Extensive vs. Intensive Margin in Japan

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Abstract

This paper studies the role of extensive and intensive margins of labor adjustment over business cycle in Japan. We find that the intensive margin accounts for much of total hours worked variation, and its contribution to the fluctuation of total hours worked is about 77%. This result is in sharp contrast with those in the U.S. and European countries where the extensive margin mainly accounts for the overall variability in total hours worked. The implication of a recent rise in non-regular employment for firms' labor adjustment behavior is also discussed.

Keywords: intensive and extensive margins, labor adjustment, Japanese labor market

JEL classification: C10, E32, J23

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1 Introduction

Over the business cycle, firms adjust their labor input by changing hours per worker (the intensive margin) and the number of workers employed (the extensive margin). The variation in labor input may arise as a result of variation in the intensive margin, variation in the extensive margin, or some combination of the two. This suggests that, in order to understand cyclical fluctuations in the labor market, it is important to study how much of cyclical fluctuations in hours worked can be accounted for by variations in intensive and extensive margins.[1] In the recent literature, a number of studies examine how labor inputs are adjusted over business cycles in the U.S. and European countries (Krause and Lubik, 2010; Merkl and Wesselbaum, 2011; Ohanian and Raffo, 2012). However, less attention has been placed in the Japanese labor market. It is well known that the long-term employment system in Japan tends to be associated with a strong commitment by employers to hoard labor during recessions. This suggests that much of the labor adjustment over business cycle is made through the intensive margin rather than the extensive margin.

The purpose of this paper is to study the contribution of the intensive and extensive margins to the cyclical fluctuations in total hours worked in Japan. Decomposing the variation in total hours worked, we find that 23% of the overall variation is accounted for by the variation in employment, while 77% is due to the variation in hours per worker. Thus, the intensive margin accounts for much of cyclical variations in total hours worked. This result is in contrast with the U.S. empirical evidence on labor adjustment in which the majority of labor adjustment takes place along the extensive margin.[2]

We also examine the implications of a rise in non-regular work for firms' labor adjustment behavior, which is one of the most important phenomena in the recent Japanese labor market.[3]

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[1]Changes in the relative rates at which labor input is adjusted through the extensive margin drive unemployment dynamics. Recently, a number of papers study the cyclical unemployment dynamics in Japan. See Miyamoto (2011) and Lin and Miyamoto (2012).

[2]Krause and Lubik (2010) find that 33% to almost 50% of the variation in total hours worked is due to the variation in hours per worker. Merkl and Wesselbaum (2011) demonstrate that the extensive margin accounts for 93.3% in Germany and 85.4% in the U.S.

[3]See Rebick (2005), Esteban-Pretel et al. (2011) and Genda et al. (2012) for the definition and description of both regular and non-regular employment in Japan.

Since firms can adjust their labor demand by controlling the number of non-regular workers with lower adjustment cost, It could be expected that firms rely less on the intensive margin and more on the extensive margin. We however find a somewhat surprising fact that Japanese firms continue to use the intensive margin more than the extensive margin even in the periods when non-regular workers increase.

The facts established in this study provide important implications to researchers who are interested in the Japanese labor market or in the international comparison of labor markets. Furthermore, our empirical results provide a guideline of the empirical features that theoretical models should ideally have.

2 Data and Empirical Analysis

We construct a measure of total hours worked (T) by using the average monthly hours worked per worker (H) and the number of employed workers (N). The total hours measure is scaled by dividing the labor force (LF). We obtain the number of employed workers and the number of the labor force from Labour Force Survey (LFS), conducted by the Statistics Bureau and the Director-General for Policy Planning. The average monthly hours worked per worker comes from Monthly Labour Survey conducted by the Ministry of Health, Labour and Welfare. All series are seasonally adjusted using the Census Bureau's X12 ARIMA procedure and transformed by taking natural logarithm. Our data are quarterly, which, if necessary, are obtained by simple averaging of monthly data. The sample covers 1970Q1-2012Q2. Logarithmic transformations of total hours worked and its components are denoted by lower case letters. Thus, the total hours worked are defined as

$$t_t = h_t + n_t.$$

Since our focus is on the cyclical fluctuations in hours and employment, the low-frequency movements in the data are filtered out by using a Hodrick-Prescott (HP) filter with smoothing parameter of 1600.

