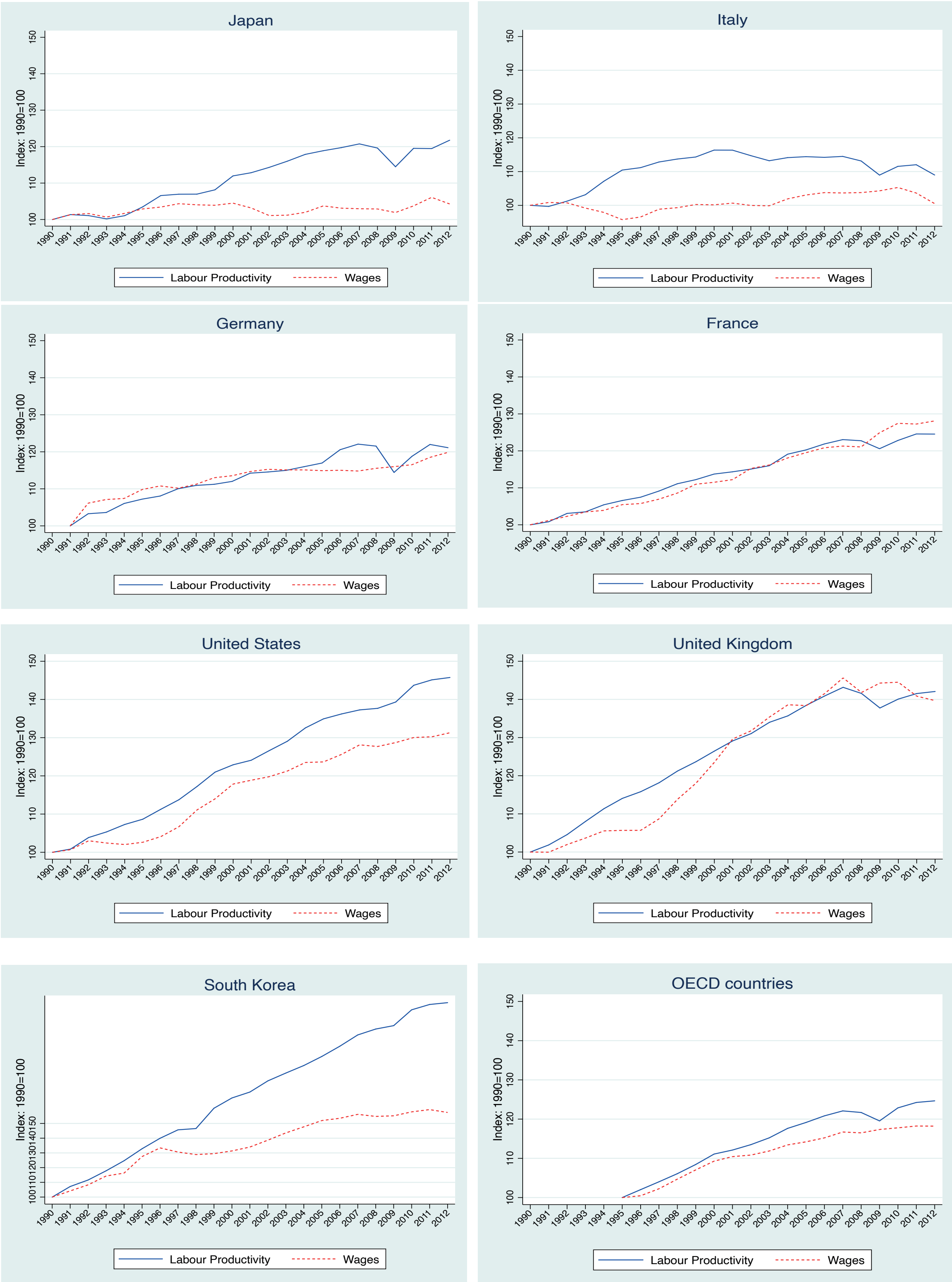
Diagram 1 provides a first hint on the importance of our research interest by describing the movements and linkages between wages and labour productivity for selected OECD countries over a period for which comparable data are available (1990-2012).

We observe that Japan shares with Italy stagnating average annual wages and, similarly to Korea, shows a remarkable and increasing gap between productivity and wages. The bottom line is that the productivity-wage divergence in Japan is much bigger than that reported for the aggregate of OECD countries.

The long-run pattern of wages in Japan has attracted extensive interest and research attention from both the perspectives of monetary policy and labour economics. On the one hand, scholars and policy makers have been wondering whether increasing nominal wages could help halting the deflationary cycle existing since the early 1990s (IMF, 2016). Aoyagi et al., (2016), in the attempt to answer this question, argued that the expectations about long-lasting deflation make companies and wage setters reluctant to raise wages. They also show that that stepping up minimum wage levels in Japan might not be enough, unless accompanied by other "heterodox measures", such as increases in public wages, stronger tax incentives and promoting an additional bargaining round in the industrial relation system (Aoyagi et al., 2016, p.4). On the other hand, Kawaguchi and Mori (2019) highlight some peculiar stylized features of the Japanese labour market, where a sluggish wage growth coexists with a tight labour market and a remarkably low unemployment rate. Their explanation of this apparent puzzle relies on compositional changes of the labour force, namely an increase in labour supply of low-skilled workers able to drive overall average wages downwards. The explanation of wage patterns in Japan has also involved the changing institutional settings and the emerging dualities of Japanese labour market. Hattori and Maeda (2000) well explain how enhancing part-time and other non-regular forms of jobs was a necessary step to prevent potential massive unemployment stemming from structural adjustments and technological changes started in the early 1990s. Besides the revolutionary ICT technologies, that made harder the struggle for existence in many companies, the labour market dualism was also consequential to the decline of the Japanese lifetime long-life employment model. Population aging and the consequent bias on the age composition of workers made less and less sustainable a system strongly founded on seniority, on which a steady economic growth had been based during the 1970-80s.

Kalantzis et al. (2012) add to the recent literature on wage inequality and between-firms productivity differentials and propose a wage efficiency model to explain the increasing wage inequality in the dualistic Japanese labour market in the Lost Decade (1992-2004). In their theoretical framework wage inequality mainly emerges between firm types with different organisational structure and wage setting policies. The first group of firms is inclined to pay wage premia and guarantee more secure jobs in exchange for higher effort from employees; the second type, on the contrary, behaves competitively and demands lower paid and less secure jobs. The model predicts that when a productivity slowdown occurs, the share of firms with more complex structure and more prone to pay efficiency wages declines, whereas the higher unemployment risk forces many employees to choose the second group.

Diagram 1. Labour productivity and wage divergence across selected OECD countries (1990-2012)



Source: *OECD*. Note: *Average annual wages and GDP per person employed are indexes calculated on 2015 constant prices at 2015 USD PPPs.*

Interestingly, their hypotheses are tested relying on differences between male and female worker flows, based on the largely accepted evidence that female employment is a benchmark for flexible and insecure jobs in Japan. Their intriguing idea, that enables their empirical strategy, is that where the difference in male and female turnover narrows, a generalized labour flexibility emerges and the probability of being in the regime of labour market shaped by the second type of firms is higher.

In our paper we test the existence of different regimes in a way not dissimilar to the one just described, but placing this strategy in the context of a bargaining model with rent sharing (Blachflower et al., 1996; Estevao and Tevlin, 2003). In doing so, we follow Kato (2016) in assigning an important role to the annual, decentralised wage negotiation system typical of Japan (*shunto*), mainly taking place on bonuses, the variable part of compensation tied to productivity performances and deemed pivotal to make the Japanese industrial relations system more flexible. We hypothesise that the rent sharing parameter, that measures the sensitivity of wages to the value added per worker, has a different magnitude depending on some labour market features (share of non-regular workers on total employees; union density; wage-seniority system) and on different technological contexts described by TFP dynamics and ICT intensity. The main idea behind our framework is that rent sharing of regular workers is not only weaker due to low bargaining power (i.e., in contexts of low union density and where the importance of lifetime employment systems declined). It is also lower when the share of non-regular workers is high. This negative impact on the dynamics of wages is not only due to a composition effect (as for Kawaguchi and Mori, 2019), but also to a dampening of the effect of the bargaining power of the regular workers.. A similar effect unfolds where skills complementary to technology is limited (low ICT intensity and TFP growth). Both factors impact indeed on labour demand for regular workers by increasing their substitutability with non-regular ones and this negatively affects their capacity to appropriate rents and, ultimately, their compensations.

We develop our investigation both theoretically and empirically. As for the theoretical part, we augment the right to manage model proposed by Estevao and Tevlin (2003) by taking into account two different categories of labour: regular and non-regular workers. By doing so, we are able to identify a rent sharing parameter as a function of elasticity of labour demand that incorporates the elasticity of substitution between the two job qualities mentioned above and is affected by labour market features and technological context. The empirical strategy, implemented on data for 91 industries of the Japanese market economy over the period 1970-2012, relies on a panel threshold model (Law et al., 2014; Seo and Shin, 2016; Seo et al., 2019) through which we identify the presence of non-linear effects in the rent sharing parameter. This allows us estimating the magnitude of the rent-sharing parameter under different regimes identified by the share of non-regular workers, union density, wage-seniority, intensity of ICT capital and TFP growth.

3. Related Literature and Theoretical Framework

3.1. Rent Sharing, Labour Heterogeneity and Technology

The availability of richer information concerning rents, profits and individual wage measurements undoubtedly contributed to the recent renewal of research interests for rent sharing (Bell et al., 2018). Providing an exhaustive survey on this extensive literature is beyond our scope and we limit here our attention to the studies investigating the heterogeneity of bargaining power across groups of workers with different characteristics and in different technological contexts.

In their recent survey, Card et al. (2018) analysed more than 20 influential papers on rent sharing in European countries, Canada and US. After adjusting all measures of rents used (value-added/quasi-rents/profits) to a single metric, value added per worker, they find an average elasticity of wages around 0.16 for industry level analyses (Christofides and Oswald, 1992; Hildreth and Oswald, 1997; Estevao and Tevlin, 2003). The rent-sharing parameter is scaled down to 0.08-0.05, or even smaller values, once researchers are able to use finer grained data, such as industry-level value added combined with individual wages (Margolis and Salvanes, 2001; Guertzgen, 2009; Arai and Heyman, 2009; Card et al., 2014, among others). According to Card et al. (2018), controlling for labour heterogeneity is important to reduce the bias in the estimation of the rent sharing parameter; as they show in their analysis on matched employer-employee data for Portugal, controlling for experience and education of workers sensibly trims down the rent-sharing parameter. Other studies, besides controlling for workers' gender, education and skills, explicitly consider the role of institutions and other context specific variables. Guertzgen (2009) focuses on Germany and finds a higher responsiveness of wages to profits for workers employed in firms with decentralised firm-level agreements compared to those complying with industry-wide collective bargaining. Bagger et al. (2014) investigate the dispersion of value added per worker and wages across Danish firms and hypothesise that sectoral differences, capital intensity and intrinsic TFP may play a role through the rent sharing channel. An extensive tradition of studies indirectly deals with rent sharing by focusing on the effect of ICT technologies on the wage structure (Dunne and Schmitz, 1995; Krueger, 1993; Entorf and Kramartz, 1998). Van Reenen (1996) more directly finds evidence of quasi-rents sharing arousing from major innovations, with more innovative contexts spurring higher sharing capacity.

In an attempt to systematize this rather sparse literature, Blanchflower et al. (1996) identify three different theoretical and interpretative frameworks. A first group of authors use modified versions of competitive models in which an upward-sloping labour supply curve in the short run, instead of an infinitively elastic one, causes temporary frictions; thus, demand shocks shape the temporary positive correlation between wages and profits (Hildreth and Oswald, 1997). Similarly, Card et al. (2018) in their attempt to reconcile rent-sharing and sorting of workers among firms, use a variant of competitive models based on monopsony and imperfect labour markets. In this case, workers heterogeneity in skills and other characteristics guides them in evaluating jobs across employers; monopsonistic firms, on the other side, have the power to set wages.

