Falling labor share in Japan: Its causes during the lost decade and beyond*

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July 30^{th} 2010

Abstract

Like in most advanced countries, the labor income share in Japan has been falling since the mid 1970s. In contrast to these advanced economies, Japan experienced an exceptional recessive period during the 1990s, the lost decade, in which the rate of unemployment rose to attain an historical maximum of 5.5% in 2002. This was followed by a mild recovery. In this paper we examine the main causes behind the structural fall in the labor income share during the lost decade (1991-2002) and the subsequent mild recovery (2003-2007). We do so by estimating a multi-equation macro model that allows us to look separately at its various components –wages, output and employment–. We confirm labor market institutions and technology as key forces driving the fall in the labor income share (Bentolila and Sain-Paul, 2003). Our main finding is that the continuous loss in union power (measured by the fall in union membership) is the fundamental cause of the decline in the labor income share in Japan. It accounts, on its own, by 8 percentage points of its fall since 1990. Technology is also relevant in both periods, while the continuous increase in Social Security benefits during 1991-2002 appears as the main counterbalancing factor.

JEL Classification: E25, J51, E24.

Keywords: Labor income share, trade unions, labor market, Japan.

*Hector Sala is grateful to the Ministry of Science and Innovation for financial support through grant ECO2009-07636.

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1 Introduction

The puzzling performance of Japan in last decades is the object of growing attention in the literature. In this paper we are concerned with a salient feature of this performance: the structural fall in the labor income share (LIS hereafter). Our goal is to examine the causes behind this fall in the crucial period of the lost decade (1991-2002) and the subsequent mild recovery (2003-2007) in which the LIS kept its downward path.

This paper should be regarded as a companion of Agnese and Sala (2009), where a labor market model was estimated and used to identify the main macroeconomic determinants of labor demand and labor supply, and assess their relative contributions to the unemployment upsurge in 1991-2002. Here we take a step forward and provide a more complete characterization of the supply-side of the economy by endogenizing real wages –so as to account for the bargaining process between labor and management–, and output –so as to be able to model labor productivity–. We will thus work with a multi-equation system containing equations for employment, the labor force, real wages and output.

The estimated labor demand and labor force equations are updated versions of those in Agnese and Sala (2009). The wage equation is consistent with the predictions of standard wage-bargaining models, and the output equation is a production function depending on capital, labor, oil prices, and technology. In view of the standard framework in which our analysis is developed, we abstain from theoretical considerations and focus on its empirical outcome.[1]

One fundamental feature of our four-equation model is that the LIS is endogenous. The contribution of this paper is to make use of this feature and provide an in depth analysis of the causes behind its structural fall. Most literature observes the decline in the LIS and tries to explain its trajectory taking it as a single variable. Here we take a disaggregated approach in which we model the different components of the LIS: real wages and labor productivity, the latter through output and employment.

It is important to state that our measure of the LIS conforms to the standard definition of total compensation per employee over value added, but is not adjusted for self-employment income. This is not an infrequent practice in the literature (see, for example, Checchi and García-Peñalosa, 2010) and, furthermore, does not distort the evolution of the LIS (see Karanassou and Sala, 2010, where the LIS in Japan is adjusted for the incomes of the self-employed and nevertheless follows the same trajectory as in Figure 1a; the only difference between the two is a parallel shift). Another important remark is that this concept admits several interpretations, such as the real unit labor cost, or the

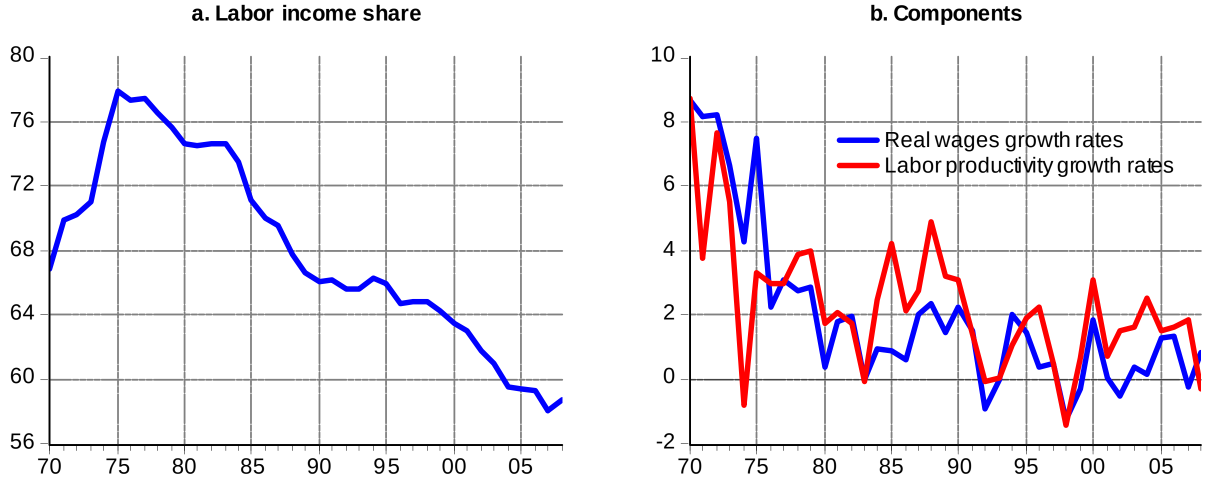
[1] Microfoundations of the labor demand, labor force and wage equations of the sort we have estimated can be found in Karanassou *et al.* (2007). A complete survey of the analytical framework in which our multi-equation analysis is developed is provided in Karanassou *et al.* (2010). Furthermore, our first task was to verify that the results obtained in Agnese and Sala (2009) hold in the context of this updated model. They do and we refer to them in Section 2.2.

wage-productivity gap (see Karanassou and Sala, 2010).

The LIS in Japan has experienced a downward trajectory since the mid 1970s (Figure 1a), as also seen in many other advanced economies. What is remarkable in this evolution is that this fall has taken place along a continuous deceleration in the growth rate of productivity (see Hayashi and Prescott, 2002) and a parallel deceleration in the growth rate of real wages (Figure 1b). In the first half of the 1970s wages were still growing at a higher rate than productivity. Since then, they have systematically grown at a lower rate. This has had consequences in terms of growing income inequality (Moriguchi, 2010) and has reflected in the falling LIS –that is, in lower real unit labor costs or wider wage-productivity gaps–.

The evolution of the LIS is intricately related to that of the labor market. For example, the fact that the productivity growth decelerates may not be due to growing employment, and even a lower unemployment rate may not reflect higher employment as can be seen from the zero growth of this variable in 2002-2007. Therefore, in allowing for a disaggregated study, our multi-equation model places us in the right position to investigate the main determinants of the fall in the LIS.

Figure 1. The labor income share and its components. Japan.



Although in other contexts, the falling LIS in Japan has already deserved attention (Iiduka, 2006; Nishizaki and Sugo, 2001; Takeuchi, 2005). Several factors have been brought up as having a potential decreasing effect. For instance, an insufficient employment level jointly with an upturn in the equilibrium return on capital is mentioned by Iiduka (2006). Takeuchi (2005), in turn, refers to the changes in the relative price of labor to capital, the decreased mobility in the labor market, and the lowered elasticity of substitution between production factors by firms, all enabling a more elastic management of the capital-labor ratio.

To explain the evolution of real wages relative to that of labor productivity, Miura (2008) refers to Maier's (1987) notion of the 'politics of productivity'. There it is suggested that a system of labor relations based on a fair distribution of shares among capital and labor was implemented in Japan during the first stages of rapid growth. A system that would sideline class struggle, stimulate consumption, and thereby enhance productive efficiency so as to feed capital accumulation and fasten economic growth. Such a system lasted until 1975. Figure 1 in Miura (2008, p. 168) shows the same information as in our Figure 1b, but using an index where the values of the real wage and labor productivity are normalized to 100 in 1975. The politics of productivity began to fall from that year, "when private-sector unions began to curb wage increases in exchange for employment protection" [Miura (2008), p. 168)]. This is precisely the turning point in the trajectory of the LIS.

In this paper we use the estimated multi-equation macro model to conduct a series of simulations in which we assess how much the trajectory of the exogenous variables have contributed to the falling LIS. Since this is a structural fall, we are interested in examining its causes across business cycles. Thus, we consider two periods in which the starting and final years are set coinciding with the minimum and maximum unemployment rate during the last two decades. Unemployment went down to 2.1% in 1990, reached a historical maximum at 5.5% in 2002, and then fell back to 3.9% in 2007. These three years distinguish our two periods of analysis for the simulations: 1991-2002 and 2003-2007.