Figure 1 plots the filtered total hours worked series and its components. Figure 1 shows that total hours worked and its components fluctuate significantly over business cycles and they are pro-cyclical. Both hours per worker and employment display co-movement with total

3

hours worked. In the recessions 1991-1993, 1997-1999, 2008-2009, hours per worker contributed more to the variation in total hours worked, while the recession from 2000-2002, both hours per worker and employment were important.

Table 1: Measures of hours worked

	t	h	n
Standard deviation (%)	1.05	0.89	0.46
Correlation matrix			
t	1	0.90	0.53
h	-	1	0.10
n	-	-	1

Note: total hours worked (t) is constructed as the product of hours worked per worker (h) and employment (n), normalized by the size of labor force, and transformed by taking logarithm. Standard deviations are in percentage terms. All series are filtered out by using a HP-filter with smoothing parameter 1600. Sample covers 1970Q1-2012Q2.

Table 1 reports statistics for total hours, hours per worker, and employment. Since the series are in natural logarithms, the standard deviations can be interpreted as mean percentage deviations from trend. The standard deviation of total hours worked is 1.05 percent, that of hours per worker is 0.89 percent, and that of employment is 0.46 percent. This implies that a large part of the volatility in total hours can be attributed to movement in hours per worker, that is, the intensive margin. There is the strong positive relationship between total hours worked and hours per worker. The correlation between them is 0.90. We can also see the positive relationship between total hours and employment, which have a correlation of 0.50. The correlation between hours per worker and employment is 0.10. This indicates that firm adjusts labor inputs in the same direction over business cycles, but it is not strong.

We now study the relative importance of the intensive and extensive margins to the cyclical fluctuations in the total hours worked. The variance of the total hours worked can be obtained
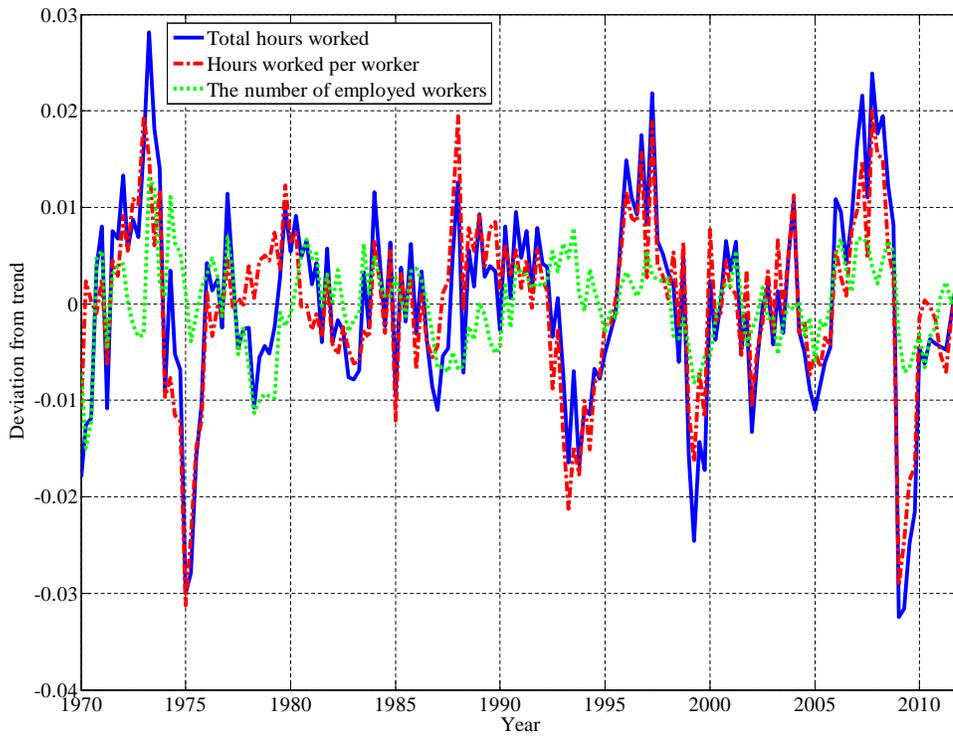
4