A second set of models are based on an implicit contract framework where both workers and employers are risk adverse and the correlation between wages and profits automatically provides a sort of insurance for workers that share profits and losses with the employers depending on the good or bad times (Guiso et al., 2005). A crucial assumption for this type of models is that wages are set under a piece-rate scheme (Bell et al., 2018).

The third and most widely used approach is the wage bargaining model in which employers and workers are interested in maximising and bargaining quasi-rents represented by profits and the remuneration exceeding the alternative wage, - the workers' outside option (Van Reenen, 1996; Blachflower et al., 1996; Estevao and Tevlin, 2003; Bell et al., 2018, among others). Bell et al. (2018) motivate their preference for this third approach and observe that rent-sharing emerging from their empirical investigations is neither a short-run phenomena nor is based on piece-rate schemes. Estevao and Tevlin (2003) point out that *right-to-manage* bargaining models are much more realistic than *efficient bargaining* ones, especially in contexts where labour relations are highly decentralised, as it is the case in the US and Japan. In such circumstances, it is more plausible that workers and employer bargain over wage first, and then firms decide the level of employment (*right-to-manage*), rather than agreeing on wages and employment simultaneously. According to the same authors, workers and employers maximise a quasi-rent function in which a production function is nested. By differentiating the quasi-rent function with respect to the wage, they obtain a rent-sharing equation as follows:

$$W = \gamma \frac{Af(L)}{L} + (1-\gamma)Z \qquad [1]$$

where $\frac{Af(L)}{L}$ is the value added per employee expressed as function of the labour hired (L) and depending on a productivity parameter A; this is the pie to be divided between workers and the employer. Z is the market wage, or alternative wage, a proxy for the workers' outside option. Depending on the rent sharing parameter γ, workers may appropriate the whole rent per employee ($\gamma = 1$), or rather gain a weighted average of the portion of the rent and their alternative wage Z ($0 < \gamma < 1$). More interestingly, Estevao and Tevlin's rent sharing parameter reads as follows:

$$\gamma = \mu \frac{1}{1-\frac{\mu\varepsilon_{NW}(1-\varepsilon_{fN})}{\varepsilon_{fN}}} \qquad [2]$$

where μ is the bargaining power of workers, ε_{NW} is the elasticity of labour demand and ε_{fN} the elasticity of value added with respect to employment. Since $\varepsilon_{NW} < 0$ and $0 < \varepsilon_{fN} < 1$, γ is lower than μ; the larger the sensitivity of employment to contracted wages (ε_{NW}) the lower the term next to μ and the larger the difference between the two parameters. The high elasticity of demand dampens the effect of bargaining power as firms can respond to a high contracted wage with a contraction of labour demanded. Labour heterogeneity and workers' quality do not enter this model and the role of high/low skilled or regular/irregular workers in shaping the rent sharing parameter cannot be singled out. In the next section we build upon the framework proposed by Estevão and Tevlin (2003) so to allow for the existence of different types of labour, namely regular and non-regular workers. The model suggests that some factors (related to technology, employment shares and other institutional settings) alter the extent to which regular workers are able to appropriate part of the rents.

3.2. Theoretical Model

We show here how the introduction of non-regular workers into the right-to-manage model of Estevão and Tevlin (2003, pp. 601-602) affects their theoretical results and the factors shaping the rent-sharing parameters.

Let us assume the following value added production function

$$Y = AL^{\alpha}K^{1-\alpha} \qquad [3]$$

$$L = \{\beta(A_R L_R)^{\sigma} + (1-\beta)(A_N L_N)^{\sigma}\}^{\frac{1}{\sigma}} \qquad [4]$$

where *Y*, *L*, and *K* denote total output, total labor input, and capital service input. *L* depends on labor input of regular and non-regular workers, L_R and L_N. We assume that elasticity of substitution between the two types of labor is constant and given by 1/(1–σ). σ is assumed to be smaller than one. Firms are price takers in its output market, capital service market and non-regular worker market and prices of output and these two factors, *p*, *r* and w_N are exogenously determined. We also assume that capital service input is given in the short-run equilibrium we analyse. Wage rate of regular workers, w_R is determined by a bargaining between each firm and its regular workers. And after this negotiation, each firm decides its input of regular workers, L_R. Each firm's profit is defined by

$$\Pi = pAL^{\alpha}K^{1-\alpha} - w_R L_R - w_N L_N \quad [5]$$

Following Estevão and Tevlin, we do not explicitly take account of capital cost, rK, and study about how firm's rent $pAL^{\alpha}K^{1-\alpha}-w_N L_N$ is divided between the firm and the regular workers.

Let us express this rent as a function of input of regular workers, L_R, and the shift parameter A.

$$f(L_R, A) = pA\{\beta(A_R L_R)^{\sigma} + (1-\beta)(A_N L_N{}^{*})^{\sigma}\}^{\frac{\alpha}{\sigma}} K^{1-\alpha} - w_N L_N{}^{*} \quad [6]$$

where $L_N{}^{*}$ denotes optimal level of non-regular worker input. $L_N{}^{*}$ is endogenously determined and depends on L_R. Let ε_{fLR} denote elasticity of rent $f(\ )$ with respect to input of regular workers, L_R.

This firm's profit maximization conditions are:

$$p\frac{\partial Y}{\partial L_R} = w_R \quad [7]$$

$$p\frac{\partial Y}{\partial L_N} = w_N \quad [8]$$

Under a given set of output price and the factor prices, p, w_N and r, and fixed capital service input, K, the optimal employment levels of the two types of labor are determined by equations (7) and (8) and can be expressed as functions of w_R, $L_R{}^{*} = L_R(w_R)$, $L_N{}^{*} = L_N(w_R)$. From the above profit maximization conditions, we have:

$$\varepsilon_{fL_R} = \frac{L_R}{f(L_R, A)}\frac{df}{dL_R} = \frac{w_R L_R}{f(L_R, A)} \quad [9]$$

From the above equation, we also have

$$\Pi = \left(1 - \varepsilon_{fL_R}\right) f(L_R, A) \quad [10]$$

From equations (7) and (8), we can explicitly derive demand function for regular and non-regular workers;

$$L_R = (\alpha A)^{\frac{1}{1-\alpha}} (\beta A_R^{\sigma})^{\frac{1}{1-\sigma}} K \left(\frac{P}{\Phi}\right)^{\frac{1}{1-\alpha}} \left(\frac{w_R}{\Phi}\right)^{-\frac{1}{1-\sigma}} \quad [11]$$

$$\frac{L_N}{L_R} = \left\{\frac{(1-\beta)A_N{}^{\sigma}}{\beta A_R{}^{\sigma}}\right\}^{\frac{1}{1-\sigma}} \left(\frac{w_N}{w_R}\right)^{-\frac{1}{1-\sigma}} \quad [12]$$

where Φ denotes average wage rate of regular and non-regular workers;

$$\Phi = \left\{\beta^{\frac{1}{1-\sigma}} A_R{}^{\frac{\sigma}{1-\sigma}} w_R{}^{-\frac{\sigma}{1-\sigma}} + (1-\beta)^{\frac{1}{1-\sigma}} A_N{}^{\frac{\sigma}{1-\sigma}} w_N{}^{-\frac{\sigma}{1-\sigma}}\right\}^{-\frac{1-\sigma}{\sigma}} \quad [13]$$

The last term in the right-hand side of equation (11) denotes substitution effect between regular and non-regular workers on demand for regular workers. The second term from the right in the right-hand side of equation (11) denotes how increase of average labor cost reduces demand for regular workers through decline of optimal production level.

The Nash bargaining function to be maximized is

$$\Omega = \left[L_R(w_R)\left(v(w_R) - v(Z)\right)\right]^{\mu} \Pi^{1-\mu} \quad [14]$$

where $v(x)$ measures the utility derived by an individual from income x and Z denotes reservation wage of regular workers. Differentiating (14) with respect to w_R, using (7), (8), (9), (10) and linearizing $v(x)$ around w_R, gives

$$\mu\frac{\varepsilon_{L_R w_R}}{w_R}+\mu\frac{1}{w_R-Z}-(1-\mu)\frac{L_R(W_R)}{\Pi}=\mu\frac{\varepsilon_{L_R w_R}}{w_R}+\mu\frac{1}{w_R-Z}-(1-\mu)\frac{L_R(W_R)}{(1-\varepsilon_{fL_R})f(L_R,A)}=0 \qquad [15]$$

where ε_{LRWR} denotes elasticity of demand for regular workers, L_R, with respect to wage rate of regular workers, w_R. We can derive this value from equation (11)

In a similar way as Estevão and Tevlin (2003, p. 602), we can derive the following relationship from equation (9), (10), and (15);

$$w_R=\gamma\frac{f(L_R,A)}{L_R}+(1-\gamma)Z \qquad [16]$$

$$\gamma=\gamma\left(\mu,\varepsilon_{fL_R},\varepsilon_{L_R w_R}\right) \qquad [17]$$

where the functional form of γ( ) is given in endnote 12 in Estevão and Tevlin (2003, pp. 614-615).

$$\gamma=\mu\frac{1}{1-\frac{\mu\varepsilon_{L_R w_R}(1-\varepsilon_{fL_R})}{\varepsilon_{fL_R}}} \qquad [18]$$

The parameter μ, as already explained, is a measure of the bargaining power of regular workers that increases with more protective labour market institutional settings (such as powerful unions and persistence of lifetime employment system). As in Estevão and Tevlin (2003) the impact of μ on γ is mitigated by the ratio on its right side, which is lower than one. In Estevão and Tevlin (2003) the gap between μ and γ is larger the higher the elasticity of labour demand (ε_{NW}, see equation 2). Correspondingly, in equation (18) the difference between μ and γ increases the lager the elasticity of demand for regular workers $\varepsilon_{L_R w_R}$ and this marks the role played, in our specification, by the heterogeneity of labour. Once the wage for regular workers is contracted in a bargaining round, firms will set the level of their employment as commanded by $\varepsilon_{L_R w_R}$ which, in addition to technological parameters, now also depends on the substitutability or regular workers with non-regular ones. In view of our aims, we turn now to formally single out the determinants of $\varepsilon_{L_R w_R}$, in particular the role played by an increasing presence of non-regular workers and different technological regimes in shaping γ. Taking log values of the both sides of equation (11) and differentiate it about L_R and w_R, we have

$$\frac{dL_R}{L_R}=-\frac{1}{1-\sigma}\frac{dw_R}{w_R}+\left(\frac{1}{1-\sigma}-\frac{1}{1-\alpha}\right)\frac{d\Phi}{\Phi} \qquad [19]$$

In a similar way, we can derive the following equation from equation (13):

$$\frac{d\Phi}{\Phi}=\frac{\beta^{\frac{1}{1-\sigma}}A_R^{\frac{\sigma}{1-\sigma}}w_R^{-\frac{\sigma}{1-\sigma}}}{\beta^{\frac{1}{1-\sigma}}A_R^{\frac{\sigma}{1-\sigma}}w_R^{-\frac{\sigma}{1-\sigma}}+(1-\beta)^{\frac{1}{1-\sigma}}A_N^{\frac{\sigma}{1-\sigma}}w_N^{-\frac{\sigma}{1-\sigma}}}\frac{dw_R}{w_R} \qquad [20]$$

As equations (11) and (12) shows, the coefficient of t he right-hand side of equation (20) denotes the share of the labor cost of regular workers in the total labor cost, $w_R L_R/(w_R L_R + w_N L_N)$. Let θ_R denote this share:

$$\theta_R=\frac{\beta^{\frac{1}{1-\sigma}}A_R^{\frac{\sigma}{1-\sigma}}w_R^{-\frac{\sigma}{1-\sigma}}}{\beta^{\frac{1}{1-\sigma}}A_R^{\frac{\sigma}{1-\sigma}}w_R^{-\frac{\sigma}{1-\sigma}}+(1-\beta)^{\frac{1}{1-\sigma}}A_N^{\frac{\sigma}{1-\sigma}}w_N^{-\frac{\sigma}{1-\sigma}}} \qquad [21]$$

From equations (19), (20) and (21), we have

$$\varepsilon_{LRwR} \equiv \frac{\frac{dL_R}{L_R}}{\frac{dw_R}{w_R}} = -\frac{1-\theta_R}{1-\sigma} - \frac{\theta_R}{1-\alpha} = -\frac{1}{1-\sigma} + \left(\frac{1}{1-\sigma} - \frac{1}{1-\alpha}\right)\theta_R \quad [22]$$

When w_R increases, total labor cost will also increase by θ_R per cent of the increase of w_R (equation 20). The increase of w_R will affect optimal level of regular worker input through two mechanisms (equation 22). Firstly, relative price of regular workers and total labor input will increase by $(1-\theta_R)dw_R/w_R$. This change will reduce optimal level of regular workers $\{1-\theta_R)/(1-\sigma))\}dw_R/w_R$ through substitution. Secondly, cost of the total labor input will be raised by $\theta_R dw_R/w_R$. This increase of the labor input cost will reduce demand for regular workers through decline of the optimal production level by $\{\theta_R/(1-\alpha)\}dw_R/w_R$ (equation 11).