These simulations provide answers to the following question: What would had happened had these exogenous variables kept their values in 1990 and 2002? Comparison of the endogenous variables' trajectory in the presence and absence of a particular explanatory variable gives us information of its contribution to their path. These are counterfactual experiments and should be understood as dynamic accounting exercises. By no means should this be taken as an assessment of what would have actually happened had this or that variable behaved differently than it actually did, in which case we would run afoul of the Lucas Critique.

Overall, our results are in line with the existing literature: labor market institutions and technological factors are the main driving forces behind the changes in the LIS. Social security benefits, trade union power, taxes, capital accumulation, and technology have all contributed to shape the downward path of the LIS in Japan. However, in this standard context, we have uncovered a strong relationship between the continuous process of deunionization in Japan and the structural fall experienced by the LIS. With the falling productivity growth rates observed in Japan, weaker labor unions have allowed for the downward adjustment of real wages (Figure 1b above) that eventually led to the drop in the LIS. Akimoto and Sonoda (2009) place the progressive change in union behavior in the context of several major changes such as (i) demographic changes; (ii) economic changes (from a high growth to a stagnated economy); (iii) a structural economic shift towards service industries; (iv) globalization; and (v) socio-cultural changes leading from a 'mutual help' system based on public welfare programs, to a 'self-help' system where unions start taking a role of welfare providers (not receivers). In such a context, the 1990s remain a crucial period where the aging population became a concern, and there was a long-term recession in parallel with the acceleration of the globalization process. More precisely, Miura (2008) identifies the year of 1995 as a turning point in Japanese industrial relations, when the Nikkeiren (Japan Federation of Employer's Association) argued for a new Japanese management model, and a new government agency, 'the deregulation subcommittee', was created.[2] Our results show that the period of 1995 and onwards is when the deunionization process has had more influence in the falling LIS. All in all, the result of the deuniozation process has been a growing inability of unions to secure wage rates according to productivity growth.

The strong link between union power and the LIS in Japan stems from its idiosyncratic labor market. This close connection may have been hidden by the fact that more than 90% of Japanese unions are enterprise unions and the fact that Japan usually receives a low score on the standard measures of centralization on wage bargaining. However, as shown by Sakamoto (2004), wage settlements are highly coordinated and have made wage restraint relatively easy. "Japan did not suffer the latter [unemployment] because its system of decentralized but coordinated wage determination made it possible for employers and unions to achieve nationwide diffusion of wage restraint without confronting low-paid workers' demands for higher or solidaristic wages" [Sakamoto (2004), p. 423]. What our paper uncovers in this context, is not only the expression of this restraint in terms of a lower LIS, but the main channel through which this has taken place: the overall and progressive change in the system of labor relations which in our model is captured through the rate of union organization.

The paper is structured in two main sections. Section 2 presents a multi-equation macro model for the Japanese economy. Section 3 uses this model to disentangle the main causes behind the structural fall in the labor income share in Japan. Section 4 concludes.

[2] Along these lines, Sekiguchi (2005) states that "changes of labor relations in Japan are characterized as the decreasing rate of union membership, losing influence of Shunto or the spring wage offensive in industry-wide wage determination, and increasing number of non-regular workers such as temporary, part-time, and contract employees. It seems that the important choice has also been made at this level. That is, the nature of labor-relations in Japan is changing from collective labor–management relations to individual-based labor-management relations. This is also associated with the individualization and diversifications of employment practices" [Sekiguchi (2005), p. 99].

2 A macro model of the Japanese economy

2.1 Data and methodology

We use time-series macro data running from 1970 to 2008 obtained from the following sources: OECD Economic Outlook, the IMF International Financial Statistics (IFS), the Ministry of Finance of Japan, and the Statistics and Information Department of the Minister's Secretariat, Ministry of Health, Labour and Welfare. The definitions of the variables entering the chosen specifications of the equations are provided in Table 1.

Table 1. Definitions of variables and sources.

			Source:
n	:	total employment (log)	(1)
l	:	total labor force (log)	(1)
u	:	unemployment rate ($\simeq l - n$)	(1)
w	:	total real compensation per employee (log)	(1)
b	:	social security benefits (% of GDP)	(1)
τ^f	:	direct taxes on business (% of GDP)	(1)
gd	:	government debt (% of GDP)	(1)
d^{97}	:	dummy (value 0 up to 1997, 1 afterwards)	(1)
u_t^{d97}	:	$u_t * d^{97}$	
k	:	real capital stock (log)	(1)
kd	:	capital deepening ($= k - n$)	(1)
y	:	real GDP (log)	(1)
pr	:	real labor productivity ($= y - n$)	(1)
lis	:	labor income share [$= w - (y - n)$]	(1)
z	:	working-age population (log)	(1)
fi	:	firms' long-term indebtedness $\left(= \frac{\text{long-term borrowings and bonds}}{\text{assets}}\right)$	(2)
ro	:	unions, rate of organization $\left(= \frac{\text{membership}}{\text{employees}}\right)$	(3)
oil	:	real oil prices, yens per barrel (log)	(4)
t	:	time trend	
Δ	=	difference operator	

Sources: (1) OECD, Economic Outlook; (2) Ministry of Finance of Japan; (3) Ministry of Health, Labour and Welfare, Japan; (4) IMF-IFS.

Regarding the econometric strategy, we proceed as follows. First, we estimate each of the equations individually (we use Eviews and Microfit). Second, we estimate the selected specifications as a system. The resulting estimated multi-equation structural model is the one presented in Tables 2 to 5 and used in the simulation analysis. Third, we reparameterize the estimated equations as error correction models (ECM) to obtain the cointegrating vectors among the $I(1)$ variables (including standard errors for the long-run coefficients to check their significance in the long-run). Finally, we estimate these cointegrating relationships using Johansen's procedure to check whether the long-run relationships according to Johansen's method conform with those obtained through the estimation of the multi-equation structural model. Given that the four estimated equations contain growing variables, this is the right procedure to ensure a correct econometric outcome.

Although we start from the labor demand and labor force specifications presented in Agnese and Sala (2009), variations in the data (due to new data points and methodological changes) leads us to select updated specifications with slight changes in the explanatory variables (see below). All equations pass a standard battery of misspecification tests such as heteroskedasticity (HET) and conditional heteroskedasticity ($ARCH$) tests; a Lagrange multiplier test for serial correlation (SC); Ramsey's linearity test (LIN); and the Jarque-Bera test for normality (NOR). The latter is distributed as $\chi^2(2)$, the rest as $\chi^2(1)$. By means of the Cusum and Cusum^2 tests we also ensure that the estimated equations are structurally stable. The best specifications are selected on the basis of the standard selection criteria (Akaike and Schwarz Bayesian). These selected equations are then re-estimated as a system by Three-stage least squares (3SLS), so that the estimates are safe from endogeneity and cross-equation correlation problems.

To decide on the best specification of each equation we follow the Autoregressive Distributed Lagged (ARDL) or Bounds testing approach, developed in Pesaran and Shin (1999) and Pesaran *et al.* (2001). This procedure is helpful for different reasons. First of all, it yields consistent estimates, both in the short and long-run, irrespective of whether the underlying regressors are $I(1)$, $I(0)$, or fractionally integrated. This is important because the pretesting problem in the standard cointegration techniques of determining the degree of stationarity of the series can be avoided. These standard cointegration techniques are Johansen's maximum likelihood method (Johansen, 1991) and the Phillips-Hansen's procedure (Phillips and Hansen, 1990). Pesaran and Shin (1999) show that the ARDL is "directly comparable to the semi-parametric, fully-modified OLS approach of Phillips and Hansen (1990) to estimation of cointegrating relations". The second reason is that the ARDL can be reliably used in small samples to estimate and test hypotheses on the long-run coefficients. Pesaran and Shin (1999) show that the Phillips and Hansen's estimator is outperformed by the ARDL-based estimator, especially when having a relatively small sample period of analysis. They show, in particular, that using the delta method or Bewley's approach valid standard errors can be computed for the estimated long-run coefficients. Third, the ARDL yields consistent long-run estimates of the equation parameters under potential endogeneity of some of the regressors (Harris and Sollis, 2003). It is also important to note that the estimated ARDL equations can be reparameterized and expressed in terms of an ECM which, on its own, indicates cointegration of the variables in case the error correction term is negatively signed and significant.

2.2 Estimated equations

Next we present the estimated equations. Tables 2 to 5 show their estimated coefficients when estimated as a system by 3SLS. Table 6 shows the error correction term corresponding to the reparameterized equations; the implied cointegrating vectors when using the ARDL and Johansen's methods; and the likelihood ratio (LR) test checking whether these vectors conform statistically with one another, and thus the long-run relationships between the growing variables estimated in our models are not spurious.