Figure 1: Total hours worked and its components. *Note*: The solid line indicates the cyclical component of total hours worked. The dash-dotted line indicates the cyclical component of hours worked per worker. The dashed line indicates the cyclical components of employed workers. The cyclical components are obtained by using the HP-filter with smoothing parameter 1600. Sample covers 1970Q1-2012Q2.

as

$$Var(t_t) = Var(h_t) + Var(n_t) + 2Cov(h_t, n_t)$$
$$= Cov(t_t, h_t) + Cov(t_t, n_t). \tag{1}$$

The term $Cov(t_t, h_t)$ gives the amount of variation in t_t that derived from variation in h_t and through its correlation with n_t. Similarly, the term $Cov(t_t, n_t)$ is the amount of variation in t_t that derived from variation in n_t and through its correlation with h_t. By dividing (1) by $Var(t_t)$, we have

$$1 = \frac{Cov(t_t, h_t)}{Var(t_t)} + \frac{Cov(t_t, n_t)}{Var(t_t)}$$
$$= \beta^h + \beta^n.$$

Note that β^h and β^n are equivalent to the concept of beta in finance, and they are the relative contributions of variance in h_t and n_t to the total variation in t_t.[4]

Table 2: Decomposition of labor input adjustment

	β^h	β^n
Full sample	0.77	0.23
1970Q1-1999Q4	0.77	0.23
2000Q1-2012Q2	0.76	0.24

Note: See text for definitions of β^h and β^n. Full sample covers 1970Q1-2012Q2.

Table 2 reports the beta values. We find that the intensive margin is more important than the extensive margin. While the extensive margin accounts for 23% of variation in total hours worked, the intensive margin explains 77% of variation in total hours worked. Our results show that over business-cycles, Japanese firms adjust labor inputs in the same direction both along intensive and extensive margins, but they use the intensive margin more than the extensive margin to adjust labor inputs. This result is in contrast with what we observed in the U.S., where the majority of labor adjustment happens along the extensive margin.

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[4]Fujita and Ramey (2009) and Petrongolo and Pissarides (2008) use the concept of the "beta values" to quantify the contribution of inflow and outflow rates to unemployment dynamics.

One of important changes that are taking place in the Japanese labor market is an increase in non-regular employment. The proportion of non-regular workers to total employed workers increases from 15.3% in 1984 to 34.4% in 2010. Thus, recently, the proportion of non-regular employment reached one-third of employment as a whole in Japan. The rise in non-regular work may shifts the burden of labor input adjustment from hours to employment in response of adverse output shocks. We now study how the rise in non-regular work affects the adjustment behavior of Japanese firms by dividing the sample period into 2 sub-samples, based on the incidence of non-regular employment.[5] From 1970-1999, the proportion of non-regular employment is less than 1/4 of total employed workers. On the other hand, in 2000s, the proportion of non-regular employment to total employed workers exceeds 25%. Table 2 shows that there are no big differences between these two sub-sample periods. This implies that Japanese firms use the intensive margin to adjust labor inputs more than the extensive margin although non-regular workers increase.

3 Conclusion

This paper studies the role of the extensive and intensive margins of labor input adjustment over business cycles in Japan. We find that the intensive margin accounts for much of cyclical variations in total hours worked. While the extensive margin accounts for 23% of cyclical variations in total hours worked, the intensive margin explains 77% of them. This result is in contrast with the U.S. empirical evidence on the labor input adjustment in which the majority of labor adjustment takes place along the extensive margin.

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[5]Genda et al. (2012) study the implications of the rise in non-regular work for the adjustment behavior of establishments at the micro-level.

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