Equation (22) implies that when substitution between regular and non regular workers is relatively high and $1/(1-\sigma)>1/(1-\alpha)$ holds[1], a decline of the share of regular workers in total labor cost, θ_R, will raise the absolute value of the elasticity of demand for regular workers to a change in its own wage rate, ε_{LRWR} will increase. This change will reduce the rent sharing parameter of regular workers, γ (equation 18).

From the definition of θ_R, (21) and equation (12), we get

$$\theta_R = \frac{W_R L_R}{W_R L_R + W_N L_N} = \frac{1}{1+\frac{W_N L_N}{W_R L_R}} = \frac{1}{1+\left\{\frac{(1-\beta)A_N{}^{\sigma}}{\beta A_R{}^{\sigma}}\right\}\left(\frac{L_N}{L_R}\right)^{\sigma}} \quad [23]$$

Equation (23) offers "the anatomy" of θ_R parameter and shows that an increase of the share of regular workers $L_R/(L_R+L_N)$, inversely proportional to the ratio L_N/L_R, or an increase of A_R/A_N, i.e. a technological change likely to raise the marginal contribution of regular workers in comparison with non-regular workers, will raise the share of regular workers in total labor cost, θ_R, and reduce the absolute value of the elasticity of demand for regular workers to a change in its own wage rate, ε_{LRWR}. This change will raise the rent sharing of regular workers, γ (equation 18). It is worth noting that, conceptually, the terms $\left(\frac{L_N}{L_R}\right)^{\sigma}$ and $\left\{\frac{(1-\beta)A_N{}^{\sigma}}{\beta A_R{}^{\sigma}}\right\}$ in equation (23) describe, ceteris paribus, different forces that affect θ_R (and consequently ε_{LRWR} and γ). Technological parameters being unchanged, a higher $\left(\frac{L_N}{L_R}\right)^{\sigma}$, i.e. a decline in the share of regular workers due to the fact that they can be easily replaced with non-regular ones, negatively affects θ_R via a composition effect. Similarly, $\left(\frac{L_N}{L_R}\right)^{\sigma}$ being equal, θ_R (and consequently γ) is lower when the regular worker augmenting productivity parameter (A_R) is relatively low. The share of regular workers being equal, in those sectors in which TFP or IT capital intensity did not grow much, the productivity of regular workers is relatively low and makes them, potentially, more easily substitutable with non-regular workers. In such conditions, regular workers might be not replaced and $\left(\frac{L_N}{L_R}\right)^{\sigma}$ stays unchanged, but their rent sharing capacity (and remuneration) is lower.

Since production function is constant return to scale and Cobb-Douglas about L and K, labor income

[1] This condition indicates that a decrease in the share of regular workers negatively affects their rent sharing if the elasticity of substitution between regular and non-regular workers $1/(1-\sigma)$ is sufficiently high. If we assume, based in existing evidence (Fukao and Perugini, 2020) that in Japan the labour share – or the output elasticity of labour – (α) ranges from 0.6 to 0.7, the condition is satisfied when the elasticity of substitution between regular/non regular workers is over 2.5 or 3.3, respectively, which are plausible values.

share in the total value added, $(w_R L_R + w_N L_N)/pY$, will be equal to α. From this and equation (9), we have

$$\varepsilon_{fL_R} = 1 - \frac{f(L_R,A) - w_R L_R}{f(L_R,A)} = 1 - \frac{1-\alpha}{1-\alpha+\alpha\theta_R} \quad [24]$$

This equation implies that an increase of the share of regular workers in total labor cost, θ_R, will raise ε_{fLR}, elasticity of rent f ( ) with respect to input of regular workers, L_R. According to equation (18), this increase of ε_{fLR} will raise rent-sharing, γ.

Among the assumptions on which the theoretical framework is shaped, two points deserve particular attention. The first one is related to the wage negotiation model, the *right-to-manage* scheme, in which workers and firms bargain over wages only and firms then decide unilaterally the overall level of employment. This model well fits to contexts where wage negotiations tend to be fairly decentralised and deregulated. This is the case for Japan (see, for a comparative view, Du Caju et al., 2008), where wage negotiations take place almost completely at the company level between enterprise unions and the management, with a model highly centred on cooperation rather than conflict and antagonism (Fujimura 2012). A second important assumption of our model, capital input services taken as given, is also consistent with the features of the Japanese bargaining mode, the *Shunto* system. Negotiations typically involve two key parameters, wage and bonuses (see Komiya and Yasui, 1984). The capacity to revise wages upward has declined remarkably over time (see OECD, 2017), due to adverse economic conditions driving unions to focus their attention on protecting the existing pay structures and their members' jobs; conversely, the relative role of bonuses, used to remunerate non-regular workers to a much more limited extent (Kato 2016), has been increasing. More importantly, negotiations between enterprise unions and employers take place annually, between March and April (*shunto* – spring wage offensive); it is therefore reasonable to assume, in such a short-run perspective, that the capital stocks observed by the parties in each bargaining round are regarded as fixed. This assumption is, in any case, not crucial for the implications of our theoretical model regarding the factors behind the rent-sharing parameter. As we show in Appendix A, they are all confirmed, even though under stricter conditions, if we allow capital to adjust and redefine the nature of the pie over which negotiations take place accordingly.

4. Data and Variables

Our data is extracted from the Japan Industrial Productivity (JIP) database (version 2015), compiled by RIETI (Research Institute of Economy, Trade and Industry) and Hitotsubashi University, Tokyo[2]. The 2015 JIP release covers, for the period 1970–2012, various types of annual data for 108 industries of the Japanese economy. We excluded from our analysis non-market services (JIP codes 84 and 98–108) and other sectors which presented always negative profits and labour costs regularly exceeding value added, such as private medical, education, research, and hygiene services (JIP codes 80–83) and housing (72) (see Appendix B for all relevant details). Our sample (total market economy – TME) is therefore composed of 91 industries. For some robustness checks we then restrict the sample to 84 industries (non-primary market economy – NPME) after having excluded agriculture and mining (codes 1 to 7) and to manufacturing and market services only (78 industries - NPME minus constrictions and utilities).

[2] See: https://www.rieti.go.jp/en/database/JIP2015/#01. For a detailed account of the JIP database, see Fukao et al. (2007).

The JIP database has various distinctive characteristics making it particularly suitable to our analysis. The first one is that it supplies labour remuneration and hours worked by employment type, separating regular workers (with dependent, full-time, open-ended contracts), non-regular workers (temporary and part-time contracts) and self-employed/family workers. This detail allows properly depicting the existing segmentation in the Japanese labour market (see Kalantzis et al., 2012; Miyamoto, 2016). Consistent with our theoretical model (see equation 5), the pie to be allocated between employers and regular workers is represented by value added, calculated subtracting from gross output the value of intermediate material inputs, indirect taxes minus subsidies, and non-regular labour costs (considered as a flexible input). The pie over which the bargaining takes place is therefore composed of the remunerations of regular workers plus capital, the remuneration of self-employment and family workers (i.e., of the entrepreneur and her/his family components) and pure rents. Labour income of self-employed and their family workers is therefore considered as one component of the value that can be appropriated by regular workers, if their bargaining power is high. Value added is then deflated using the consumer price index and standardized on the total number of hours worked by regular workers to obtain our measure of value added per hours worked. Real hourly wages for regular and non-regular workers are calculated dividing the relevant real labour compensation by the amount of hours worked; the JIP data provides information on labour, for each sector and year, by gender, age and education. Our total number of observations amounts to 156,520 corresponding to year (43), industry (91), gender (2), age (5) and education (4) wage cells[3].

As second major advantage of the JIP dataset is to provide at a very refined industry detail a number of variables able to define the different technological and institutional regimes that, in our theoretical model, can shape the size of the rent-sharing parameter. We use the stock of real IT capital to build measures of IT-capital intensity over value added (IT K/VA) and over non-IT capital stock (IT K/non-IT K)[4]. As a proxy for technological change we use the total factor productivity annual growth rate (TFP), directly available in the dataset. Regarding labour market variables, besides the share of non-regular on total hours worked (non-Reg share), we can first of all count on union density rate by sector (UD), compiled by dividing the total number of union-member workers in each industry by the total number of workers available in the JIP database[5]. This variable is intended to be a proxy of the parameter (μ) in equation [18], the bargaining power of workers. A similar role is assigned in our empirical analysis to a proxy for the importance of seniority at industry level, constructed as the relative hourly wage of workers aged over/under 45 years (Seniority). In order to reduce the effects of confounding factors, the comparison is between average wages of male, tertiary-educated, regular workers. The metric depicts the importance of the deferred compensation schemes, a crucial feature of the lifetime employment system, which granted high levels of protection (and therefore bargaining power) to regular workers. A higher level of seniority, however, also depicts technological contexts in which the role of experience is stronger and where regular workers are less exposed to the competition of non-regular employees.

[3] Age intervals are defined as: 15-24; 25-34; 35-44; 45-54; 55-64. Education is classified into Lower Secondary, Upper Secondary, Junior College and University diploma.

[4] The definitions used in the 2015 JIP database correspond to those from EU-KLEMS 2012 of ICT and non-ICT capital (see O'Mahony and Timmer, 2009).

[5] Data is provided in the Basic Survey on Labour Unions carried out annually by the Ministry of Labour, Health and Welfare (see: http://www.mhlw.go.jp/english/database/db-l/labour_unions.html). Detailed data is available (in Japanese) at: http://www.mhlw.go.jp/toukei/list/13-23.html

Table 1. Summary statistics: value added, wages, technology and labour market features (Total Market Economy 1970-2012)

	p1	p5	p10	p25	p50	p75	p90	p95	P99
VA / h	1522.54	2007.36	2336.61	2977.89	4223.54	7151.98	14232.97	23440.65	67563.76
hwage_reg	1080.46	1420.59	1601.25	2107.18	2781.25	3504.52	4398.41	5214.85	6446.037
hwage_nreg	506.24	614.98	677.00	739.05	872.00	949.45	1027.49	1070.88	1348.85
IT K / VA	0.00	0.00	0.01	0.03	0.09	0.21	0.49	0.79	3.26
IT K/non-IT K	0.00	0.00	0.01	0.02	0.05	0.10	0.21	0.29	0.61
TFP	-15.46	-7.57	-4.73	-1.96	0.55	3.26	6.62	11.18	30.83
UD	0.20	2.90	7.70	13.80	26.10	52.50	70.30	83.80	100
Non-Reg share	0.02	0.03	0.04	0.06	0.09	0.12	0.18	0.24	0.36
Seniority	1.45	1.69	1.81	2.03	2.26	2.48	2.69	2.82	3.09

Source: authors' elaborations on JIP data. Value added per worker and wages expressed in real terms (2000 yen).

