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## **Abstract**

Korea's unemployment rate has returned to the pre-financial crisis level of 1997. However, Korean workers still have the longest working hours among OECD countries. Labor unions and the government are pushing for a reduction in legal working hours to improve the quality of life. This paper investigates the short-run production effects of the reduction in legal working hours on the Korean economy by industry using a two-stage approach. The short-run production effect on the Korean economy was negative in all industries and manufacturing was most severely affected by the reduction in legal working hours.

JEL Classification: C20, E23, J30

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## I. Introduction

In Korea, working hours were reduced to about 1,600 hours a year by the time of the first oil shock, but since then the trend has been reversed. This is in contrast to several advanced countries which have reduced legal working hours as economic growth has slowed.

Korea experienced a severe financial crisis in 1997 and a rapid increase in the unemployment rate. The Korean government and labor unions have considered work sharing as a necessary, if not sufficient, condition for combating the unemployment problem. The issue of work sharing has not received much attention since the unemployment rate fell below 4 percent in May 2000. However, labor unions requested a reduction in legal working hours to improve quality of life<sup>1</sup> and recently the government has pushed for a reduction in the standard 44-hour workweek to 40 hours per week.<sup>2</sup>

Labor unions argue that reducing the legal number of working hours per week will alleviate unemployment through "work-sharing". The Korean government argues that by reducing the number of legal working hours it will enhance the quality of life of workers. They believe this in part because the average working hours of a Korean worker was 2,497 in 1999, the highest among OECD countries.<sup>3</sup> On the other hand, business managers maintain that such a policy will increase labor costs, and therefore not decrease the unemployment rate. They also argue that actual working hours will not decrease that much since Korean workers prefer earning money to taking time off. If this is correct it would mean that the reduction of legal working hours would eventually result in higher labor costs and will not improve the quality of life of workers.

The main objective of this paper is to estimate the short-run production effect of a reduction in legal working hours in a single industry. The reason we call this effect the short-run effect is

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<sup>1</sup> A special Committee was created to draw up an agreement on the issue of legal working time reduction between labor and management in May 2000.

<sup>2</sup> This is equivalent to taking a full day off on Saturdays instead of the current half-day off.

<sup>3</sup> See Evans, Lippoldt, and Marianna (2001) for more details.

that we assume constant capital stock in the analysis. This type of analysis is important because the government, labor unions and business managers of all industrial sectors need objective empirical estimates to use as a basis for policy discussions. The issues to be discussed include the proper timing for the new legislation's introduction, the industries to include when reducing legal working hours, and the determination of the overtime premium wage rate etc. Although much research has already been done on the effect of the reduction of legal working hours on the economies of foreign countries, not much work has been done in Korea.

Booth and Schiantarelli (1987) analyzed the employment effects of a cut in hours worked using the monopoly union and efficient bargaining models of the union and management. Under various conditions of the models, they found that a reduction in legal working hours produces employment effects that are at best ambiguous and often negative. The effect of recent reductions in the workweek of manual workers on the competitiveness of the engineering industry was also examined using surveys. Richardson and Rubin (1993) show that managers expect over half of the cost of the working time reduction to be absorbed by productivity improvements and lower wage increases. They claim that the reduction of two hours less worked adds less than one percent to expected manual labor costs when the responses are weighted by factory size. Change in costs is expected to be smaller for large factories than small ones particularly in turbulent circumstances.

The relationship between the length of the workday and wages per hour was investigated by Nymoén (1989). Using both dynamic modeling and cointegration techniques, the author could not reject a hypothesis of long-run independence of real wages and hours worked under the condition of constant productivity and unemployment in Norwegian manufacturing. However, the author confirmed that there are significant short-run effects of changes in working hours, corresponding to the wage compensation schemes introduced along with reduction in the length of working hours.

In the French case, Jefferys (2000) studied the effects of reducing working time from 39 to 35 hours on January 1st, 2000, and suggested that while a direct job creation effect was limited, the revised law moderated wage settlements and led to more flexible work patterns. Recently Cacace (1999) reviewed the history of the reduction of working hours. The author argued that work sharing was a necessary condition for growth, flexibility, training and research and the competitiveness of firms could be improved because there was a tradeoff between working hours and flexibility.

The cross-industry variation in legal working hours reductions has been used to examine their impact on actual hours worked, wages, and employment in West Germany by Hunt (1996). The author suggests that work sharing may have reduced employment between 1985 and 1995. Using individual data from the German Socio-Economic Panel, the author also finds that a one-hour reduction in legal working hours appears to have translated into a reduction in actual hours worked of between 0.85 and 1 hour in manufacturing.