2.2.1 Labor demand

The labor demand equation presents a strong inertia in the firms' aggregate level of employment, as shown by its persistence coefficient (0.87). It also presents the expected negative slope, as indicated by a short-run elasticity of employment with respect to wages of -0.06 and a long-run one of -0.46 $\left(=\frac{-0.06}{1-0.87}\right)$. These elasticities imply that a 1% rise of real wages would explain an overall reduction of employment by 0.46%.

Table 2. Labor demand. 1972-2008.

		cnt	n_{t-1}	w_t	pr_t	τ^f_{t-1}	kd_t	gd_t	fi_t	Δl_t
n_t	=	1.65	0.87	−0.06	0.06	−0.25	0.04	−0.02	−0.09	1.16
		[0.000]	[0.000]	[0.000]	[*]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

$s.e. = 0.001;\ LL = 210.19$

Structural stability tests (5% signif.):
Cusum: ✓; Cusum^2 : ✓
Misspecification tests (5% critical value):
SC$[\chi^2(1)]=\underset{[0.533]}{0.39}$; LIN$[\chi^2(1)]=\underset{[0.365]}{0.82}$; NOR$[\chi^2(2)]=\underset{[0.508]}{1.35}$; HET$[\chi^2(1)]=\underset{[0.138]}{2.20}$; ARCH$[\chi^2(1)]=\underset{[0.467]}{0.53}$.

Note: * restricted coefficient so that the coefficient on w equals the coefficient of pr (with the opposite sign).

Since the coefficients associated to the labor productivity and real wages are rather similar, a Wald test is run to see if they can be restricted to have the same value (and opposite sign). We fail to reject this restriction and thus conclude that both coefficients are statistically equal, suggesting that it is predominantly the LIS what determines employment. Karanassou and Sala (2010) obtain the same result in a slightly different context, adding to the robustness of this particular feature for the labor demand in Japan. Together with the labor productivity, the capital deepening (kd) variable is yet another important driver behind the employment decisions made by firms, with short and long-run elasticities of 0.04 and 0.31.

As for the direct taxation on firms' profits, the variable exerts a negative influence on employment. The estimated semielasticity indicates that a 1 percentage point (p.p.)

increase in this variable would explain a drop of 0.25 p.p. in employment in the short-run and 1.92 p.p. in the long-run. About this, Kuttner and Posen (2001) estimate the effects of fiscal policies for Japan using a structural VAR and find that a tax cut was an effective measure for stimulating the economy in the 1990s.

The public and private sectors are deeply intertwined in Japan. To account for this we should consider variables that reflect the intervention of government into the employment decisions of Japanese firms. On this, Phelps (1994) considers government expenditures and public debt as relevant determinants of the labor market performance. However, the direct effect of Keynesian fiscal policy (government expenditures) is not significant here, so it is taken out of the equation. As for the government debt (gd) it shows up with a negative and significant coefficient that represents the Japanese "burden of the debt" and the implied opportunity cost for the private sector.[3] This opportunity cost refers to the job destruction and jobs that fail to open due to central planning mismanagement (e.g. the "zombie firms" hypothesis examined in Ahearne and Shinada, 2005, and Caballero *et al.*, 2008). Short and long-run semi-elasticities are, respectively, -0.02 and -0.15.

Our labor demand equation entertains two additional variables. First, the firms' indebtedness variable (fi) which, as studied in Ogawa (2003), serves to evaluate the consequences of financial distress on employment (in particular, Ogawa examines several channels through which this variable affects the labor demand negatively). Here our model produces short and long-run semi-elasticities of -0.08 and -0.61. Second, the change in the available labor supply for firms (Δl), which provides with a source of interactions between the labor demand and supply (the unemployment rate in the labor force equation is the other source). This can also be seen as a matching effect, since job matches depend more on new entrants to the labor force than on its actual level. Accordingly, the more the new applicants, the greater the number of matches. The value of 1.15 for this coefficient implies that a 1% rise in Δl is fully translated into employment. This variable does not entail a long-run elasticity of employment with respect to the labor force since it is only expressed in differences.

This equation is an updated version of the one estimated in Agnese and Sala (2009), where more details are provided. The same applies to the labor force equation.

2.2.2 Labor force

Our labor force equation is very much in line to what is usually found in the literature. The adjustment coefficient (0.92) points to a high persistence in the households' behavior regarding labor supply decisions. Further, as shown by the real wages short and long-run

[3] The government spending and direct taxes on firms are generally in tight relation with the government debt of countries. However, the steep growth in the latter and its above-than-average extent for Japan during a great part of the period under analysis have little or nothing to do with the evolution of the first two variables.

elasticities of 0.03 and 0.37, the labor force is positively sloped.

Table 3. Labor force. 1972-2008.

		cnt	l_{t-1}	w_t	u_t	u_t^{d97}	Δro_t	Δro_{t-1}	Δb_t	z_t
l_t	=	-0.48	0.93	0.03	-0.75	0.15	-0.50	0.27	-0.67	0.07
		[0.000]	[0.000]	[0.000]	[0.000]	[0.018]	[0.000]	[0.010]	[0.001]	[*]

$s.e. = 0.003$; $LL = 174.59$

Structural stability tests (5% signif.):
Cusum: ✓; Cusum^2 : ✓
Misspecification tests (5% signif.):
SC$[\chi^2(1)]=\underset{[0.431]}{0.62}$; LIN$[\chi^2(1)]=\underset{[0.570]}{0.32}$; NOR$[\chi^2(2)]=\underset{[0.220]}{3.03}$; HET$[\chi^2(1)]=\underset{[0.405]}{0.69}$; ARCH$[\chi^2(1)]=\underset{[0.547]}{0.36}$.

Note: * restricted coefficient so that the long-run elasticity of l with respect to z is unity.

A discouragement effect is picked up by the coefficient of the unemployment variable (-0.75), but this is mitigated after 1997, as indicated by the dummy u^{d97} (from 1997 onwards the coefficient of u is -0.60=-0.75+0.15). Apparently, higher unemployment rates discourage people in their searching for new jobs and opportunities, leading to a reduced sensitiveness of the labor force to the growing unemployment problem. This stabilization in the participation rate is more pronounced after the East Asian crisis of 1997.

We also introduce institutional variables that might deter individuals from entering the labor market. These variables are the rate of organization of unions and the social benefits, yet enter the labor force equation only in differences.

Finally, the working-age population is the only growing driving-force of the labor supply and takes account of the important demographic influences on the Japanese labor market. For our data we cannot reject the hypothesis of a unit long-run elasticity (via Wald test) so the equation is restricted accordingly.

2.2.3 Real wage

Real wages are determined by three standard variables such as labor productivity, social security benefits, and union power.

The coefficient of the lagged endogenous variable (0.68) is not as large as in the previous equations of the system, implying that current wage decisions are not as much dependent on past decisions than employment and participation in the labor market.

As expected, the long-run elasticity of wages with respect to productivity is one implying that all productivity increases are eventually translated into wage increases (the Wald test could not reject this hypotheses, which was imposed and the equation accordingly reestimated).

As for the labor market institutions –or wage-push factors– it is important to stop on their definitions. First, as Fitoussi *et al.* (2001) we use social security benefits, which is a wider measure of the often used unemployment benefits. This allows us to control for the fact that the Japanese "government facilitates wage restraint by providing workers with welfare benefits that serve as the social wage, and also by socializing the risks of unemployment with public unemployment and unemployment benefits" [Sakamoto (2004), p. 441]. Second, to proxy the power of unions there is (i) the measure constructed by Fuess (2001), which is the share of the actual raise in wages over the raise demanded by unions; and (ii) the rate of organization, defined as the ratio between membership and total employees. Even though Fuess's (2001) measure is an interesting proxy, it covers the span 1960-1999, making it unfitting for our study. Nevertheless, in view of the dominant role exerted by the rate of organization in explaining the LIS movements, we hold Fuess conclusion that there is a misleading preconception that "labor unions in Japan are relatively docile, meekly submitting to managerial objectives" [Fuess (2001), p. 12].

Regarding the estimated coefficients of benefits and union power, both show the expected positive sign. Their short-run semi-elasticities are, respectively, 0.77 and 0.23, while long-run ones are 2.41 and 0.72.