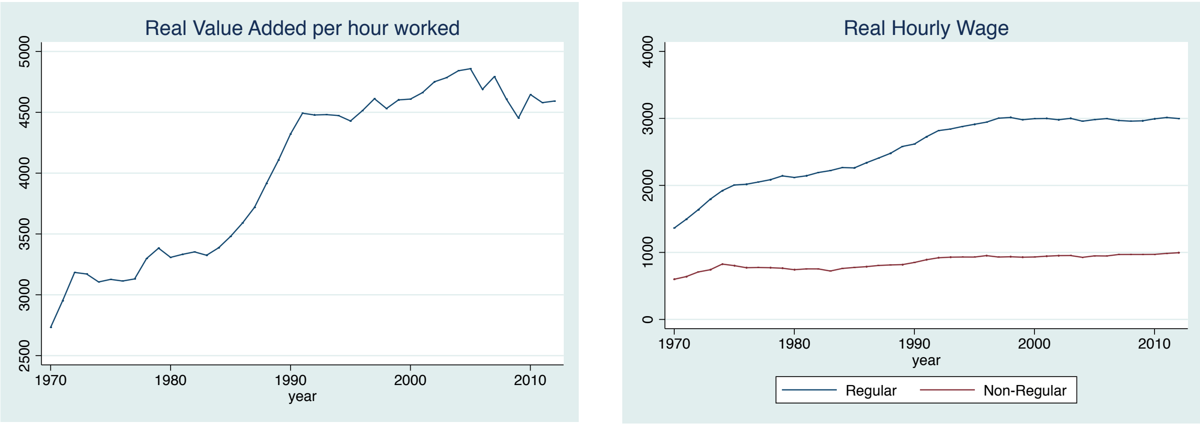
Table 1 summarizes some basic information on the distribution of the variables used in our study. The figures are obtained by pooling years and industries, so to provide a first hint on the overall high variability of the indicators across the distribution, which also reflects the heterogeneity across sectors. This can be also grasped by differences in averages of the variables of interest for macro-sectors of the economy at different level of aggregation, reported in Table A1 in appendix C. Besides total market economy (TME) and non-primary market economy (NPME), we distinguish manufacturing (MAN – 53 JIP industries) and market services (MSERV – 26 JIP industries). These two aggregates are further broken down, according to the Eurostat/OECD classification, as follows: medium- and medium-high-technology manufacturing (MHM – 23 JIP sectors), medium- and medium-low-technology manufacturing (MLM – 29 sectors), knowledge-intensive services (KIS – 12 sectors), less-knowledge-intensive services (LKIS – 14 sectors)[6].

Such aggregates seem to provide relevant information on the differences existing across industries and a further confirmation for the need for a fine industry level analysis. All variables indicate a clear dichotomy between high and medium-low technology or knowledge intensive sectors. The first ones exhibit a larger size of the pie to be shared (VA/hour), higher wages, a higher wage gap between regular and non-regular workers, faster technological change and a higher importance of traditional employment and seniority. This suggests that remarkable differences exists between sectors in which the accumulation of industry- and firm-specific knowledge represents a more crucial asset (MHM and KIS) and those in which more flexible employment options can instead be more easily used (MLM and LKIS) as workers' seniority is less important for productivity. Workers are also more unionised in manufacturing than in services and, within the two macro-sectors, in higher knowledge/technology-intensive industries.

Diagrams 2 and 3 add information on the variability over time of the core variables (the dimension actually exploited in our econometric analysis – see the following section).

[6] The Eurostat classification is obtained by aggregating manufacturing and services based on NACE Rev. 2 (see http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf9). The classification largely overlaps with the one provided by the OECD (see: https://www.oecd.org/sti/ind/48350231.pdf)

Diagram 2. Value added and wages (Total Market Economy - 1970-2012)



Source: authors' elaborations on JIP data

Diagram 3. Technology and labour market features (Total Market Economy - 1970-2012)

Source: authors' elaborations on JIP data (outside values not plotted)

The first one provides an accurate picture of many well-known features of the Japanese economy over the last decades, in particular of the stagnating pattern of real value added and wages starting from the 1990s, when the gap between regular and non-regular hourly compensations stopped growing.

Such trends were mirrored by a monotonic increase in more innovative forms of capital, that went hand in hand with a spectacular increase in its dispersion across sectors, ranging from zero to almost 50% of the stock of non-IT capital in 2012 (top right panel of Diagram 3). Total factor productivity growth was mainly positive and, as expected, cyclical, again with a remarkable variability across sectors. On the labour market side, the share of non-regular contracts increased sharply and continuously along with a monotonic decline of unionisation. Starting from the 1990s, the employment systems based on seniority clearly started to decline and the reduction in variability across sectors also signals a downward convergence to the median value.

5. Empirical Model and Econometric Methods

The baseline empirical specification of equation [16] is

$$w_{igjkt}^{R} = \alpha + \gamma \frac{r_{it}}{n_{it}^{R}} + \tau_t + \eta_{igjk} + \varepsilon_{igjkt} \qquad [24]$$

where w is hourly wage rate for a regular worker in industry i (i = 1, …, 91), of gender g (g = 1, 2), age j (j = 1, …, 5), education k (k =1,…, 4) and in year t (t=1, …, 42). On the right-hand side of the equation, γ is the rent-sharing parameter that links wages to industry level rents (r_{it}) per regular worker (n_{it}^{R}), τ_t are year fixed effects that control for common time shocks and η_{igjk} are industry/gender/age/education (cell) fixed effects; ε is the usual error term. All our estimations are in levels, not logarithms, as the variable next to the rent sharing parameter (value added per hour worked) assumes, in a few cases, a negative value. As in Estevao and Tevlin (2003), we do not observe an alternative wage that a representative worker in a given industry and with given characteristics would receive if dismissed and rehired. However, time fixed effects control for the state of aggregate labour market. Similarly, the alternative wage will depend on factors specific to the industry and on the characteristics of the workers (age, education, gender), that are controlled for by cell fixed effects. To account for possible correlation of errors within groups of workers with similar characteristics, standard errors are clustered in all estimations at the most conservative level (industry/gender/age/education cell).

Our conceptual and theoretical framework requires an empirical specification able to identify the heterogeneity of the relationship between wages and rents in different regimes defined by technological and labour market features. To enable the empirical aims of our analysis, we use panel threshold regression models (see Hansen 1999), specifically designed to capture the jumping character or structural break in the relationship between variables. Despite having become increasingly popular in many empirical domains, including income distribution (see, for example, Savvides and Stengos, 2000; Law et al., 2014), the implementation of this approach in the study of rent sharing has no priors. The model takes in our case the following form:

$$w_{igjkt}^{R} = \begin{cases} \alpha + \gamma^{1} \frac{r_{it}}{n_{it}^{R}} + \tau_t + \eta_{igjk} + \varepsilon_{igjkt}, & \omega \leq \lambda \\ \alpha + \gamma^{2} \frac{r_{it}}{n_{it}^{R}} + \tau_t + \eta_{igjk} + \varepsilon_{igjkt}, & \omega > \lambda \end{cases} \qquad [25]$$

where ω is the threshold variable used to split the sample into regimes or groups and λ is the unknown threshold parameter. This modeling strategy allows the extent of the effect of interest (in our case the extent of rent-sharing, γ) to differ depending on whether the regime variable is above or below some unknown level λ. Under the hypothesis $\gamma^1 = \gamma^2$, the model becomes linear and reduces to equation [24]. The null hypothesis of linearity is preliminarily tested against the threshold model. As explained by Law et al. (2014), since the threshold parameter λ is not identified under the null (Hansen, 1996 and 2000) inferences are implemented by calculating a Wald or LM statistic for each possible value of λ and subsequently basing inferences on the supremum of the Wald or LM across all possible λs via bootstrapping (see Hansen, 1996, for validity conditions and properties). Once an estimate of λ is obtained (as the minimizer of the residual sum of squares computed across all possible values of λ), estimates of the slope parameters follow.

Obviously, an issue of potential endogeneity of rents with respects to profit exists, due to possible reverse causation. Although to a much lesser extent compared to the case of profits, value added may also be endogenous if, as it is plausible, firms change labour inputs in response to autonomous variations in wages (Estevao and Tevlin, 2003). We follow the literature and address this issue by means of instrumental variable approaches, implemented in two stages. Along the lines indicated by Caner and Hansen (2004), in the first stage we run fixed effects regression of value added per hours worked on a set of instrumental variables (and time dummies) and obtain the fitted values of value added. In the second stage, the predicted values of value added is used into the threshold equation model to determine the value of the threshold variable and of the coefficients γ^1 and γ^2. Valid instruments (correlated to value added but not to wages) should be able to capture shocks on the demand side or on intermediate input markets. The existing empirical literature for similar industry-level studies has employed, for this purpose, the cost of energy (Blanchflower et al., 1996), exogenous demand shocks derived from input-output tables (Estevao and Tevlin, 2003) and internal lags (Blanchflower et al., 1996; Bell et al., 2009; Chirstofides and Oswald, 1992). Following this literature, and exploiting the richness of the JIP dataset, we constructed a battery of potential instrumental variables that included: (i) the ratio of gross output on its average over the past 3 or 5 years (as a proxy for demand shocks); (ii) import and export price indexes, to capture external shocks; (iii) real oil price weighted by the share of petrol input on gross output at industry level (from JIP input-output tables); (iv) the share of inputs coming from energy sectors on gross output (again from IO tables): (v) a metric of intermediate input price at industry level, obtained as the ratio of nominal to real value of intermediate input (divided by nominal/real gross output ratio). Within this set, the usual tests for the validity of instruments (see the next sections for the details), suggested to use a mix of lags of value added and the measure of intermediate input price at sector level. In a two-stage approach statistical inference problems can arise due to the estimation of the parameter vector in the second stage being conditional on the result from the first one. We therefore implement a standard bootstrap method to adjust the estimated covariance matrix for the second step so to account for the variability of the parameter vector obtained in the first step.

The empirical model described in equations [24] and [25] is designed to be fully consistent with our theoretical framework. However, an obvious econometric concern for the estimation of our core relationship (the rent-sharing parameter) is, given the extended time span of our analysis, the possible non-stationarity of the time series and the consequent risks of spurious correlation. To test the robustness of our baseline model to such issues we follow the standard approaches of: (i) estimating the model in first differences; (ii) rewriting a dynamic version of equation [24] using an autoregressive distributed lag process ARDL(p,q) and reformulating it as an error, or equilibrium, correction model (ECM) by augmenting the first-differences regression with the lags of the dependent and the explanatory variables:

$$\Delta w_{igjkt}^{R} = \alpha + \psi^{1} w_{igjkt-1}^{R} + \psi^{2} \Delta \frac{r_{it}}{n_{it}^{R}} + \psi^{3} \frac{r_{it-1}}{n_{it-1}^{R}} + \eta_{igjk} + \varepsilon_{igjkt} \quad [26]$$

The ECM approach allows deriving estimates of the long-run relationships by combining level and first-difference estimated coefficients. In our case, the long-run effect (or co-integration parameter) of rents on wages corresponds to $\gamma^{LR} = -(\psi^{3}/\psi^{1})$. The coefficient of the lagged dependent variable (the hourly real wage) ψ^{1} describes the speed of adjustment towards the long-run equilibrium, and inference on this parameter provides information on the presence of a long-run equilibrium relationship. This is indeed the intuition behind ECM models: following a shock in the economy, if $\psi^{1}$is significantly negative and $0 < \psi^{1} < 1$, an error correction mechanism exists that drives the economy back into its long-run equilibrium path. This means that co-integration exists between the variables and processes in levels (Eberhardt and Presbitero 2015). In view of the nature of our dataset, in particular the fact that our panel individual observations are industry/education/age/gender cells, equation [26] is estimated relying on the panel time-series literature which emphasizes: (i) possible non-stationarity of the processes; (ii) cross-section dependence, i.e., the possible correlation in the disturbances across sectors; and (iii) slope, not just group time-invariant, parameter heterogeneity (Eberhardt 2013). In particular, we make use of the common correlated effects mean group (CCEMG) estimator (see Pesaran, 2006) and of the augmented mean group (AMG) estimator introduced by Eberhardt and Teal (2010). Both estimators allow for heterogeneous slope coefficients across group members and for unobserved correlation across panel members (cross-section dependence); the use of two alternative approaches is aimed at testing the robustness of outcomes obtained.