Bosch (1990) reviews the development of changes in working hours and discusses collective agreements on the reduction of hours worked and the increased flexibility of working time. The author also examines the instruments used to implement the reduced working hours at the enterprise level in West Germany. A simple model of hours, employment, and earnings for Japanese manufacturing was developed by Brenello (1989). The author shows that a reduction in legal working hours is likely to increase overtime and reduce employment

The legal working hours in Korea were 48 per week after 1953. During 1989-1991, they were reduced to 44 hours. There has not been much research on the effect of the reduction in legal working hours in Korea. The first attempt on this was by Baek (1992), who simulated the production and employment effect when one legal holiday was abolished. These results suggested that the abolition of one holiday increased the number of employees by 10,000 and

GDP by 0.07 percent.<sup>4</sup> This result implied that a reduction of 4 legal working hours would cause a 1.8 percent decrease in GDP.

Kim (2000) also estimated the effect of the reduction of legal working hours on actual hours worked and found the elasticity was almost one. Unlike Kim (2000), Ahn and Lee (2001) showed that a 4 hour reduction in legal working hours from 44 to 40 would result in a 1.9 hour decrease in actual hours worked per week, a 4.7 percent increase in employment, and a 10.1 percent increase in real wages. On the other hand, Lee et al. (2000) suggested that the 4-hour reduction would increase labor costs by about 0.5-14.6 percent. They argue that a 1 percent decrease in actual hours worked would increase labor productivity by about 0.65 percent.

This paper concentrates on estimating the short-run production effect of a reduction in legal working time in a one-sector model of production and employment using a two-stage approach. In the first stage, we calculate the direct intra-industry production effect of a reduction in legal working hours in one sector. For this purpose we study (i) the effect of a reduction of legal working hours on actual working hours, (ii) the effect of a change in actual working hours on employment and (iii) the effect of a change in actual working hours on labor productivity and production. In the second stage, we analyze the inter-industry production effect, induced value-added effect and induced import induction effect based on input-output analysis.

This paper is organized as follows. Section II introduces the methodology for our analysis. We estimate the direct intra-industry production effect of the reduction of legal working hours a one-sector model of production and employment in section III. Section IV estimates the inter-industry production effect, total production effect, induced value-added effect and induced import effect using input-output analysis. We provide some remarks in section V and our conclusions in section VI.

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<sup>4</sup> Baek (1992) actually estimated the additional production and employment effect by reducing the number of legal holidays by one.

## **II. Methodology**

There are several different ways to estimate the production effect of a reduction in legal working hours in one industry on the economy as a whole and on other industries. We adopt a two-stage approach to estimate the effect. The first stage is to estimate the direct intra-industry production effect of the reduction of actual working time. Then the indirect inter-industry production effect is measured in the second stage using input-output analysis. Therefore, the total production effect is the natural sum of the intra-industry and inter-industry production effects.

The first-stage production effect is measured in the production side only. Changes in factor costs are not considered, even though the cost data are generally less affected by measurement errors. Wages are determined by negotiations between labor unions, managers and the government once a year. The government has frequently intervened in capital markets and affected in the cost of capital since 1970. Therefore it is reasonable to concentrate on short-run analysis and assume that the amount of working capital is fixed.

Our estimates do not consider the effect of changes in leisure time on specific industries. For example, it is well known that increases in leisure time have had a positive effect on certain service industries. However, it takes time for the increased leisure time to stimulate the service industry. To examine such effects, a general equilibrium model or multivariate time series model is required. Since we are interested in the short-run production effect, we neglect this kind of effect in this paper.

### **1. First Stage: Direct Intra-industry Effects**

The production function of industry  $i$  at time  $t$  can be written as

$$Y_{it} = F(K_{it}, L_{it}, t) \quad (1)$$

where  $Y_{it}$  is real value-added (1995 constant price),  $K_{it}$  is real net capital stock,  $L_{it}$  is labor input measured as employment multiplied by working hours per worker, and  $t$  is a time trend.

There are several types of production functions such as Cobb-Douglas, CES (constant elasticity of substitution), and VES (varying elasticity of substitution). We chose to use a Cobb-Douglas production function for estimation of the production function in our research. The specific Cobb-Douglas production function used in this paper is as follows:

$$Y_{it} = A_i e^{\lambda_{it}} K_{it}^{\alpha_i} L_{it}^{1-\alpha_i} \varepsilon_{it} \quad (2)$$

Equation (2) assumes that the error term is multiplicative and that there are constant returns to scale (CRS). If we take the logarithms of equation (2), we get

$$\ln Y_{it} = \ln A_i + \lambda_i t + \alpha_i \ln K_{it} + (1 - \alpha_i) \ln L_{it} + \eta_{it} \quad (3)$$

and rearranging it gives

$$\ln(Y/L)_{it} = \ln A_i + \lambda_i t + \alpha_i \ln(K/L)_{it} + \eta_{it} \quad (4)$$

where  $\eta_{it}$  is  $\ln \varepsilon_{it}$ . We assume the error term  $\eta_{it}$  follows an AR(1) process,

$$\eta_{it} = \rho \eta_{it-1} + v_{it}, \quad v_{it} \sim N(0, \sigma^2) \quad (5)$$



Since the elasticity of production with respect to labor is  $(1-\alpha_i)$ , a one percent reduction of labor induces a  $(1-\alpha_i)$  percent reduction of total production. If we estimate the reduction in labor input resulting from the change in legal working hours, we can then easily estimate the resulting change in total production using equation (3).