Table 4. Real wage. 1972-2008.

$$w_t = \underset{[0.000]}{-0.33}\,cnt + \underset{[0.000]}{0.68}\,w_{t-1} + \underset{[\;*\;]}{0.32}\,pr_t + \underset{[0.000]}{0.77}\,ro_t + \underset{[0.204]}{0.23}\,b_t \qquad s.e. = 0.008;\; LL = 133.54$$

	cnt	w_{t-1}	pr_t	ro_t	b_t	
w_t =	-0.33	0.68	0.32	0.77	0.23	$s.e. = 0.008$; $LL = 133.54$
	[0.000]	[0.000]	[*]	[0.000]	[0.204]	

Structural stability tests (5% signif.):
Cusum: ✓; Cusum^2 : ✓
Misspecification tests (5% signif.):
SC[$\chi^2(1)$]=$\underset{[0.891]}{0.19}$; LIN[$\chi^2(1)$]=$\underset{[0.005]}{7.82}$; NOR[$\chi^2(2)$]=$\underset{[0.021]}{7.73}$; HET[$\chi^2(1)$]=$\underset{[0.087]}{2.93}$; ARCH[$\chi^2(1)$]=$\underset{[0.545]}{0.36}$.

Note: * restricted coefficient so that the long-run elasticity of w with respect to pr is unity.

2.2.4 Output

Output depends on the two standard production factors, capital and labor, oil prices, and a linear trend.

Regarding the effects of capital and labor, we systematically obtained coefficients close a situation of constant returns to scale (CRS). Since this hypothesis could not be rejected by a Wald test, we imposed the restriction of CRS. This resulted in short-run elasticities of 0.35 and 0.15 for labor and capital respectively, whereas these figures become 0.7 $\left(=\frac{0.35}{1-0.50}\right)$ and 0.3 $\left(=\frac{0.15}{1-0.50}\right)$ in the long-run. These values are in line with other studies

(Hayashi and Prescott, 2002, among others).

Table 5. Production function.

		cnt	y_{t-1}	n_t	Δn_t	k_t	oil_t	t
y_t	=	5.39 [0.000]	0.50 [0.000]	0.35 [*]	2.24 [0.000]	0.15 [0.000]	−0.007 [0.003]	0.005 [0.000]

$s.e. = 0.011;\ LL = 123.85$

Structural stability tests (5% signif.):
Cusum: ✓; Cusum^2 : ✓
Misspecification tests (5% signif.):
$\text{SC}[\chi^2(1)] = \underset{[0.762]}{0.92}$; $\text{LIN}[\chi^2(1)] = \underset{[0.301]}{1.07}$; $\text{NOR}[\chi^2(2)] = \underset{[0.111]}{4.41}$; $\text{HET}[\chi^2(1)] = \underset{[0.136]}{2.22}$; $\text{ARCH}[\chi^2(1)] = \underset{[0.619]}{0.25}$.

Note: * restricted coefficient so that the constant returns to scale hypothesis holds.

At this point we need to state that we do not intend to estimate the Japanese aggregate production function. First of all, because the capital stock series provided by the OECD Economic Outlook do not consider residential capital stock. Second, because we lack and appropriate global series for energy consumption or, on its absence, on energy prices, which we have proxied by the real oil price. Finally, because we follow the common practice of capturing technological change through a linear time-trend. We obtain a good approximation of output through its standard determinants and we value the fact that this allows us to study the different components of the LIS. In any case, and from a theoretical point of view, a time-varying LIS can emerge in a situation of CRS provided there is imperfect competition in the product market (for a discussion on these issues see Raurich *et al.* 2010).

2.3 Model diagnosis

To further check the validity of the estimated model we perform two controls. First, we test validity of the long-run relationships implied by our estimated cointegrating vectors by contrasting whether they conform with those that would be obtained following Johansen's procedure. Second, we check whether our model allows us to track the actual trajectories of the endogenous variables.

Regarding Johansen's procedure, the maximal eigenvalue and trace statistics indicate that the variables involved in the equations are cointegrated. We thus estimate a VAR featuring the main characteristics of the estimated equations (in terms of variables, lag order, sample period, and inclusion, or not, of trends) and obtain the cointegrating vectors (CVs) for the four equations in the model. Table 6 shows these CVs resulting from the ARDL estimated specifications, and those obtained through Johansen's method.[4] A likelihood ratio (LR) test, distributed as a $\chi^2(q)$ where q is the number of restrictions, restricts Johansen's CVs to take the corresponding ARDL values. Since none of these restrictions can be rejected at conventional critical values, it is confirmed that our estimates deliver the correct long-run relationships between growing variables. Note, also, that the ECM coefficients turn out negative and significant in all cases, thereby providing an extra indication of cointegration.

Table 6. Validity of the long-run relationships.

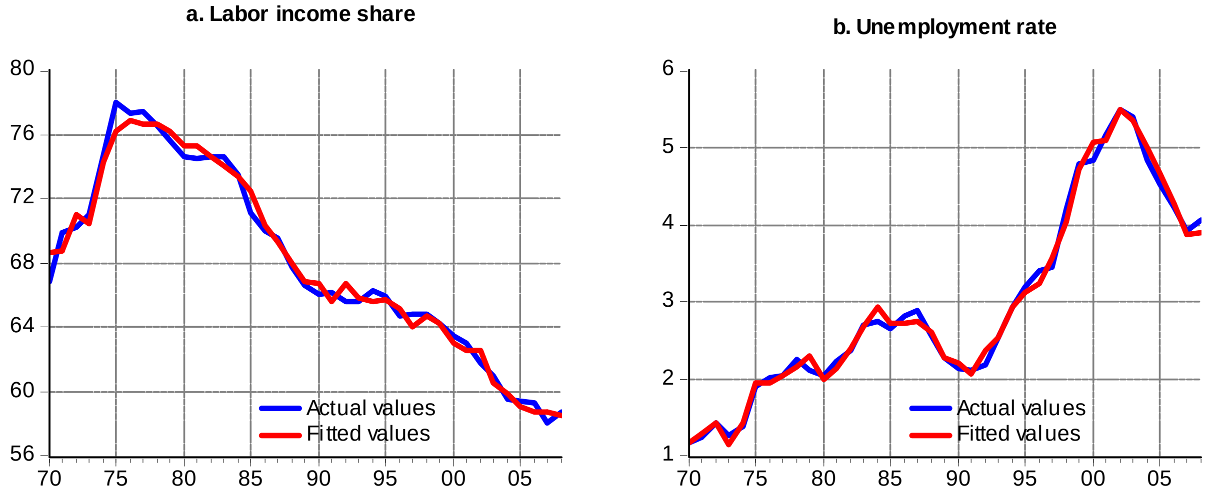
	ARDL		Johansen		LR test
	ecm_{t-1}	CV	r	CV	
$[LD]$	-0.14 [0.000]	$\begin{pmatrix} n & w & pr \\ 1 & -0.50 & 0.50 \end{pmatrix}$	1	$\begin{pmatrix} n & w & pr \\ 1 & -0.52 & 0.30 \end{pmatrix}$	5.37 [0.068]
$[LF]$	-0.07 [0.029]	$\begin{pmatrix} l & w & z \\ 1 & 0.49 & 1 \end{pmatrix}$	1	$\begin{pmatrix} l & w & z \\ 1 & 0.20 & 1.38 \end{pmatrix}$	2.51 [0.285]
$[WS]$	-0.39 [0.000]	$\begin{pmatrix} w & pr \\ 1 & 1 \end{pmatrix}$	1	$\begin{pmatrix} w & pr \\ 1 & 0.71 \end{pmatrix}$	1.92 [0.166]
$[PF]$	-0.47 [0.000]	$\begin{pmatrix} y & n & k & t \\ 1 & 0.71 & 0.29 & 0.009 \end{pmatrix}$	1	$\begin{pmatrix} y & n & k & t \\ 1 & 0.79 & 0.25 & 0.010 \end{pmatrix}$	2.97 [0.397]

Notes: CV = cointegrating vector; r = number of CVs; p-values in parentheses;
5% critical values for the LR test: $\chi^2(1) = 3.84$; $\chi^2(3) = 7.82$;
LD is labor demand, LF is labor force; WS is wage-setting; PF is production function.

The second control consists in checking that the model delivers accurate fitted values. As shown in Figure 2, our four-equation model tracks the actual evolution of the LIS and the unemployment rate at a close range. Note that unemployment is generated as $(l_t - n_t) * 100$, while the LIS is computed as $\exp[w_t - (y_t - n_t)]$. In this way, the presented fitted values reflect all the endogenous variables in the model, and their interactions, and are representative of the overall fit of the model.

[4] These tests are conducted using the restricted estimates of all equations taken from their individual regressions, so they are not exactly the same as the long-run coefficients that would be drawn from the joint estimation (Tables 2 to 5). Note, also, that underlying this table there is sizable information (on the unit root tests and the whole cointegration analysis using Johansen's method), which is available upon request.

Figure 2. Actual and fitted values.