6. Results

6.1. Baseline Model

Table 2 reports the outcomes of the baseline empirical model (equation 24). In the first column we estimate a simple Mincer type equation for full-time workers' hourly wages pooling all years, sectors, levels of education, age classes and genders. The relevant dummy variables provide results in line with the expectations and with the theory: male workers earn more than females, hourly wages increase with the level of education and with age/experience, reaching the peak in the age 45-54 and slightly declining afterwards. In column 2 we add in the same model the rent-sharing variable (value added per hours worked) and, as expected, its sign is positive indicating the existence of rent sharing. The size of the coefficient suggests that for any 100-yen increase in value added per hour, workers are able to appropriate additional 2.5 yen. This apparently low magnitude is in line with that found by other studies encompassing labour heterogeneity, as underlined by Card et al. (2018), see section 3.1. Indeed, when the external conditions favour substitutability between regular and non-regular workers, the elasticity of demand for regular workers could be much higher than the one hypothesised by Estevao and Tevlin (2003) and, consequently, the rent sharing parameter can decline remarkably. The result is obviously identical if we run the same model with a fixed effect estimator, using the cells as 'individual' observations (column 3). As explained in the previous section, we need to address a potential issue of endogenity of value added per hour with respect to hourly wages; to this aim, we estimate an instrumental variable panel effect model by means of Generalised Methods of Moments, using as instruments (tests reported at the bottom of the table) the intermediate input price index at sector level and two years lag of value added. The size and significance of the rent sharing parameters are both confirmed.

Table 2. Baseline estimation, rent sharing (Total Market Economy, 1970-2012)

Dependent Variable: hwage_reg	(1)	(2)	(3)	(4)
	OLS	OLS	FE	IV
VA/h		0.025***	0.025***	0.024***
		(0.002)	(0.002)	(0.002)
Male	1,019.048***	1,019.048***		
	(21.452)	(21.452)		
Upper secondary	366.341***	366.341***		
	(25.303)	(25.303)		
Junior College	738.533***	738.533***		
	(26.069)	(26.069)		
University	1,500.210***	1,500.210***		
	(34.355)	(34.355)		
Age (25-34)	617.786***	617.786***		
	(33.619)	(33.619)		
Age (35-44)	1,330.344***	1,330.344***		
	(31.252)	(31.252)		
Age (45-54)	1,861.956***	1,861.956***		
	(41.172)	(41.172)		
Age (55-64)	1,582.438***	1,582.438***		
	(38.375)	(38.375)		
Constant	-1,400.655***	-1,984.055***	1,736.528***	
	(94.830)	(103.569)	(13.927)	
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	No	No
Cell Fixed Effects	No	No	Yes	Yes
Observations	156,520	156,520	156,520	149,240
R-squared	0.672	0.678	0.217	0.173
F-test / W-test	116.8	129.2	263.6	145.8
Adj. R-squared	0.671	0.678	0.217	0.152
Number of panelid			3,640	3,640
Underidentification test (Chi-sq p-value)				178.565 (0.000)
Hansen J statistc (Chi-sq p-value)				0.740 (0.389)

*Robust standard errors in parentheses, clustered at industry/gender/age/education/age cell level; *** p<0.01, ** p<0.05, * p<0.1*

As a first robustness check on the baseline results we re-estimate the same model in first differences, as done by Estevao and Tevlin (2003). As explained in section 5, first differencing of the variables, besides eliminating the fixed effects, also addresses potential non-stationarity issues and the risk of spurious correlation driven by a common time trend. The outcomes of these estimations, obtained by means of OLS and IV estimators, are reported in columns 1 and 2 of Table A2 in Appendix C. Results indicate that the rent-sharing parameter is always significant and positive and, for the IV estimates, larger than the one estimated in levels. The estimation of the ECM model (with both the CCE and the AMG estimators) in columns 3 and 4 of Table A2 provides similar evidence in a dynamic framework and in terms of long-run relationships. The long-run rent-sharing parameter, once potential heterogeneity across panels and cross-sectional dependence are allowed for, is again positive, statistically significant and larger compared to baseline estimation in levels. Overall, the robustness checks reported in Table A2 suggest that the significance and the sign of the rent-sharing parameter obtained with our baseline estimation is not driven by econometric issues that could potentially affect the model. On the contrary, as the magnitude of the rent-sharing parameter is larger when such potential sources of bias are accounted for, the coefficients provided by our panel GMM IV static approach (in the following used for the threshold models) are to be considered downward biased and regarded as conservative estimates.

6.2. Threshold Model Estimates

Table 3 illustrates the first set of results of the estimation of threshold models (see equation 25), in which industry-level technological features are used as regime variables. For each regime indicator we report both non-IV and IV estimations.

Table 3. Threshold models, technological regime variables (Total Market Economy, 1970-2012)

Dependent Variable: hwage_reg	(1)	(2)	(3)	(4)	(5)	(6)
	THRES	THRES (IV)	THRES	THRES (IV)	THRES	THRES (IV)
VA/h if TFP < λ	0.023***	0.024***				
	(0.002)	(0.002)				
VA/h if TFP > λ	0.031***	0.033***				
	(0.002)	(0.002)				
VA/h if (IT-k / VA) < λ			0.016***	0.017***		
			(0.001)	(0.001)		
VA/h if (IT-k / VA) > λ			0.091***	0.082***		
			(0.006)	(0.005)		
VA/h if (IT-k / non IT-k) < λ					0.016***	0.017***
					(0.002)	(0.002)
VA/h if (IT-k / non IT-k) > λ					0.027***	0.028***
					(0.002)	(0.002)
Constant	1,731.592*	1,701.291***	1,728.782	1,709.843***	1,779.786***	1,757.542***
	(13.659)	(20.218)	(13.176)	(19.638)	(14.594)	(22.671)
Threshold estimate (λ)	3.678	3.678	0.302	0.302	0.042	0.042
95% confidence interval	(3.641;	(3.641;	(0.295; 0.305)	(0.295; 0.305)	(0.041;0.042)	(0.041;0.042)
F-test for threshold	541.98	548.47	15,700.57	10,809.42	1,177.86	1,012.24
Bootstrapped p-value	0.000	0.000	0.000	0.000	0.000	0.000
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cell Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	156,520	156,520	156,520	156,520	156,520	156,520
R-squared	0.219	0.214	0.288	0.262	0.222	0.216
F-test / W-test	266.09	150646.38	288.45	90196.30	259.73	44480.72
Adj. R-squared						
Number of panelid	3,640	3,640	3,640	3,640	3,640	3,640

*Robust standard errors in parentheses. Clustered at industry/gender/age/education/age cell level; Bootstrapped standard errors (50 replications) for the IV regressions. *** p<0.01, ** p<0.05, * p<0.1*

All results clearly indicate that, consistent with the expectations driven by our theory, more innovative environments are beneficial to regular workers' ability to share rents. Results indicate that the hypothesis of linearity of the relationship between rents and wages is to be rejected in favour of the alternative hypothesis of the existence of a threshold in the regime variable, after which the strength of the relationship changes. For TFP growth rate, this threshold is quite high (beyond 3.5%) and over the 75th percentile of its distribution; after this threshold, the size of the rent sharing parameters increases from 0.024 to 0.033. This could indicate that when the rate of technological change is very high, the role of regular workers becomes crucial in absorbing and empowering such evolutions and their capacity to appropriate a larger share of the rents produced increases.

Similarly, when innovative capital (i.e., IT capital) is high, regular workers enjoy a larger share of the rents produced; however, the position of the threshold is rather high when the importance of IT capital over value added is used (0.302, over the 75th percentile), but is relatively lower when the ratio of IT to non-IT capital features the regime variable (0.042, lower than the median). Hence, IT-capital intensity (on value added) remarkably increases the capacity of regular workers to appropriate rents (from 0.017 to 0.082, column 4), but only at the top quartile of the IT-capital intensity distribution. However, results reported in columns 5 and 6 suggest that, regardless the IT-capital intensity, in contexts where IT-capital is over 4% of the value of non-IT capital (more than half of our sector/year observations, as the threshold, 0.042, falls below the median - see Table 1), rent sharing increases. The change in the coefficient, from 0.017 to 0.028, is of smaller magnitude compared to the case of IT-capital intensity on value added.

Table 4 reports the second set of results of the threshold models, in which labour market-related features are used as regime variables. A higher share of non-regular workers, as predicted by our theoretical model, deteriorates the capacity of regular workers to appropriate part of the rents produced; the threshold after which the rent-sharing parameter declines remarkably is found around the median of the distribution of the non regular share of employees (around 5%), indicating that regular workers suffer the potential substitution with part-time and temporary workers even if their incidence is not high. Union density (see columns 3 and 4 of Table 4) also affect the rent-sharing parameter, presumably impacting on the bargaining power of workers; however, probably due to the highly decentralised labour relation model of Japan, the level of union density after which regular workers can appropriate a higher share of the pie produced is rather advanced (around 45%, which is close to the 75th percentile of its distribution). This is consistent with the evolution of the Japanese bargaining system observed over the last decades. Enterprise unions in Japan have been traditionally organized around regular employees and the increase in the number of non-regular workers over time has significantly reduced the coverage of the company workforce in negotiations with the management. Despite being now allowed to join some unions and a growing unionisation rate, the interests of part-time and temporary contract workers are still largely under-represented (according to the 2010 Basic Survey of Labour Unions they accounted for about 7% of total union members in 2009). On one side this creates an asymmetry of representation in favour of regular workers; on the other, the power of unions is more limited and only translates into visible outcomes in terms of rent-sharing in contexts where the role of unions is pervasive. Lastly, rent sharing is more favourable to labour in those contexts where the traditional employment system of Japan, strongly centred on accumulation knowledge through experience and seniority, is more pervasive (columns 5 and 6 of table 4). The strength of this regime variable emerges as remarkable as, over the threshold, the size of the rent sharing parameter doubles.

Table 4. Threshold models, labour market variables regime variables (Total Market Economy, 1970-2012)

Dependent Variable: hwage_reg	(1)	(2)	(3)	(4)	(5)	(6)
	THRES	THRES (IV)	THRES	THRES (IV)	THRES	THRES (IV)
VA/h if non-reg share < λ	0.046***	0.044***				
	(0.005)	(0.005)				
VA/h if non-reg share > λ	0.024***	0.028***				
	(0.002)	(0.002)				
VA/h if UD < λ			0.011***	0.012***		
			(0.001)	(0.001)		
VA/h if UD > λ			0.040***	0.040***		
			(0.004)	(0.004)		
VA/h if Senior < λ					0.023***	0.026***
					(0.001)	(0.001)
VA/h if Senior > λ					0.050***	0.044***
					(0.006)	(0.005)
Constant	1,645.500***	1,616.777***	1,741.383***	1,719.586***	1,666.94'***	1,651.079***
	(20.961)	(26.110)	(14.553)	(20.252)	(18.586)	(21.608)
Threshold estimate (λ)	0.057	0.057	43.40	45.00	2.710	2.710
95% confidence interval	(0.056; 0.057)	(0.056; 0.057)	(42.95; 43.70)	(44.90; 45.20)	(2.704; 2.717)	(2.704; 2.717)
F-test for threshold	1964.00	1079.52	2994.16	2181.88	2551.66	1171.35
Bootstrapped p-value	0.000	0.000	0.000	0.000	0.000	0.000
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cell Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	156,520	156,520	156,520	2,181.88	156,520	156,520
R-squared	0.226	0.216	0.231	0.222	0.229	0.217
F-test / W-test	270.32	73,195.18	269.19	63,197.39	266.69	59,959.04
Adj. R-squared						
Number of panelid	3,640	3,640	3,640	3,640	3,640	3,640

*Robust standard errors in parentheses, clustered at industry/gender/age/education/age cell level; Bootstrapped standard errors (50 replications) for the IV regressions. *** p<0.01, ** p<0.05, * p<0.1*

6.3. Robustness Tests

As a first robustness checks for the results obtained by means of threshold models, we run the same estimates restricting the sample to a lower number of industries, progressively dropping those that may exhibit some intrinsic peculiarities. As a first pass, we have excluded the primary sectors (6 farming industries and mining), trimming the sample to 84 industries (non-primary market economy – NPME). Outcomes, summarised in Table 5, are all consistent with the ones just commented. Similarly, the further exclusion of constructions and 5 utilities sectors (sample consequently restricted to 78 sectors of manufacturing and market services) does not produce any noteworthy modifications of the outcomes (see Table A3 in Appendix C).