## 2. Second Stage: Indirect Inter-industry Effects

To measure the inter-industry production effect, we use input-output analysis. We needed to estimate both the indirect and total production effects that result from a change in production in one particular industry,  $h$ . It is first necessary to transform a standard input-output table into an appropriate form, and then proceed to estimation of the second stage. In Table 1 sector  $h$  is the exogenous sector and other sectors are endogenous sectors.

$X_i$  both in the last column and the last row denotes gross output or gross input of sector  $i$ ,  $X_{ij}$  is sector  $i$  input used for production of sector  $j$  output,  $F_i$  is final demand for sector  $i$ , and  $M_i$  is import of sector  $i$ . Using the superscript 'd' for domestic and 'm' for import, we write the input-output equation for industry  $i$  as follows.

$$a_{i1}^d X_1 + a_{i2}^d X_2 + \dots + a_{in}^d X_n + a_{ih}^d X_h + F_i^d = X_i \quad (6)$$

Using matrix notation,  $A_h^d$  (domestic input matrix coefficients of the  $h^{\text{th}}$  sector),  $X((n-1)$  gross input or output vector excluding the  $h^{\text{th}}$  sector) and  $F^d$  (( $n-1$ ) final demand vector excluding the  $h^{\text{th}}$  sector), the above equation system is written as

$$A^d X + A_h^d X_h + F^d = X \quad (7)$$

<Table 1> Input-Output Table with Exogenized h<sup>th</sup> Sector

	Intermediate Demand (Endogenous Sectors) h <sup>th</sup> sector excluded	Exogenous Sector		Import	Aggregate Output
		h <sup>th</sup> sector Int. Demand	Final Demand		
Domestic Int. Input (Endogenous sectors, h <sup>th</sup> sector excluded) (d)	X <sub>11</sub> <sup>d</sup> X <sub>12</sub> <sup>d</sup> ... X <sub>1n</sub> <sup>d</sup> X <sub>21</sub> <sup>d</sup> X <sub>22</sub> <sup>d</sup> ... X <sub>2n</sub> <sup>d</sup> . X <sub>n1</sub> <sup>d</sup> X <sub>n2</sub> <sup>d</sup> ... X <sub>nn</sub> <sup>d</sup>	X <sub>1h</sub> <sup>d</sup> X <sub>2h</sub> <sup>d</sup> . X <sub>nh</sub> <sup>d</sup>	F <sub>1</sub> <sup>d</sup> F <sub>2</sub> <sup>d</sup> . F <sub>n</sub> <sup>d</sup>		X <sub>1</sub> X <sub>2</sub> . X <sub>n</sub>
Imports (m)	X <sub>11</sub> <sup>m</sup> X <sub>12</sub> <sup>m</sup> ... X <sub>1n</sub> <sup>m</sup> X <sub>21</sub> <sup>m</sup> X <sub>22</sub> <sup>m</sup> ... X <sub>2n</sub> <sup>m</sup> . X <sub>n1</sub> <sup>m</sup> X <sub>n2</sub> <sup>m</sup> ... X <sub>nn</sub> <sup>m</sup>	X <sub>1h</sub> <sup>m</sup> X <sub>2h</sub> <sup>m</sup> . X <sub>nh</sub> <sup>m</sup>	F <sub>1</sub> <sup>m</sup> F <sub>2</sub> <sup>m</sup> . F <sub>n</sub> <sup>m</sup>	M <sub>1</sub> M <sub>2</sub> . M <sub>n</sub>	
Domestic Int. Input h <sup>th</sup> sector	X <sub>h1}</sub> X <sub>h2}</sub> ... X <sub>hn}</sub>	X <sub>hh}</sub>	F <sub>h</sub> <sup>d</sup>		X <sub>h}</sub>
Value Added (v)	X <sub>1</sub> <sup>v</sup> X <sub>2</sub> <sup>v</sup> ... X <sub>n</sub> <sup>v</sup>	X <sub>h}</sub> <sup>v</sup>			
Aggregate Input	X <sub>1}</sub> X <sub>2}</sub> ... X <sub>n}</sub>	X <sub>h}</sub>			

If all terms of X are arranged on the left hand side, then

$$X = (I - A^d)^{-1} (A_h^d X_h + F^d) \quad (8)$$

where  $(I - A^d)^{-1}$  is the inverse domestic input matrix that excludes the h<sup>th</sup> sector.