3 Causes of the fall in the labor income share

We use the estimated macro model to compute the *dynamic contributions* of all the exogenous variables in the model. The dynamic contribution of a variable informs on the extent to which the evolution of that variable has affected the trajectory of the endogenous variable in some selected period of analysis. For its computation, we simulate our model in two scenarios. In the first one, the exogenous variable takes its actual values. In the second one, the time-series of that variable is fixed at the beginning of the period. Because these two simulations only differ in one respect –the trajectory of the selected exogenous variable– comparison of the two predictions regarding the endogenous variables will give us information on the influence of that particular trajectory. And given that this contribution is obtained from a dynamic simulation (across the selected period of analysis, and by taking into account all lagged and spillover effects contained in the model), its outcome is called a dynamic contribution.[5]

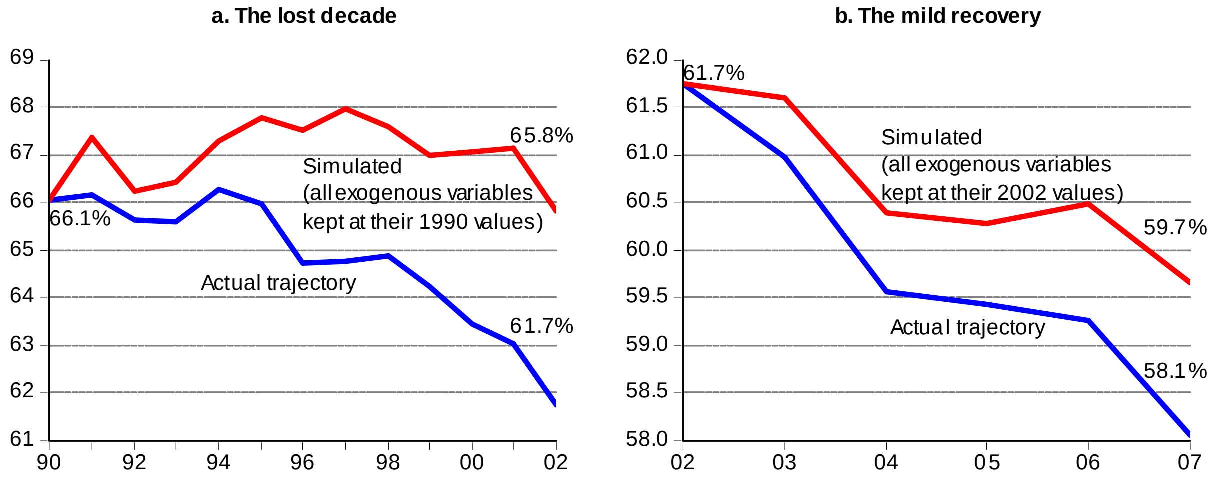
To illustrate how relevant a contribution is to explain the actual evolution of the endogenous variables, we plot together the actual trajectory of the labor income share and the simulated one had each exogenous variable under scrutiny remained fixed at its value in the initial period (see Figures 4 to 8). We distinguish two periods: (i) the lost decade, going from 1991 –when the unemployment rate was 2.1%– to 2002 –when it reached a historical maximum of 5.5%–; and (ii) the mild recovery of years 2003-2007, when the unemployment rate fell to 3.9%. To account for the facts during these periods, we 'fix' the economy at 1990 and 2002, respectively. Note that the actual value of the LIS is retrieved from $\exp[w_t - (y_t - n_t)]$.

Our first exercise consists in fixing all the exogenous variables in the model at their 1990 and 2002 values (Figure 3). Had they remained at their situation before the start of

[5] Karanassou and Sala (2009) provide the analytical development of such analysis.

the lost decade, the LIS would have stayed roughly constant throughout the period, going from 66.1% in 1990 to 65.8% in 2002 (Figure 3a). On the contrary, its actual trajectory was downward until reaching 61.7% in 2002. Thus, the model is able to explain a fall of 4.1 percentage points (pp) –from 65.8% to 61.7%– which is 93% of the actual decline of 4.4 pp.

Figure 3. Joint dynamic contributions.



During the mild recovery, the LIS fell more intensively, by 3.6 pp in just 6 years, from 61.7% to 58.1%. In this case, the model explains 1.6 pp of this fall (from 59.7% to 58.1%), which is less than half its actual decline. Next we decompose this decline on its various sources according to our estimated model.

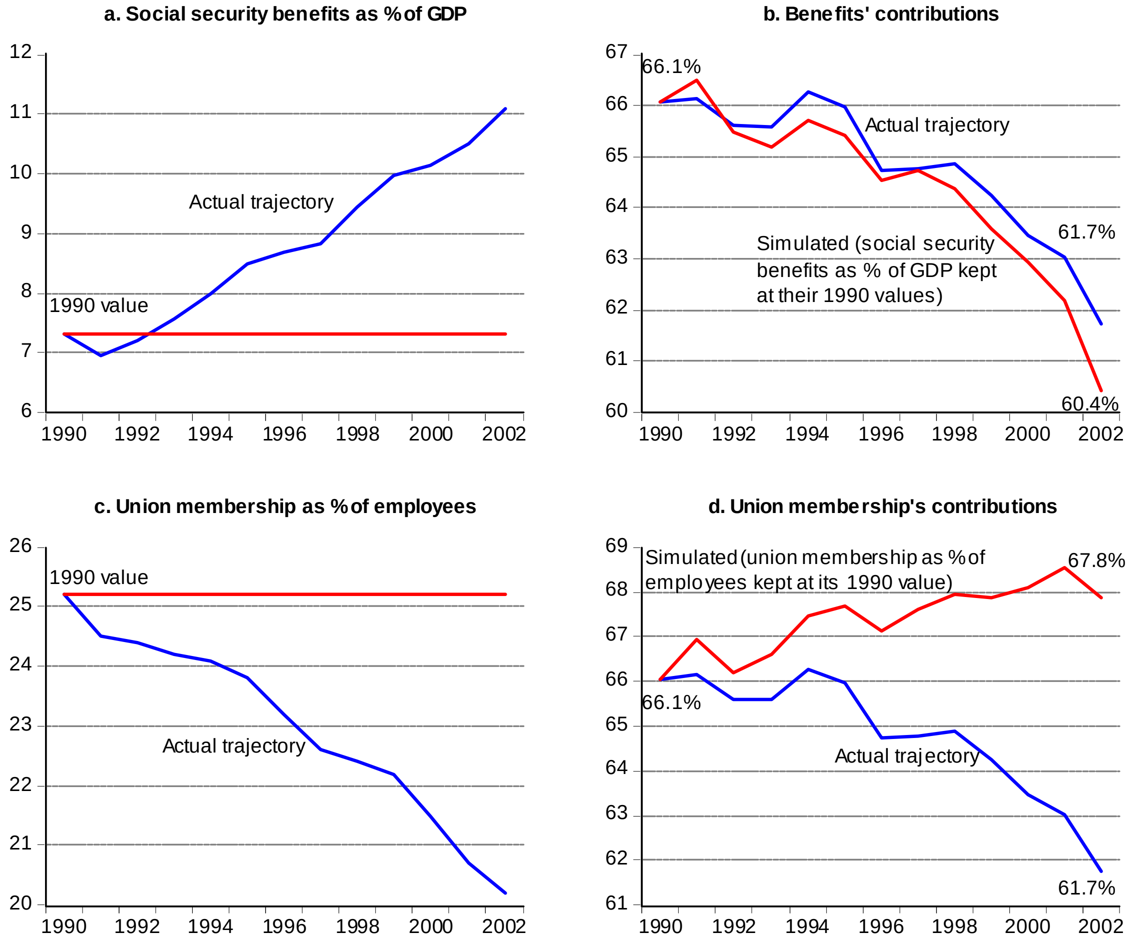
3.1 The lost decade: 1991-2002

The model has ten exogenous variables, some of which have had little influence on the evolution of the LIS. The most surprising one is government debt, which is crucial to explain the evolution of employment –and thus of unemployment–, but it is found irrelevant as determinant of the labor share. The evolution of oil prices and working-age population is also innocuous to the LIS.

With respect to the rest of the variables, we have grouped them into those related to labor market institutions (Figure 4), capital and technological factors (Figure 5), and other variables determining firms' operational environment (Figure 6).

Regarding the first set, we observe two important phenomena. On the first hand, Social Security benefits increased by 3.8 pp, from 7.3% in 1990 to 11.1% in 2002. This evolution, which implies income transfers to the society, contributed to raise the LIS by 1.3 pp during this period. In other words, had benefits remained at 7.3% throughout these years, the LIS would have decreased by 1.3 extra percentage points reaching 60.4% in 2002. When discussing the role played by the welfare regime in Japan in relation to the macroeconomic policy and wage coordination, Sakamoto (2004) argues that the government can be seen as the source for wage restraints in providing with welfare benefits that serve as some form of social wages.