A second robustness check aims at testing to what extent our results depend on the assumptions implicit in our theoretical framework regarding (fixed) capital inputs and the consequent definition of value added, the pie to be divided between employers and regular workers.

Table 5. Threshold IV models estimates, primary sectors excluded (NPME sample, 1970-2012)

Dependent Variable: hwage_reg / *Regime Variables*	(1) TFP	(2) IT-k / VA	(3) IT-k / non IT-k	(4) Non-reg share	(5) UD	(6) Seniority
VA/h if regime variable < λ	0.026***	0.018***	0.018***	0.046***	0.012***	0.027***
	(0.002)	(0.001)	(0.002)	(0.004)	(0.001)	(0.002)
VA/h if regime variable > λ	0.036***	0.082***	0.028***	0.029***	0.040***	0.051***
	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.005)
Threshold estimate (λ)	3.675	0.299	0.042	0.057	45.000	2.733
95% confidence interval	(3.636; 3.701)	(0.295; 0.303)	(0.041; 0.042)	(0.056; 0.057)	(44.90;45.20)	(2.726; 2.747)
F-test for threshold	654.78	9749.40	740.28	1090.47	1907.06	1460.48
Bootstrapped p-value	0.000	0.000	0.000	0.000	0.000	0.000
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cell Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	144,480	144,480	144,480	144,480	144,480	144,480
R-squared	0.216	0.262	0.217	0.219	0.223	0.220
W-test	65,706.60	37,296.73	55,547.43	50,105.43	66286.63	51555.89
Number of panelid	3,360	3,360	3,360	3,360	3,360	3,360

*Robust standard errors in parentheses, clustered at industry/gender/age/education/age cell level; Bootstrapped standard errors (50 replications) for the IV regressions. *** p<0.01, ** p<0.05, * p<0.1*

As explained at the end of section 3.2 and in Appendix A, if capital inputs can be adjusted, their remuneration needs to be excluded from the amount on which employers and regular employees compete (as it is the case for the remuneration of non-regular workers). We therefore estimate again our empirical models with a new definition of rent calculated by subtracting from gross output the value of intermediate material inputs, indirect taxes minus subsidies, non-regular labour costs as well as capital input costs (both factors being considered now as flexible inputs).

Table 6. Threshold models, IV estimates (Total Market Economy, 1970-2012), flexible capital

Dependent Variable: hwage_reg	(1) TFP	(2) IT-k / VA	(3) IT-k / non	(4) Non-reg share	(5) UD	(6) Seniority
VA/h if regime variable < λ	0.022***	0.013***	0.016***	0.033***	0.011***	0.024***
	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.001)
VA/h if regime variable > λ	0.037***	0.126***	0.029***	0.024***	0.033***	0.057***
	(0.003)	(0.008)	(0.002)	(0.002)	(0.003)	(0.007)
Threshold estimate (λ)	4.311	0.477	0.042	0.057	43.700	2.710
95% confidence interval	(4.256; 4.346)	(0.468; 0.485)	(0.041; 0.042)	(0.056; 0.057)	(43.40; 44.10)	(2.704; 2.717)
F-test for threshold	963.09	13,337.47	1,299.94	342.96	851.54	1616.94
Bootstrapped p-value	0.000	0.000	0.000	0.000	0.000	0.000
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cell Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	156,520	156,520	156,520	156,520	156,520	156,520
R-squared	0.204	0.262	0.205	0.201	0.203	0.207
W-test	99,335.99	60,086.20	40,694.42	50,264.50	51,261.74	46,515.41
Number of panelid	3,640	3,640	3,640	3,640	3,640	3,640

*Robust standard errors in parentheses, clustered at industry/gender/age/education/age cell level; Bootstrapped standard errors (50 replications) for the IV regressions. *** p<0.01, ** p<0.05, * p<0.1*

The predictions of our model do not change (see the modified framework in Appendix A), they are just subject to stricter conditions (on the elasticity of substitution and the factor's shares). On the empirical ground, the new estimations, summarized in Table 6, clearly confirm the results previously discussed and the theoretical prediction in indicating that the appropriation of rents by regular workers if facilitated by more innovative environments and in contexts where the importance of non-regular employment is low, unions play a stronger role and the traditional employment system based on seniority more pervasive.

7. Conclusions

This study aimed at offering a contribution on a still rather underexplored issue, i.e., the extent of rent sharing in Japan and its sensitivity to technological and labour market features. Our analysis allowed us adding novel explanations to the long-lasting debate on stagnating wages in Japan, an issue that has crossed Japanese borders and captured increasing attention of leading international institutions (see IMF, 2016; Aoyagi et al., 2016). Similarly, Euro-Area authorities expressed concerns about a potential "Japanification" of Europe (see Wolff and Yoshii, 2014); a Japanese recovery based on raising wages, lowering income inequality, boosting inclusive growth and escaping the long-run deflationary trap became a shared interest within the international community.

Focusing on labour markets, the sluggish growth in average wages in Japan, combined with a very low unemployment rate, has been mainly attributed to the compositional changes of employment occurred in the last decades, driven by the massive increase in female labour supply and non regular (fixed-term and part-time) jobs (Kawaguchi and Mori, 2019). In our paper we show, theoretically and empirically, that an additional explanation of the stagnating pattern of Japanese wages could be related to rent sharing mechanisms. To this aim, we show how the capacity of regular workers to appropriate a larger share of rents (in our model measured by value added) depends on specific labour market and technological conditions that significantly evolved in Japan in the last decades. In particular we provide evidence that, independent of the compositional effects mentioned above, wages of regular workers suffer from a weakening of their capacity to appropriate rents in the presence of: (i) a larger share of non-regular employees, low union density and declining importance of seniority; (ii) weak technological change; and (iii) low intensity of innovative types of capital.

On the theoretical side, we augmented the Estevao and Tevlin (2003) *right to manage model* of rent sharing with labour heterogeneity and showed that in contexts characterised by a higher share of non regular workers or where IT capital /TFP growth are low, the elasticity of demand for regular workers is higher. In such contexts, even if regular workers have high potential bargaining power and manage to obtain an increase in their contracted wage, this will not materialize into higher rent sharing, as firms react by setting low levels of employment of regular workers.

On the empirical ground, our analysis relied on detailed industry level data spanning from 1970 to 2012. More precisely, we consider 91 sectors of the Japanese market economy and employ as units of observation for wages industry/education/age/gender cells. We first of all showed that a rent sharing mechanism is at work in the Japanese economy, and that a positive relationship exists between value added per worker and wages. This relationship remains significant even if we depart from a static econometric specification and we introduce an error correction model allowing for potential spurious correlations induced by non-stationary of the series. In a second step we implemented panel threshold regression methods to test the labour market and technological regime hypotheses discussed in the theoretical model. Consistent with our expectations, we regularly find a non-linearity of the rent sharing parameter, which varies in the different regimes hypothesized in the theoretical model and defined by: IT capital intensity, TFP growth rate, importance of seniority systems, non-regular workers' share, and union density. In particular, we find that a share of irregular workers exceeding 5.7% halves the rent sharing parameter; this means that even a small fraction of irregular workers negatively affects wages not via a compositional effect, but through a remarkable weakening of the capacity of regular workers to appropriate rents. On the other hand, our analysis show that this effect can be counterbalanced by increasing capital intensity in information technology (when IT-capital stock is over 30% of value added); in such contexts workers with skills complementary to IT capital are predominant and are probably able to appropriate more rents. Also, in those industries in which union members exceed 45% of total employees rent sharing is significantly higher (more than double) compared to contexts in which the presence of unions is weaker. However, values of IT capital intensity and union density beyond the threshold have been found in less than one third of year/industries. This probably reflects structural changes that have seen a downsizing of manufacturing and a remarkable increase of less knowledge intensive services, such as those related to the health care system, where women and non-regular workers offer home-based care services to an increasing fraction of elderly in need (Kawaguchi and Mori, 2019). Contrasting such secular trends with adequate policy measures is a daunting task, provided that it is feasible at all. Our concluding remarks are therefore rather in line with the labour market solutions proposed by the IMF (2016) *"to get Abeconomics back on track"*. We refer, in the first place, to the measures aimed at reducing labour market dualities by reinforcing the already existing *"equal pay for equal work*" program, which already helped closing the wage gap between regular and non-regular employees. And we also refer to the provisions designed to provide better incentives to convert the informal contracts for non-regular workers in "intermediate contracts", able to balance job security and wage growth.

References

Acemoglu, D. (2003a). Labor-and Capital-Augmenting Technical Change. Journal of the European Economic Association, 1(1), 1-37.

Acemoglu, D. (2003b). Cross-Country Inequality Trends. The Economic Journal, 113(485), F121–F149.

Aoyagi, C., Ganelli G. (2013). The Path to Higher Growth: Does Revamping Japan's Dual Labor Market Matter? IMF Working Paper No. 13/202. International Monetary Fund, Washington, D.C.

Aoyagi, C., Ganelli, G., Tawk, N. (2016). Minimum Wage as a Wage Policy Tool in Japan. The Japanese Political Economy, 42(1-4), 72-88.

Arai, M., Heyman, F. (2009). Microdata Evidence on Rent Sharing. Applied Economics, 41(23), 2965–2976.

Autor, D., Dorn, D., Hanson, G. (2016). The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade. Annual Review of Economics, 8, 205-240.

Autor, D., Dorn, D., Hanson, G., Song, J. (2014). Trade Adjustment: Worker-Level Evidence. The Quarterly Journal of Economics, 129(4), 1799-1860.

Bagger, J., Christensen, B.J., Mortensen, D.T. (2014), Wage and Labor Productivity Dispersion: The Roles of Total Factor Productivity, Labor Quality, Capital Intensity, and Rent sharing. 2014 Meeting Papers 473, Society for Economic Dynamics.

Bell, B., Bukowski, P., Machin, S. (2018). Rent Sharing and Inclusive Growth. CEP Discussion Paper 1584, Centre for Economic Performance, LSE.

Blanchflower, D., Oswald, A., Sanfey, P. (1996). Wages, Profits, and Rent-Sharing. The Quarterly Journal of Economics, 111(1), 227-251.

Caner, M., Hansen, B.E. (2004). Instrumental Variable Estimation of a Threshold Model. Econometric Theory, 20(5), 813–843.

Card, D., Cardoso, A. R., Heining, J., and Kline, P. (2018). Firms and Labor Market Inequality: Evidence and Some Theory. Journal of Labor Economics, 36(S1), S13-S70.

Card, D., Devicienti, F., Maida, A. (2014). Rent-sharing, Holdup, and Wages: Evidence from Matched Panel Data. Review of Economic Studies, 81(1), 84–111.