Now we are ready to estimate the indirect inter-industrial production effect. From equation (8), it is

$$\Sigma [(I - A^d)^{-1} A_h^d \Delta X_h] \quad (9)$$

where ‘ $\Sigma$ ’ denotes the sum of all elements of the column vector. Therefore, the total production effect of the intra-industry and inter-industry production effect of sector h,  $\Delta X_h$ , becomes

$$\Sigma[(I - A^d)^{-1} A_h^d \Delta X_h] + \Delta X_h \quad (10)$$

Similarly, the total induced value added effect and the induced import effect are

$$A^v (I - A^d)^{-1} A_h^d \Delta X_h + A_h^v \Delta X_h \quad (11)$$

and

$$\Sigma [A^m (I - A^d)^{-1} A_h^d \Delta X_h] + A_h^m \Delta X_h \quad (12)$$

respectively.<sup>5</sup>

### III. Estimating the Direct Production Effect

We first estimate the direct production effect of the reduction of legal working hours by industry in this chapter. The output of this analysis will be used in the second stage analysis based on the input-output table to estimate the inter-industry production effect in the next section.

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<sup>5</sup> The notations ‘v’ and ‘m’ denote ‘value-added’ and ‘import’ respectively.

## 1. Data

The data used in this study are annual time series on real GDP, capital, the number of employees, actual hours worked, and legal working hours by industry for Korea from 1970 to 1999. Real GDP is measured in 1995 constant billion won and is from the Bank of Korea (BOK).<sup>6</sup> For capital, estimates of real net capital are taken from Pyo and Kwon (2001). Annual gross working hours are calculated by multiplying the number of employees and the number of working hours. Figures on actual hours worked by industry come from the *Report on Monthly Labor Survey* published by the Ministry of Labor (MOL) and the number of employees is taken from both the *Annual Report on the Economically Active Population Survey* and the *Population and Housing Census Report* by the National Statistical Office (NSO).<sup>7</sup>

Production functions were estimated using annual data from 1970 to 1999 but we used monthly data from 1988.01-1992.12 to analyze the effects of a reduction in legal working hours on both actual working hours and on the rate of change in the number of employees. The reason we restrict our analysis to these five years is that the reduction of legal working hours in the Korean labor market was introduced during the 1989-1991 period. We extended this period by one year each at the beginning and at the end of this period to examine the full effects of the reduction in legal working hours. If we estimate such effects from the full sample period, other structural factors may influence the relationship between the legal working hours and the actual hours or the number of employees.

The BOK classifies Korean industries into the following large industrial groups: (i) agriculture, forestry and fishing, (ii) mining and quarrying, (iii) manufacturing, (iv) electricity, gas and water, (v) construction, (vi) wholesale and retail trade, restaurants and hotels, (vii)

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<sup>6</sup> *The Population and Housing Census Report* has been published every 5 years since 1970. Because the *Report on Monthly Labor Survey* does not classify the service industry in detail from 1970 to 1979, we inferred the number of employees statistics based on the *Report on Monthly Labor Survey*. This data can be obtained from the BOK at <http://www.bok.or.kr>.

<sup>7</sup> This data can be obtained from the KOSIS, a database of the NSO at <http://www.nso.go.kr>.

transport, storage and communications, (viii) finance, insurance, real estate and business services, and (ix) community, social and personal services. The agriculture, forestry and fishing industry was excluded from the analysis because the legal working hours do not have much meaning in this industry. Community, social and personal services were also excluded because appropriate data could not be obtained.<sup>8</sup> Therefore we analyze the seven industries in Table 2 below.

<Table 2> Industries Analyzed

No. of industry	Name of industry
1	All industries
*	Agriculture, forestry and fishing
2	Mining and quarrying
3	Manufacturing
4	Electricity, gas and water supply
5	Construction
6	Wholesale and retail trade, hotels and restaurants
7	Transport, storage and communications
8	Finance, insurance, real estate and business services
*	Community, social and personal services

Note: \*= excluded industries.

## 2. Production Function Estimation

We estimated equations (4) and (5) by industry using annual data from 1970-1999. We performed unit root tests and found that all variables in this study are nonstationary in levels but stationary if first differenced. In other words, the series are integrated of order one, I(1). We also performed a cointegration test, which showed that a stable long-run relationship between Y/L and K/L did not exist in mining and quarrying (No. 2), manufacturing (No. 3),

<sup>8</sup> We matched the industry classifications of the Bank of Korea, the Ministry of Labor and the National Statistical Office in this paper. Because we first matched the first 7 industries of the MOL and NSO data, we could not match the 9<sup>th</sup> industry precisely and excluded it from our analysis.