Figure 4. Labor market institutions, 1990-2002.



On the second hand, union membership fell steadily from 25.2% to 20.2%. These 5 pp decrease were the major source under the declining path of the LIS during those years. Had union membership not decreased by a fifth, the LIS would have risen to reach 67.8% in 2002. In other words, the steep fall in union membership has contributed to reduce the LIS by 6.1 pp. It is also important to note that, within the lost decade, this contribution is especially relevant during the second part of the 1990s as indicated by the growing divergence between the actual and simulated trajectories of the LIS (Figure 4d). This may be reflecting the ability of unions to initially cope with the adverse situation brought by the 1990s (Benson and Debroux, 2000), and the consequences of the aggravated position of unions from 1995 onwards, as described by Miura (2008). In a context of weaker unions, among other things, managers responded to the economic downturn by “shifting the key wage criteria from age to seniority; and by introducing an increasingly dominant skill component into wage composition" [Benson and Debroux (2000), p. 114]. In any case, this reduction in the LIS, which would be surmountable in an expansionary context, worsens as a problem when the economy grinds to a halt, like Japan during the 1990s, or even moves back as in the aftermath of the East Asian crisis of 1997 when Japan's GDP growth was negative for two consecutive years (1998 and 1999) for the first time in more than twenty years.

The crucial role of unions in explaining the evolution of the LIS is consistent with their traditional ability to increase labor income. According to Fuess (2001), and his developed measure of union power is specially suitable for making this judgement, trade unions in Japan have consistently "been able to secure its pay demands more than halfway. Furthermore, company unions have been quite willing to press for aggressive pay hikes. Frequently unions accelerated demands from the previous year and were able to realize increased bargaining leverage" [Fuess (2001), p. 12]. In this context, the progressive deunionization witnessed in last decades may be a crucial factor deterring this ability. A growing percentage of company unions are becoming weaker as they are progressively endorsed by a smaller percent of the firm manpower. This is hurting, at the aggregate level, the capacity of wages to trail productivity and, therefore, since this is a structural phenomenon, it leads to a continuous fall in the LIS. This important result is a reflection of the overall change experienced by Japan in the labor relations system in last decades. Different appraisals of this process are provided in Akimoto and Sonoda (2009), Benson and Debroux (2000), Miura (2008), Sakamoto (2004), Sekiguchi (2005), and Takeshi (2001).

Figures 5a and 5b show the trajectories of capital accumulation and capital deepening. The growth rates of capital stock display a clear downward tendency, which is not apparent in capital deepening due to the underlying deceleration in job creation, which in some particular years is larger than the one in capital accumulation. The joint contribution of these variables is plotted in Figure 5c. Note that had the growth rates of capital stock and capital deepening remained constant at their 1990 levels, the labor share would have been 1 pp lower. Thus, the deceleration in capital accumulation had a significant upward influence on the labor share (this 1 pp is equivalent to almost 25% of the period's fall). Accompanying the effect of capital accumulation on the LIS, another important effect is determined by the time trend, which is a measure representative of the technological change, and contributed to a 1.0 pp reduction.

It should be stated that the exact counterbalancing effect of capital accumulation and technology is just a particular feature of the lost decade. Although the existence of this trade-off is an interesting feature of our analysis, further research should aim at endogenizing technological change. Existing literature (Bentolila and Saint-Paul, 2003;

Bental and Demouguin, 2010, for example) explains that the labor share may shift in response to changes in factor productivity and the labour-capital ratio, which are driven by technological progress and the relative price of each production factor. In turn, this relative price is directly affected by product and labour market policies.[6] In the context of this variety of factors, which are indeed featured in our model, our finding needs to be understood as the short- and medium-run consequence of the deceleration in capital stock growth. In the long-run, and as a consequence of technological progress, returns to capital tend to increase thereby accruing the share of capital income. In turn, in seeking to maintain competitiveness, the product and labour market policies generally undertaken have tended to weaken the bargaining position of labor *vis-à-vis* the firms.

Figure 5. Capital accumulation and technology, 1990-2002.

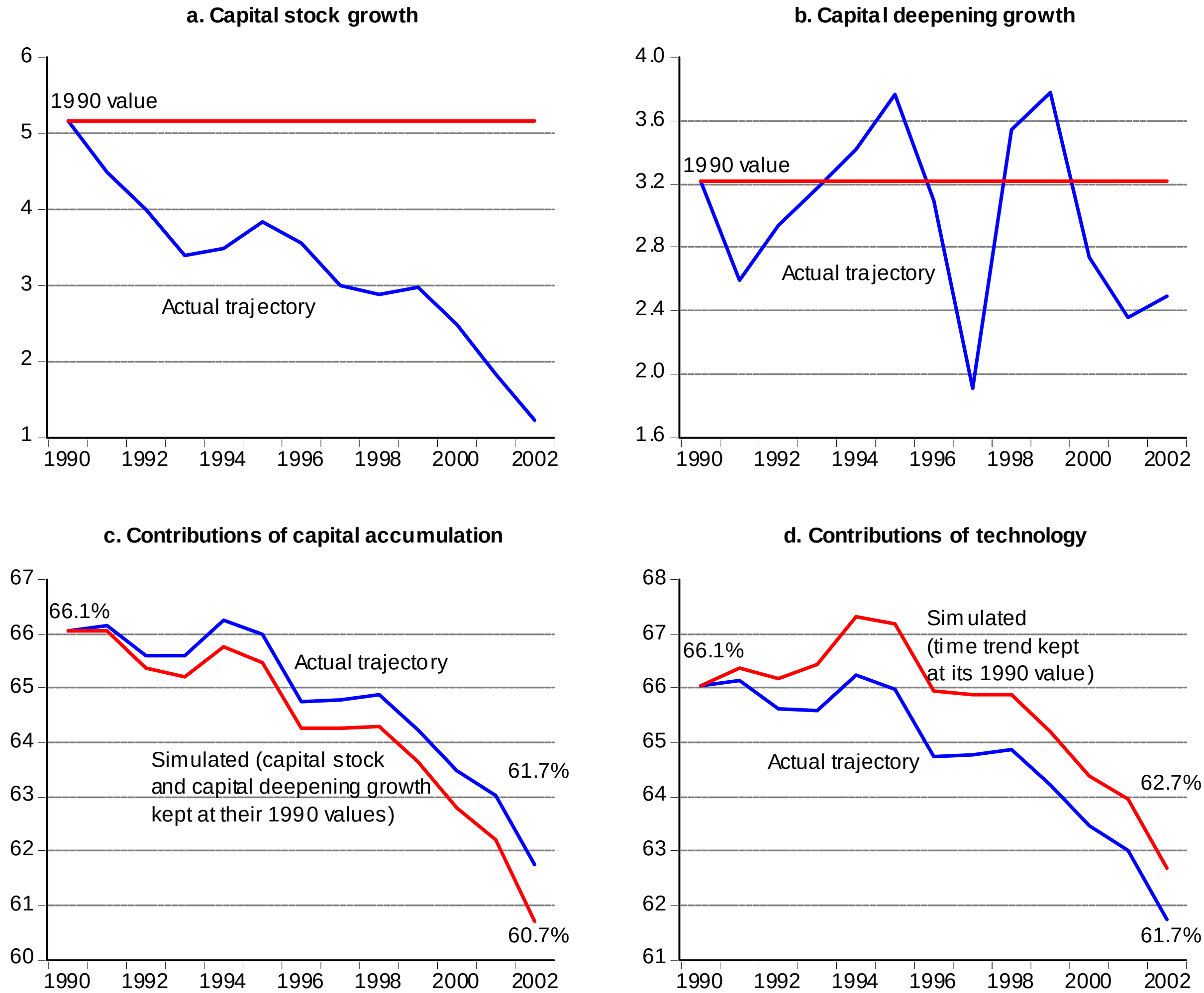
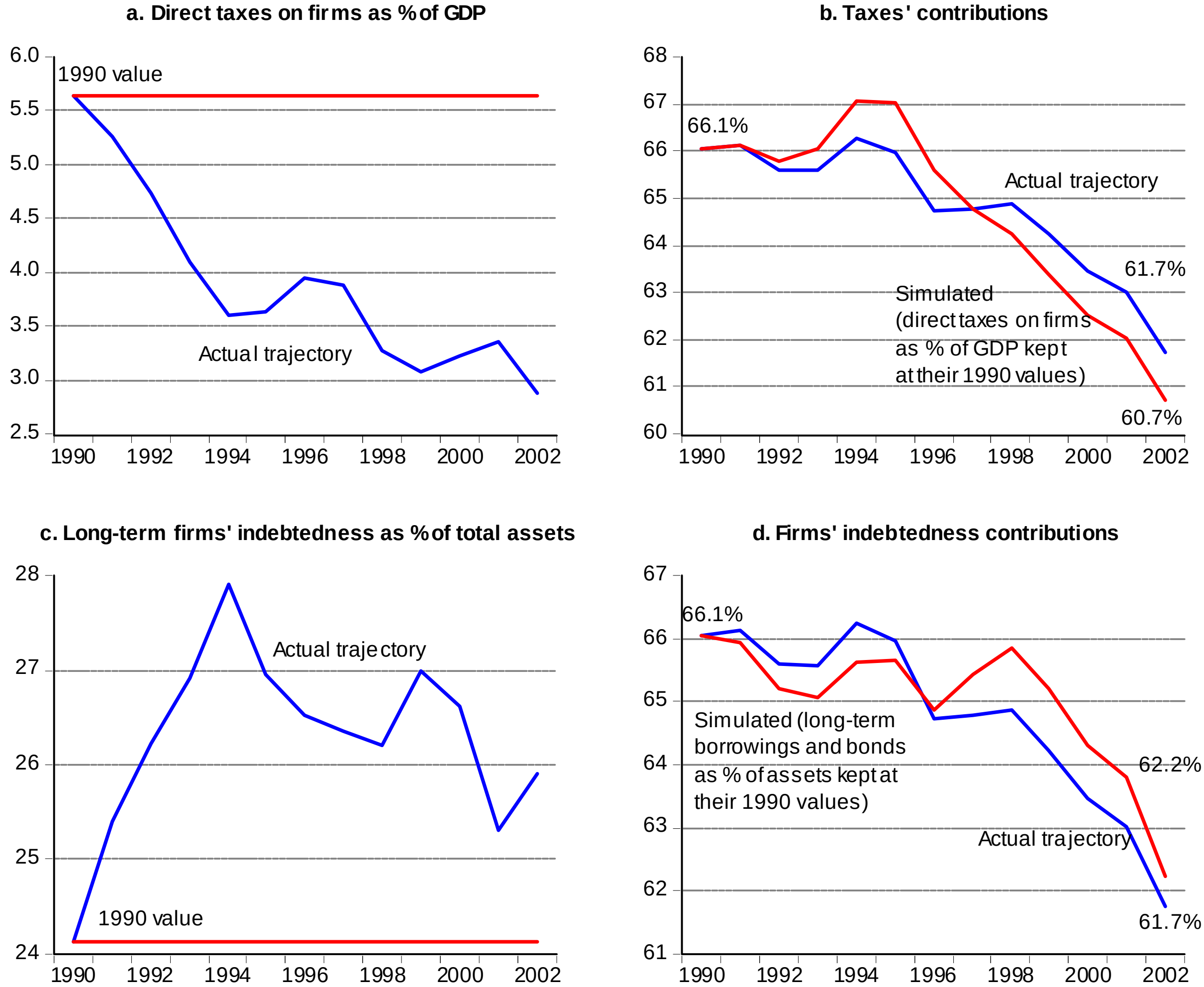