Christofides, L. N., Oswald, A. J. (1992). Real Wage Determination and Rent Sharing in Collective Bargaining Agreements. Quarterly Journal of Economics, 107(3), 985–1002.

Du Caju, P., Gautier, E., Momferatou, D., Ward-Warmedinger, M. (2008). Institutional Features of Wage Bargaining in 23 European Countries, the US And Japan. Working Paper Series, 974, European Central Bank, Frankfurt.

Dunne, T., Schmitz Jr, J.A. (1995). Wages, Employment Structure and Employer Size-Wage Premia: Their Relationship to Advanced-Technology Usage at US Manufacturing Establishments. Economica, 62(245), 89-107.

Eberhardt, M. (2013). Estimating Panel Time-series Models with Heterogeneous Slopes, Stata Journal, 12(1), 61–71.

Eberhardt, M., Presbitero, A.F. (2015). Public Debt and Growth: Heterogeneity and Non-linearity. Journal of International Economics, 97, 45–58.

Eberhardt, M., Teal, F. (2010). Productivity Analysis in Global Manufacturing Production. Discussion Paper 515, Department of Economics, University of Oxford.

Entorf, H., Kramarz, F. (1998). The Impact of New Technologies on Wages: Lessons from Matching Panels on Employees and on their Firms. Economics of Innovation and New Technology, *5*(2-4), 165-198.

Estevão, M., Tevlin, S. (2003). Do Firms Share their Success with Workers? The Response of Wages to Product Market Conditions. Economica, 70(280), 597-617.

Fujimura, H. (2012). Japan's Labour Unions: Past, Present and Future. Japanese Labour Review, 9(1), 6-24.

Fukao, K., Hamagata, S., Inui, T., Ito, K. Ug Kwon, H., Makino, T., Miyagawa, T., Nakanishi, Y., Tokui, J. (2007). Estimation Procedures and TFP Analysis of the JIP Database 2006. RIETI Discussion Paper, 07-E-003.

Fukao, K., Perugini, C. (2020). The Long-Run Dynamics of the Labour Share in Japan, The Review of Income and Wealth, forthcoming.

Guiso, L., Pistaferri, L., Schivardi, F. (2005). Insurance Within the Firm. Journal of Political Economy, 113(5), 1054-1087.

Guuertzgen, N. (2009). Rent-Sharing and Collective Bargaining Coverage: Evidence from Linked Employer-Employee Data. Scandinavian Journal of Economics, 111(2), 323–349.

Hansen, B. E. (1999). Threshold Effects in Non-Dynamic Panels: Estimation, Testing, and Inference. Journal of Econometrics, 93, 345–368.

Hansen, B.E. (1996). Inference When a Nuisance Parameter Is Not Identified Under the Null Hypothesis. Econometrica, 64(2), 413–430.

Hansen, B.E. (2000). Sample Splitting and Threshold Estimation. Econometrica, 68(3): 575–603.

Hattori, R., Maeda, E. (2000). The Japanese Employment System (summary). Bank of Japan Monthly Bulletin, January 2020.

Hildreth, A. K. G., Oswald, A., J. (1997). Rent-Sharing and Wages: Evidence from Company and Establishment Panels. Journal of Labor Economics, 15(2), 318–37.

IMF (2016). Country Report No. 16/267, Japan: Article IV Consultation-Press Release and Staff Report. International Monetary Fund, Washington.

Izumi, Y. Naomi, K., Yoshio, H. (2016). What Happened to Wage Inequality in Japan during the Last 25 Years? Evidence from the FFL Decomposition Method. Rieti Discussion Paper Series 16-E-081.

Kalantzis, Y., Kambayashi, R., Lechevalier, S. (2012). Wage and Productivity Differentials in Japan: the Role of Labor Market Mechanisms. Labour, 26(4), 514-541.

Karabarbounis, L., Neiman, B. (2013). The Global Decline of the Labor Share. The Quarterly Journal of Economics, 129(1), 61-103.

Kato, T. (2016). Productivity, Wages and Unions in Japan. Conditions of Work and Employment Series, 73, ILO, Geneva.

Kawaguchi, D., Mori, H., (2019). The Labor Market in Japan, 2000–2018. IZA World of Labor, 385v2, 1-12.

Komiya, R., Yasui, K. (1984). Japan's Macroeconomic Performance since the First Oil Crisis: Review and Appraisal. Carnegie-Rochester Conference Series on Public Policy, 20(1), 69-114.

Krueger, A.B. (1993). How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984–1989. The Quarterly Journal of Economics, 108(1), 33-60.

Law, S.H., Tan, H.B., Azman-Saini, W.N.W. (2014). Financial Development and Income Inequality at Different Levels of Institutional Quality. Emerging Markets Finance and Trade, 50(sup1), 21-33.

Margolis, D. N., Salvanes, K., G. (2001). Do Firms Really Share Rents with Their Workers? IZA Discussion

Paper 330, IZA Institute of Labor Economics, Bonn.

Miyamoto, J. (2016). Growth and Non-regular Employment. The B.E. Journal of Macroeconomics, 16(2), 523-554.

O'Mahony, M. Timmer, M.P. (2009). Output, Input and Productivity Measures at the Industry Level: the EU KLEMS Database. The Economic Journal, 119(538), F374-F403.

OECD (2017). Employment Outlook. June, OECD Publishing, Paris.

Pesaran, M. H. (2006). Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure. Econometrica, 74: 967-1012.

Savvides, A, Stengos, T. (2000). Income Inequality and Economic Development: Evidence from the Threshold Regression Model. Economics Letters, 69, 207–212.

Seo, M.H., Kim, S., Kim, Y.J. (2019). Estimation of Dynamic Panel Threshold Model using Stata. The Stata Journal , 19(3), 685-697.

Seo, M.H., Shin, Y. (2016). Dynamic Panels with Threshold Effect and Endogeneity. Journal of Econometrics, 195(2), 169-186.

Stansbury, A.M., Summers, L.H. (2017). Productivity and Pay: Is the link broken? NBER Working Paper Series, 24165, National Bureau of Economic Research.

Van Reenen, J. (1996). The Creation and Capture of Rents: Wages and Innovation in a Panel of UK Companies. The Quarterly Journal of Economics, 111(1), 195-226.

Wolff, G.B., Yoshii, M. (Eds) (2014). Japan and the European Union in the Global Economy. Bruegel Blueprint 22, 2014.

Appendix A: Extension of the theoretical model to the case of flexible capital

In this appendix, we extend our theoretical model of section 3.1 by assuming that firms can choose its capital input.

Let us assume the following value added production function

$$Y = AL^{\alpha}K^{\delta}\Lambda^{1-\alpha-\delta} \quad [A1]$$

where Y, L, K and Λ denote total output, total labor input, capital service input, and firm specific fixed production factor, such as an entrepreneurship. L depends on labor input of regular and non-regular workers, L_R and L_N. This relationship is defined by equation [4]. We assume that $0<\delta<1-\alpha$. Firms are price takers in its output market, capital service market and non-regular worker market. We also assume that input of the firm specific fixed production factor, Λ is given in the equilibrium we analyze. Wage rate of regular workers, w_R is determined by a bargaining between each firm and its regular workers. And after this negotiation, each firm decides its input of regular workers, L_R. Each firm's profit is defined by

$$\Pi = pAL^{\alpha}K^{\delta}\Lambda^{1-\alpha-\delta} - rK - w_R L_R - w_N L_N \quad [A2]$$

We study about how firm's rent $pAL^{\alpha}K^{\delta}\Lambda^{1-\alpha-\delta}-rK-w_N L_N$ is divided between the firm and the regular workers.

Let us express this rent as a function of input of regular workers, L_R, and the shift parameter A.

$$f(L_R, A) = pA\{\beta(A_R L_R)^{\sigma} + (1-\beta)(A_N {L_N}^{*})^{\sigma}\}^{\frac{\alpha}{\sigma}}K^{\delta}\Lambda^{1-\alpha-\delta} - rK^{*} - w_N {L_N}^{*} \quad [A3]$$

where K^* and L_N^* denotes optimal level of capital input and non-regular worker input. K^* and L_N^* are endogenously determined and depends on L_R. Let ε_{fLR} denote elasticity of rent f ( ) with respect to input of regular workers, L_R.

This firm's profit maximization conditions are:

$$p\frac{\partial Y}{\partial L_R} = w_R \quad [A4]$$

$$p\frac{\partial Y}{\partial L_N} = w_N \quad [A5]$$

$$p\frac{\partial Y}{\partial K} = r \quad [A6]$$

Under a given set of output price and the factor prices, p, w_N and r, and the level of fixed input, Λ, the optimal employment levels of the two types of labor and capital input level are determined by equations [A4], [A5] and [A6] and can be expressed as functions of w_R, $L_R^* = L_R(w_R)$, $L_N^* = L_N(w_R)$, $K^* = K(w_R)$. From the above profit maximization conditions, we have:

$$\varepsilon_{fL_R} = \frac{L_R}{f(L_R,A)}\frac{df}{dL_R} = \frac{w_R L_R}{f(L_R,A)} \quad [A7]$$

From the above equation, we also have

$$\Pi = \left(1-\varepsilon_{fL_R}\right)f(L_R, A) \quad [A8]$$

From equations [A4], [A5] and [A6], we can explicitly derive demand function for regular and non-regular workers and capital service input;

$$L_R = A^{\frac{1}{1-\alpha-\delta}}(\beta A_R^{\sigma})^{\frac{1}{1-\sigma}}\Lambda\left(\frac{\alpha P}{\Phi}\right)^{\frac{1-\delta}{1-\alpha-\delta}}\left(\frac{w_R}{\Phi}\right)^{-\frac{1}{1-\sigma}}\left(\frac{\delta P}{r}\right)^{\frac{\delta}{1-\alpha-\delta}} \quad [A9]$$

$$\frac{L_N}{L_R} = \left\{\frac{(1-\beta)A_N{}^{\sigma}}{\beta A_R{}^{\sigma}}\right\}^{\frac{1}{1-\sigma}} \left(\frac{w_N}{w_R}\right)^{-\frac{1}{1-\sigma}} \qquad [A10]$$

$$K = A^{\frac{1}{1-\alpha-\delta}} \Lambda \left(\frac{\alpha P}{\Phi}\right)^{\frac{\alpha}{1-\alpha-\delta}} \left(\frac{\delta P}{r}\right)^{\frac{1-\alpha}{1-\alpha-\delta}} \qquad [A11]$$

where Φ denotes average wage rate of regular and non-regular workers, which is defined by equation [13]. The last term in the right-hand side of equation [A9] denotes how decline of capital service price increases demand for regular workers through increase of optimal production level. When the role of capital stock in the production process is negligible, that is, δ=0, the right-hand side of equation [A10] will become identical with the right-hand side of equation [11] except the term Λ.