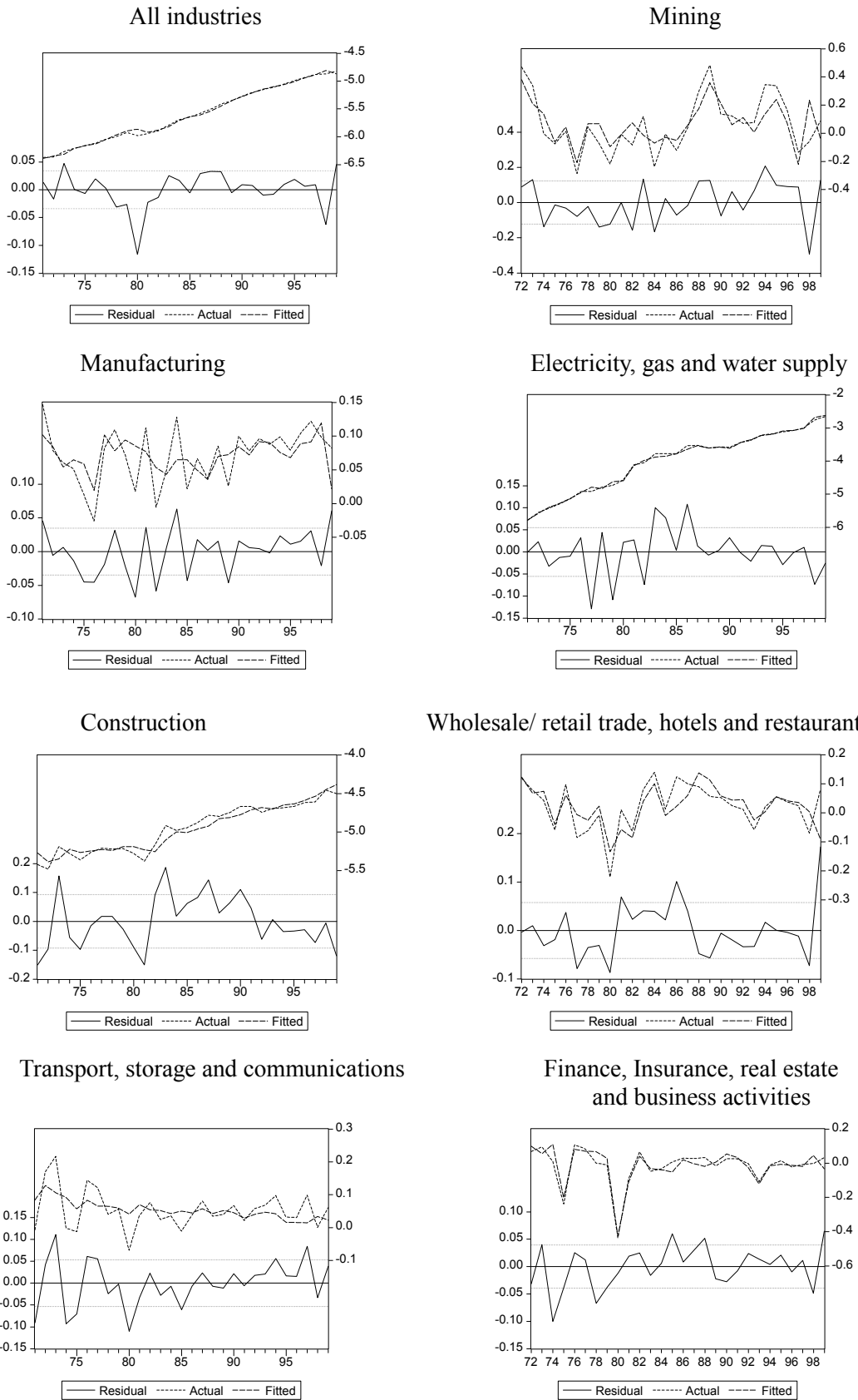
wholesale and retail trade, hotels and restaurants (No. 6), transport, storage and communications industries (No. 7), and finance, insurance, real estate and business services (No. 8). On the other hand, we found that there was a stable long-run relationship in electricity, gas and water supply (No. 4) and construction (No. 5). Thus, we used level data for the latter two industries while first differenced data were used for the former five industries. The results are shown in Table 3 and Figure 1.