Figure 6 shows the influence of two variables related to the environment in which firms operate. Direct taxes on firms decreased by almost 3 pp, from 5.6% of GDP in 1990 to 2.9% in 2002 (Figure 6a), while financial indebtedness surged with the crisis (Figure 6c).

[6]The extent to which these changes affect factor productivity and the labour-capital ratio crucially depends on the elasticity of substitution between labour and capital (see Raurich *et al.* 2010).

The reduction of the tax burden for firms had a large positive impact, of 1.0 pp, on the evolution of the LIS. This variable may exert a two-sided effect. On the one hand, the more the firms are taxed the more income is redistributed throughout the system. On the other hand, higher tax revenues obtained from firms reflect larger profits. Empirically, the collapse of this variable during the lost decade seems to be reflecting the worsening of the firms' situation in terms of their profitability. In this context, the reduction in direct taxes on firms alleviated their situation so that the falling tax burden contributed to raise their share of the pie.[7] On the contrary, the growing indebtedness of firms, on account of the larger pressure they had to face to become profitable and thereby obtain a larger share of the pie and reduce their indebtedness, contributed to reduce the labor income share by 0.5 pp.

Figure 6. Firms' environment.



The contribution of government debt goes in the same direction than firms' indebtedness, but it is smaller (-0.3 pp), just as the ones of population and oil prices which are

[7] Our results are compatible with those in Kuttner and Posen (2001), who find that a tax cut was an effective measure for stimulating the economy in the 1990s, until the tax burden increase in 1997.

even tinier.[8] The scarce relevance of government debt in explaining the fall in the labour share is in stark contrast with its major role in accounting for the unemployment upsurge in those years. The possibility of distinguishing these different effects is a strength of our dynamic multi-equation analysis.

3.2 The mild recovery: 2003-2007

Our second simulation deals with the "half-way" recovery experienced by the Japanese economy during 2003-2007. Figure 7 shows the effects of the labor market institutions on the downward trend of the LIS. While the social security benefits show no effect whatsoever on the LIS, deunionization is again, and by large, the strongest force behind the changes in the LIS. In this second simulation though, its contribution is somewhat less important when compared to the actual change in the variable (a -2.0 p.p. contribution relative to the -3.6 p.p. fall in the LIS), yet is almost the same in terms of the contribution through time.[9] Some channels through which the decline in union power has translated into a lower LIS are the losing influence of Shunto and the changes in corporate management strategies. Between 1998 and 2006 the wage level negotiated at the spring offensive declined (Miura, 2008) and the spring offensive itself has by now collapsed. There has been also a growing gap between the salaries of employees and directors, at the same time that dividends have rapidly risen and shareholders have increased their share of profits. Finally, along with the globalization process and the shift towards service industries, the amount of small-business employees and self-employed workers arose conforming a dualistic structure of welfare recipients (Sakamoto, 2004).

All these changes seem to confirm Takeshi's (2001) prediction on the increasingly weakened position of unions: "Although long-term stable employment practices are not likely to be changed drastically in the foreseeable future, it is highly likely that the seniority system will be further eroded, wage differentials will widen, terms of employment and working conditions will become individual-specific, and remuneration systems will be diversified. However, labor unions are falling to find ways of coping with these prospects, and are continuing to lose influence" [Takeshi (2001), p. 225]. Our paper unveils the consequences of these recent developments on the continued fall in the LIS, even when the economy showed some indications of recovery.

On top of these developments, there is a larger segment of irregular workers (part-time, temporary, and contract workers) with the particularity that "non-regular workers usually suffer from poor working conditions and are left unprotected and outside of the union organizations" [Sekiguchi, (2005), p. 99]. Sakamoto (2004) also remarks that low-

[8] Given their scarce relevance, the corresponding figures are not shown. They are available upon request from the authors.

[9] Recall that during the 12-year period from 1991 to 2002 the contribution of labor unions to the change in the LIS amounts to 6.1 p.p., whereas in the 5 year period between 2003 and 2007, it is 2 p.p.

paid irregular workers have lacked the proper channels of influence to effectively make high wage demands. Thus, not only are unions losing their strength, but now a larger segment of the labor market is beyond their covering umbrella. It should be mentioned at this point that our model does not control for the growing heterogeneity within employees. This may be one of the reasons why during this period of mild recovery we are unable to explain a larger percentage of the fall in the LIS.

Figure 7. Labor market institutions, 2002-2007.