The Nash bargaining function to be maximized is

$$\Omega = \left[L_R(w_R)\big(v(w_R) - v(Z)\big)\right]^{\mu} \Pi^{1-\mu} \qquad [A12]$$

where $v(x)$ measures the utility derived by an individual from income x and Z denotes reservation wage of regular workers. Differentiating [A12] with respect to w_R, using [A4], [A5], [A6], [A7], [A8] and linearizing $v(x)$ around w_R, gives

$$\mu \frac{\varepsilon_{L_R w_R}}{w_R} + \mu \frac{1}{w_R - Z} - (1-\mu)\frac{L_R(W_R)}{\Pi} = \mu \frac{\varepsilon_{L_R w_R}}{w_R} + \mu \frac{1}{w_R - Z} - (1-\mu)\frac{L_R(W_R)}{(1-\varepsilon_{fL_R}) f(L_R, A)} = 0 \qquad [A13]$$

where ε_{LRWR} denotes elasticity of demand for regular workers, L_R, with respect to wage rate of regular workers, w_R. We can derive this value from equation [A9]

In a similar way as Estevão and Tevlin (2003, p. 602), we can derive the following relationship from equation [A7], [A8], and [A13];

$$w_R = \gamma \frac{f(L_R, A)}{L_R} + (1-\gamma)Z \qquad [A14]$$

$$\gamma = \gamma\left(\mu, \varepsilon_{fL_R}, \varepsilon_{L_R w_R}\right) \qquad [A15]$$

where the functional form of γ( ) is given in endnote 12 in Estevão and Tevlin (2003, pp. 614-615).

$$\gamma = \mu \frac{1}{1 - \frac{\mu \varepsilon_{L_R w_R}(1-\varepsilon_{fL_R})}{\varepsilon_{fL_R}}} \qquad [A16]$$

We analyse how importance of non-regular workers affects γ. For this analysis, we study determinants of ε_{LRWR}. Taking log values of the both sides of equation [A9] and differentiate it about L_R and w_R, we have

$$\frac{dL_R}{L_R} = -\frac{1}{1-\sigma}\frac{dw_R}{w_R} + \left(\frac{1}{1-\sigma} - \frac{1-\delta}{1-\alpha-\delta}\right)\frac{d\Phi}{\Phi} \qquad [A17]$$

In a similar way, we can derive equation [20] from equation [13]:

From equations [A17], [20] and [21], we have

$$\varepsilon_{LRwR} \equiv \frac{\frac{dL_R}{L_R}}{\frac{dw_R}{w_R}} = -\frac{1-\theta_R}{1-\sigma} - \frac{\theta_R}{1-\alpha} = -\frac{1}{1-\sigma} + \left(\frac{1}{1-\sigma} - \frac{1-\delta}{1-\alpha-\delta}\right)\theta_R \qquad [A18]$$

$$\varepsilon_{LRwR} \equiv \frac{\frac{dL_R}{L_R}}{\frac{dw_R}{w_R}} = -\frac{1-\theta_R}{1-\sigma} - \frac{\theta_R(1-\delta)}{1-\alpha-\delta} = -\frac{1}{1-\sigma} + \left(\frac{1}{1-\sigma} - \frac{1-\delta}{1-\alpha-\delta}\right)\theta_R$$

Where θ_R denotes the share of the labor cost of regular workers in the total labor cost.

When w_R increases, total labor cost will also increase by θ_R per cent of the increase of w_R (equation 20).

The increase of w_R will affect optimal level of regular worker input through two mechanisms (equation A18). Firstly, relative price of regular workers and total labor input will increase by $(1-\theta_R)dw_R/w_R$. This change will reduce optimal level of regular workers by $\{1-\theta_R)/(1-\sigma))\}dw_R/w_R$ through substitution. Secondly, cost of the total labor input will be raised by $\theta_R dw_R/w_R$. This increase of the labor input cost will reduce the optimal production level by $\{(1-\delta)\theta_R/(1-\alpha-\delta)\}dw_R/w_R$.

Equation [A18] implies that when substitution between regular and non regular workers is relatively high and $1/(1-\sigma)>(1-\delta)/(1-\alpha-\delta)$ holds[7], a decline of the share of regular works in total labor cost, θ_R, will raise the absolute value of the elasticity of demand for regular workers to a change in its own wage rate, ε_{LRWR}. This change will reduce the rent sharing of regular workers, γ (equation 18). We should note that when δ is close to its upper limit $1-\alpha$, that is when contribution of firm specific production factor in the production process $(1-\alpha-\delta)$ is negligible, $1/(1-\sigma)>(1-\delta)/(1-\alpha-\delta)$ will not be satisfied.

From the definition of θ_R, [21] and equation [A10], we get

$$\theta_R = \frac{W_R L_R}{W_R L_R + W_N L_N} = \frac{1}{1+\frac{W_N L_N}{W_R L_R}} = \frac{1}{1+\left\{\frac{(1-\beta)A_N{}^{\sigma}}{\beta A_R{}^{\sigma}}\right\}\left(\frac{L_N}{L_R}\right)^{\sigma}} \quad \text{[A19]}$$

If we continue to assume that elasticity of substitution between regular and non-regular workers, $1/(1-\sigma)$ is greater than one and $1/(1-\sigma)>(1-\delta)/(1-\alpha-\delta)$ holds, an increase of the share of regular workers in total number of workers, $L_R/(L_R+L_N)$, or an increase of either A_R/A_N or β, such a technological change will raise the marginal contribution of regular workers in comparison with non-regular workers in the production process. This change will raise the share of regular works in total labor cost, θ_R, and reduce the absolute value of the elasticity of demand for regular workers to a change in its own wage rate, ε_{LRWR}. Such decline of ε_{LRWR} will raise the rent sharing of regular workers, γ (equation A16).

Since production function is constant return to scale and Cobb-Douglas about L and K, labor income share in the total value added, $(w_R L_R+ w_N L_N)/pY$, will be equal to α. From this and equation [A7], we have

$$\varepsilon_{fL_R} = 1 - \frac{f(L_R,A)-w_R L_R}{f(L_R,A)} = 1 - \frac{1-\alpha-\delta}{1-\alpha-\delta+\alpha\theta_R} \quad \text{[A20]}$$

This equation implies that an increase of the share of regular works in total labor cost, θ_R, will raise ε_{fLR}, elasticity of rent $f(\ )$ with respect to input of regular workers, L_R. According to equation [A16], this increase of ε_{fLR} will raise rent sharing, γ.

[7] This condition is more restrictive than condition discussed for the short run case (see footnote 1). The higher the labour share compared to the fixed entrepreneurship factor share, that is $(1-\delta)/(1-\alpha-\delta)$, and the higher should be the elasticity of substitution between regular/non regular workers. For example, for a labour share (α) ranging from 0.6 and 0.7 and a fixed entrepreneurship factor share $(1-\alpha-\delta)$ that equals 0.2, the elasticity of substitution should be higher than 4 or 4.5, respectively.

Appendix B: List of acronyms and abbreviations

Acronym / Abbreviation	*Description*
VA / h	Real Value Added per hour worked by regular employees (in 2000 yen)
hwage_reg	Real hourly wage of regular workers (in 2000 yen)
hwage_nreg	Real hourly wage of non-regular workers (in 2000 yen)
IT-K / VA	IT capital stock on Value added
IT K/non-IT K	IT capital stock on non-IT capital stock
TFP	Total Factor Productivity annual growth rate
UD	Union Density (n. of union members/workers)
Non-Reg share	Share of hours worked by non-regular employees on total hours worked by all employees
Seniority	Average hourly wage of a male, tertiary educated worker aged over 45/under 45
Industry aggregations	
TME	Total Market Economy:
	All JIP sectors excluding: housing (72), Private Education (80), Private Research (81), Private Medical (82), Private Hygiene (83)
NPME	Non-Primary Market Economy:
	ME minus Primary sectors (1-6) and Mining (7)
MAN + MSERV	NPME minus Constructions (7) and Utilities (62-66)
MAN	Manufacturing
	JIP sectors 8–59
MLM	Medium- and medium-low-technology manufacturing
	JIP sectors: 8-–22, 30–41, 58–59
MHM	Medium- and medium-high-technology manufacturing
	JIP sectors: 23–29, 42–57
MSERV	Market services:
	JIP sectors: 61, 67–71, 73–79, 85–97
LKIS	Less-knowledge-intensive services
	JIP sectors: 67–68, 71, 73–74, 77, 79, 86–88, 94–97
KIS	Knowledge-intensive services
	JIP sectors: 61, 69–70, 75–76, 78, 85, 89–93,

Appendix C: Tables

Table A1. Summary statistics by macro-industries (means over 1970-2012)

	TME	NPME	MAN	MLM	MHM	MSERV	LKIS	KIS
VA / h	4012.02	3958.49	4038.52	3791.31	4341.87	3852.43	3350.95	5272.45
hwage_reg	2536.6	2556.40	2573.26	2306.76	2905.47	2555.21	2376.49	3062.50
hwage_nreg	855.95	852.56	796.95	795.34	800.32	876.71	863.33	939.09
IT-K / VA	0.13	0.13	0.12	0.09	0.17	0.14	0.13	0.17
IT K/non-IT K	0.06	0.07	0.08	0.05	0.11	0.08	0.06	0.13
TFP	0.45	0.49	0.88	0.09	1.88	-0.06	-0.35	0.28
UD	34.56	36.79	37.65	26.85	51.26	30.63	24.45	37.85
Non-Reg share	0.12	0.12	0.09	0.11	0.07	0.13	0.15	0.09
Seniority	2.25	2.26	2.31	2.21	2.44	2.15	2.02	2.29

TME: Total Market Economy; NPME: Non-Primary Market Economy; MAN: Manufacturing; MLM: Medium- and medium-low-technology manufacturing; MHM: Medium- and medium-high-technology manufacturing; MSERV: Market services; LKIS: Less-knowledge-intensive services; KIS: Knowledge-intensive services. Value added per worker and wages expressed in real terms (2000 yen).

Table A2. Robustness checks on the baseline model: estimations in differences and error correction model (Total Market Economy, 1970-2012)

	(1)	(2)	(3)	(4)
VARIABLES	First Diff (ols)	First Diff (iv)	ECM (ccemg)	ECM (amg)
d.VA/h	0.017***	0.040***		
	(0.003)	(0.005)		
Constant	4.662	-34.553***		
	(6.462)	(5.872)		
VA/h (long-run)			0.053***	0.067***
			(0.003)	(0.003)
ECM			-0.291***	-0.329
			(0.004)	(0.004)
Observations	152,880	152,880	152,880	152,880
Groups	-	-	3,640	3,640
R-squared	0.029	0.021		
RMSE	-	-	283.486	292.020
F-test / W-test (p-value)	95.110 (0.000)	81.62 (0.000)	7089.21 (0.000)	8955.11 (0.000)
Underidentification test (Chi-sq p-value)		248.495 (0.000)		
Hansen J statistc (Chi-sq p-value)		1.016 (0.313)		

*Columns (1) and (2): Robust standard errors in parentheses, clustered at industry/gender/age/education/age cell level; time and industry dummies included. Columns (3) and (4): Error correction models in columns (3) and (4) are estimated by means of the Pesaran (2006) common correlated effects mean group (CCEMG) estimator and the Eberhardt and Teal (2010) augmented mean group (AMG) estimator respectively. RMSE is the root mean squared error test (sigma); average long-run coefficients for the ECM results (standard errors computed via the Delta method). *** p<0.01, ** p<0.05, * p<0.1.*

Table A3. Threshold IV estimates, manufacturing and market services industries only (1970-2012)

	(1)	(2)	(3)	(4)	(5)	(6)
REGIME VARIABLES	TFP	IT-k / VA	IT-k / non	Non-reg share	UD	seniority
Regime variable < λ	0.025***	0.018***	0.016***	0.049***	0.013***	0.027***
	(0.002)	(0.001)	(0.002)	(0.006)	(0.001)	(0.002)
Regime variable > λ	0.036***	0.108***	0.027***	0.030***	0.041***	0.044***
	(0.003)	(0.007)	(0.003)	(0.003)	(0.005)	(0.006)
Threshold estimate (λ)	3.673	0.476	0.042	0.057	45.000	2.545
95% confidence interval	(3.626; 3.693)	(0.468; 0.483)	(0.042; 0.043)	(0.056; 0.057)	(44.90; 45.20)	(2.542; 2.589)
F-test for threshold	781.60	14416.33	1008.36	1337.01	1776.53	871.46
Bootstrapped p-value	0.000	0.000	0.000	0.000	0.000	0.000
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Cell Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	134,160	134,160	134,160	134,160	134,160	134,160
R-squared	0.202	0.276	0.204	0.206	0.209	0.203
W-test	220,272.62	43,984.09	127,246.51	94,018.14	143,069.28	10959,5.49
Number of panelid	3,120	3,120	3,120	3,120	3,120	3,120

*Robust standard errors in parentheses. Clustered at industry/gender/age/education/age cell level; Bootstrapped standard errors (50 replications) for the IV regressions. *** p<0.01, ** p<0.05, * p<0.1*