<Table 3> Production function estimates

No. of industry	C	K/L	t	AR(1)	DW	Adj. R <sup>2</sup>
1	-2.512 (-11.99)	0.638 (13.69)	.	0.820 (7.91)	1.65	0.50
2*	0.001 (0.18)	0.588 (5.46)	.	0.461 (2.60)	2.17	0.63
3*	0.041 (3.85)	0.353 (3.58)	.	.	2.25	0.30
4	-2.579 (-7.29)	0.938 (8.77)	0.030 (3.362)	0.685 (4.27)	2.40	0.99
5	-2.832 (-9.61)	0.380 (7.08)	.	0.614 (4.54)	1.31	0.91
6*	-0.047 (-2.11)	0.829 (5.04)	.	0.360 (1.67)	1.66	0.47
7*	0.030 (2.27)	0.255 (2.62)	.	.	1.94	0.17
8*	-0.022 (-1.25)	0.903 (14.96)	.	0.596 (3.35)	1.94	0.87

- Notes: 1. C is a constant, K/L is the capital-labor ratio, and t is the time trend.  
2. We excluded the time trend if it was not statistically significant.  
3. Values in parentheses are t-statistics.  
4. \* indicates that first differenced data were used.  
5. All data are transformed to natural logarithms.

<Figure 1> Actual, estimated and residual by industry



### 3. The Direct Intra-industry Production Effect

The estimated equations can be used to specify the parameters of the Cobb-Douglas production functions. For example, for all industries category,

$$Y_t = 0.080K_t^{0.638} L_t^{0.362}\epsilon_{1t} \quad (13)$$

This equation can then be used to calculate the effect of a reduction of actual working hours on all production in all industries category. Namely in this category, production will decrease by 0.362 percent if there is a 1 percent decrease in actual hours worked. We omit rewriting the equations for industries 2-8 for brevity.

The objective of this paper is to calculate the effect of a reduction in legal working hours on production. To do this we also need to calculate the effect of a reduction in legal working hours on both actual working hours and the rate of change in the number of employees. This will allow us to evaluate the effect of a reduction in legal working hours on total working hours. We first estimate the effect of a reduction in legal working hours on actual working hours using monthly data from 1988.08-1992.12. The reason why we selected this period to estimate the working hours effect is that legal working hours were reduced during this period in Korea. Legal working hours per week were 48 after 1953. During 1989-1991, they were reduced to 44 hours via three steps. First was a reduction from 48 hours to 46 in April 1989. Second was a reduction to 44 hours per week for workplaces with more than 300 employees and financial intermediaries. The third step was a reduction to 44 hours for all workplaces. Therefore, it is reasonable to estimate the effect of a reduction in legal working hours on actual working hours



using data for this period. To consider potential lead and lag effects, we extend the period by one year from the beginning and the end of the period in question<sup>9</sup>.

<Table 4> Estimation of the effect on actual hours worked of a reduction in legal working hours

No. of industry	C	LWH	CCI	T	AR	Adj. R <sup>2</sup>	D.W.	Month Dummy
1	-0.77 (0.66)	0.65 (6.81)	0.48 (1.75)	.	.	0.73	2.28	1,2,8,9,10
2	-7.44 (2.22)	1.35 (3.06)	1.08 (1.65)	3.90e-3 (3.41)	0.75 (8.53)	0.64	2.34	.
3	-1.35 (1.22)	0.70 (7.31)	0.56 (2.14)	.	.	0.59	2.57	.
4	-7.91 (3.82)	1.11 (3.85)	1.53 (4.49)	2.01e-3 (3.45)	.	0.38	1.97	1
5	-1.31 (0.72)	0.80 (3.14)	0.41 (1.40)	5.36e-4 (1.46)	.	0.33	2.21	.
6	-2.09 (1.62)	0.64 (3.55)	0.72 (3.44)	7.33e-4 (1.92)	.	0.45	2.26	.
7	0.69 (0.66)	0.34 (2.61)	0.41 (2.40)	5.31e-4 (1.72)	.	0.74	1.63	.
8	-3.31 (1.71)	0.92 (3.38)	0.70 (2.26)	1.34e-3 (2.34)	.	0.29	2.10	.

Table 4 shows the estimated effect of a reduction in legal working hours on actual working hours. The dependent variable is the log of actual working hours per worker (AWH) and independent variables are the log of legal working hours per week (LWH), the log of the cycle of coincident composite index (CCI), the deterministic time trend (T), and a set of monthly dummy variables. We include CCI to control business cycle effects. The coefficient on LWH (in the third column) indicates that if legal working hours are decreased by 1 percent, then actual working hours per worker will be decreased by 0.65 percent in the all industries category.<sup>10</sup> Other coefficients in this column reveal the effects in specific industries.

<sup>9</sup> The sample period starts from Aug. 1988 because data for the number of employees in some industries shows discontinuity in July 1988.