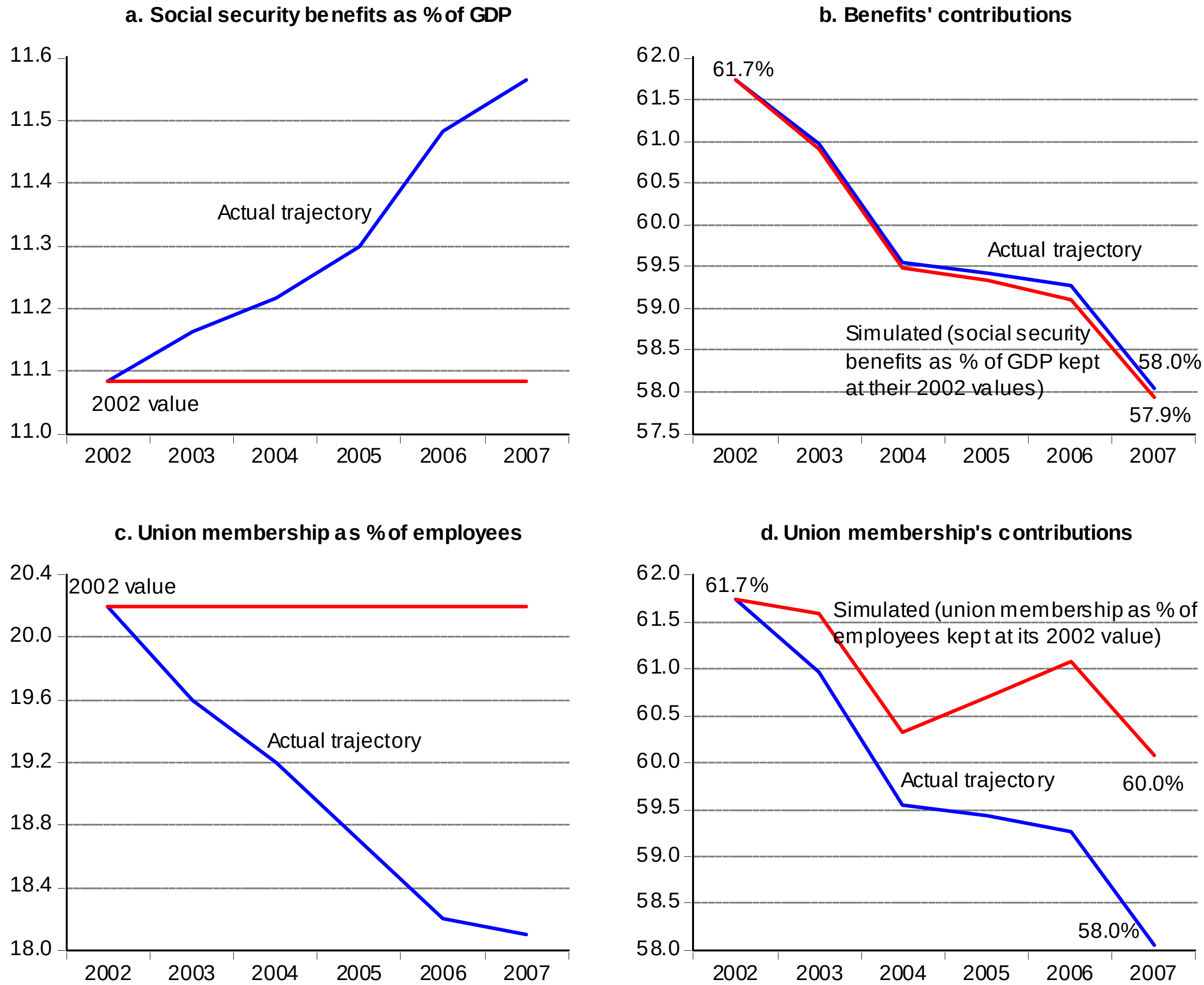
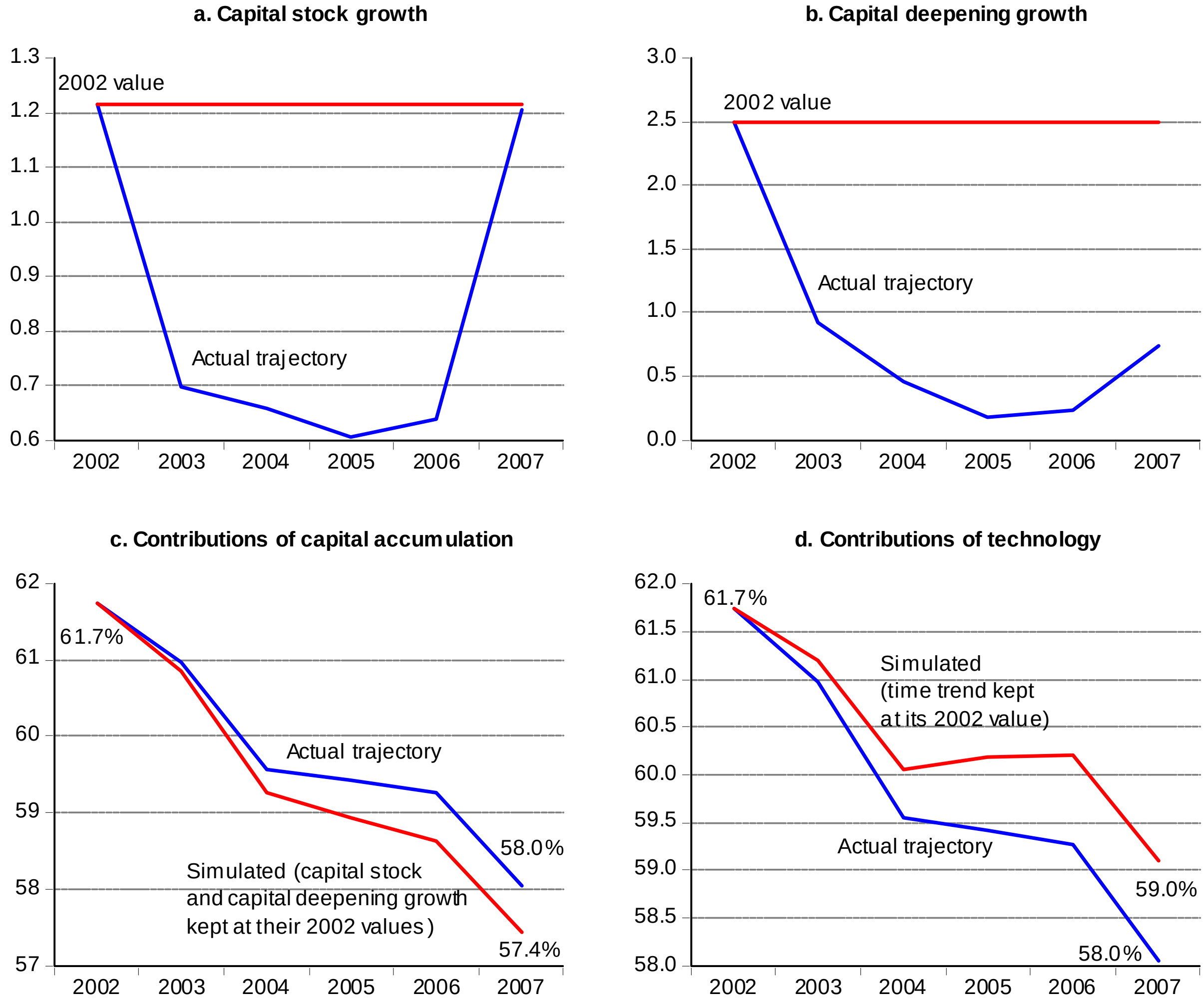


Figure 8 exhibits the contributions of technology-related variables. Technological change shows again a significant contribution (-1.0 p.p., as before) to the drop in the LIS (Figure 8d). Notice that, although the absolute impact of this factor is the same, its relative influence is larger (with respect to the smaller fall in the LIS) and more intensive (given the shorter period under scrutiny). We believe this reflects the changes witnessed in the recent decades in terms of an increased openness, both as regards trade in final and intermediate goods and services (but especially goods). On the other hand, we should stress the offsetting force of lower growth rates of capital accumulation (Figures 8a and 8b) which avoided a lower LIS to have occurred otherwise (in numbers it is a 0.6 p.p.

contribution, as seen in Figure 8c). Indeed, due to its increased openness in later years, Japan might have been more vulnerable to external shocks as has been the case with the 1997 crisis.

Figure 8. Capital accumulation and technology, 2002-2007.



4 Conclusions

We estimate a multi-equation macro model of the Japanese economy containing labor demand, labor force, wage, and output equations. This model allows us to approximate the actual pattern of the LIS in recent years, although self-employment income is left out from the analysis. We believe that future research on the effects of the different types of employment and the evolution of the LIS are certainly to be encouraged. This would further enlighten the connection between the falling LIS in Japan and the overall change in the labor relations system. The emergence of irregular work, for example, seems to be playing a role that our analysis was unable to deal with.

The crucial feature of our approximation is that it places us in a convenient position to conduct the analysis of the determinants of the LIS from a disaggregated perspective. The fact that the estimated model is able to provide a faithful replication of the trajectory of the endogenous variables supports the reliability of our findings. For the lost decade our set of exogenous variables explains 93% of the fall in the LIS, and for 2003-2007 it explains 44%.

Although most of the exogenous variables of the model matter to some extent, the main finding of our analysis is the key role played by the deunionization process. Since 1990, the falling rate of union organization accounts for 8 percentage points of the decline in the LIS. Our conclusion is that this structural decline, which is common to most advanced economies, in Japan cannot be explained without considering the loss of power progressively experienced by the trade unions in the past few decades. No other single factor is as relevant as to explain why wages have been systematically trailing productivity.

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