<sup>10</sup> We also estimated a similar function using quarterly data from 1988-1994 and obtained an estimate of 0.69, which is similar to the results obtained from monthly data. Thus we use the results obtained using the monthly data. Ahn and Lee (2001) showed that 1.9 hours per week or 3.8 percent of the actual working hours would have been reduced if the legal working hours had been cut by 4 hours. But Kim (2000) demonstrated that there is 1:1 correspondence between the legal and actual working hours.

The next step is to estimate the effect of a reduction in legal working hours on the rate of change in the number of employees. Again we use monthly data from 1988.07-1992.12. The dependant variable (EMP) is the log of the number of employees. Explanatory variables are actual working hours (AWH) and the industrial production index (IP). We use the two stage least squares (2SLS) method because actual working hours may be simultaneously determined by the number of employees. We use legal working hours (LWH), the number of employees in the following period, and the industrial production index in the following period as instruments.

Estimation results are given in Table 5. In the all industries category, the result shows that a 1 percent reduction in actual working hours caused a 0.29 percent increase in the rate of change in the number of employees. On the other hand, for the mining and quarrying industries, manufacturing industry, electricity, gas and water supply industries, and wholesale and retail trade, hotels and restaurants industries, the coefficients of actual working hours are not significant. This is consistent with the view that Korean firms in these industries may choose other adjustments instead of changing the number of employees.

<Table 5> Estimation of the effect of a reduction in working hours on the number of employees

No. of industry	C	AWH	IP	AR	Adj. R <sup>2</sup>	D.W.	Month Dummy
1	16.37 (68.85)	-0.29 (5.44)	0.34 (12.58)	0.58 (4.36)	0.98	1.50	1~11
2	19.28 (35.90)	.	-1.91 (5.08)	.	0.80	1.54	2
3	15.10 (78.34)	.	0.07 (1.64)	0.86 (13.78)	0.80	1.66	2
4	9.58 (8.01)	.	0.36 (1.26)	0.70 (8.14)	0.69	1.26	.
5	10.04 (6.05)	-0.78 (2.03)	1.67 (23.08)	.	0.96	1.35	2,4,6,7,8,9
6	12.61 (55.06)	.	0.61 (11.29)	0.23 (1.68)	0.77	1.72	.
7	15.09 (11.54)	-0.86 (3.08)	0.48 (6.68)	0.53 (4.42)	0.93	2.03	2
8	10.90 (11.36)	-0.17 (6.10)	1.29 (7.52)	0.71 (6.75)	0.94	1.93	1,2

Now we are able to calculate the effect of a reduction in legal working hours on total working hours by calculating the sum of the previous two effects.<sup>11</sup> For example, in the all industries category, a 1 percent reduction in legal working hours results in a 0.65 percent decrease in actual working hours and a 1 percent decrease in actual working hours brings about a 0.29 percent increase in the number of employees. Thus a 1 percent reduction in legal working hours results in a 0.19 percent increase in the number of employees but the total number of working hours decreases 0.47 percent.

Next, equation (13) demonstrates that a 1 percent decrease in actual working hours resulted in a 0.36 percent decrease in production. Thus, a 1 percent reduction in legal working hours also reduces production by 0.17 percent. Finally, the effect of a 4-hour per week reduction in legal working hours (from the current 44 per week), or a 9.09 percent reduction in legal working hours, would reduce production by 1.52 percent in the all industries category.<sup>12</sup> Similarly, we can compute the effect for specific industries and Table 6 shows the total effect of reducing legal working hours from 44 hours per week to 40 on production in each individual industry.

We see from Table 6 that production would fall in all the industry groups examined. The mining and quarrying industries and manufacturing industry are the two industries that would be most seriously affected, with production falling 5.06 percent and 4.12 percent, respectively. Transport, storage and communications industries and electricity, gas and water supply industries are estimated to be the two least affected industries, with production falling 0.32 percent and 0.63 percent respectively.

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<sup>11</sup> The main effective channel of reduction in legal working hours on labor demand is the increase of labor costs. This will depend on the wage premium rate for overtime hours. Trejo (1991) argues that there will be no real effect if firms reduce straight-time wages so as to offer the same package of weekly compensation and hours of work that was acceptable initially. We will discuss this later.

<sup>12</sup> Askenazy (2000) argues that the possible change in productivity after the reduction is an important factor in the calculation of the total effect. However, in this paper we assume that productivity after the reduction remains the same.

<Table 6> Effect on production of a 4 hour reduction in legal working hours by industry

No.	Name of industry	Rate of change
1	All industries	-1.52%
2	Mining and quarrying	-5.06%
3	Manufacturing	-4.12%
4	Electricity, gas and water supply	-0.63%
5	Construction	-0.99%
6	Wholesale and retail trade, hotels and restaurants	-0.99%
7	Transport, storage and communication	-0.32%
8	Finance, insurance, real estate and business services	-0.67%

The relatively large effect of a reduction in legal working hours in the mining and quarrying industries reflects structural adjustment in this industry, where production and the number of actual working hours have fallen, despite decreases in the number of employees. In other words, structural adjustment apparently resulted in simultaneous declines in both the number of actual working hours and the number of employees. Consequently, these two variables are positively correlated rather than negatively correlated as in other industries.

These results suggesting a reduction in production in each industry need to be interpreted with caution. We only measure direct intra-industry production effect from the reduction in actual hours worked in Table 6. In addition to this direct effect, changes in production in one industry have indirect effects on production in other industries because industries use the output of other industries as intermediate goods. This indirect inter-industry effect is estimated in the next chapter using the input-output analysis.

## IV. Estimating Indirect Inter-industry Effects

### 1. Data and intra-industry effects

In this section we estimate the indirect inter-industry effects of reducing legal working hours. Suppose the reduction in legal working hours is introduced gradually, industry by industry<sup>13</sup>. In this case, we need to decide which industry will be the first to reduce legal working hours. In this study we assume that the first industry to reduce legal working hours will be the industry in which the reduction of legal working hours has the smallest negative effect on the aggregate economy.<sup>14</sup>

We then calculate the indirect effects of reducing legal working hours in this industry on output (=production), value-added, and induced imports in each industry using the 1998 input-output tables. The sectoral classification in the 1998 input-output tables is based on the Korean Standard Industrial Classification and the tables include 402 endogenous industries which are matched with the industrial classification in Table 2.

To facilitate this input-output analysis, it is first necessary to estimate the absolute size of the direct production effect of a reduction in legal working hours in each industry  $h$  ( $h=2, 3, \dots, 8$ ),  $\Delta X_h$ . Because the Korean government wants to implement a reduction in the legal working hours by the end of 2002, it is most useful to calculate the resulting change in production in 2002 by industry using the estimates in Table 6. For the 2002 production levels before the change in legal working hours, we use forecasts by the Korea Development Institute.

Table 7 shows the resulting estimates of the direct production effect in 2002 by industry. The manufacturing industry is severely affected by the reduction in legal working hours with

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<sup>13</sup> For example, the reduction to 40 legal working hours per week in Germany began in the metalworking and printing sectors in 1985. This reduction was followed by reductions in other sectors and continued through 1995.

<sup>14</sup> Alternative assumptions are plausible but this assumption is understandable when we consider the negative indirect effects.

production falling an estimated 7.8 trillion won.<sup>15</sup> The finance, insurance, real estate and business activities industries follow with an estimated drop of 776 billion won. Next we use these estimates and input-output analysis to calculate indirect inter-industry effects.

<Table 7> Amount of Change in Production in 2002 by industry<sup>16</sup>

No.	Name of industry	Amount of change (Billion won)
2	Mining and quarrying	-102.52
3	Manufacturing	-7,819.94
4	Electricity, gas and water supply	-104.19
5	Construction	-488.63
6	Wholesale and retail trade, hotels and restaurants	-718.71
7	Transport, storage and communications	-125.76
8	Finance, Insurance, Real estate, Business activities	-775.72

## 2. Inter-Industry Effects

The fifth column of Table 8 first shows the estimates of indirect production effect by industry in 2002. Again, the largest negative effect is observed in manufacturing, this time followed by construction, and then by wholesale and retail trade, hotels and restaurants. The table also shows the total production effect, including both direct and indirect effects. The largest negative effect, about 9.5 trillion won, is again observed in manufacturing. However, the total effect is larger in wholesale and retail trade, hotels and restaurants (1.1 trillion won) than in construction (897 billion won). On the other hand, the smallest total effects are in electricity, gas and water supply and mining and quarrying.

<sup>15</sup> The exchange rate was 1313.50 won per U.S. dollar as of Dec. 31, 2001.

<sup>16</sup> We do not report the amount of change in production for the all industries category because we focus on the spillover effects among individual industries in this section.

<Table 8> Effects on Production by Industry

No. of Industry	Coefficients			Indirect Inter-industry Amount (Billion won)	Total Amount (Billion won)
	Indirect Inter-industry effect	Direct intra-industry effect	Total effect		
2	0.54	1	1.54	-55.62	-158.13
3	0.22	1	1.22	-1,697.89	-9,517.83
4	0.31	1	1.31	-32.77	-136.96
5	0.84	1	1.84	-408.32	-896.94
6	0.53	1	1.53	-381.14	-1,099.85
7	0.33	1	1.33	-41.97	-167.74
8	0.23	1	1.23	-175.84	-951.56

Estimates of the effects on value-added are given in Table 9. The order is only slightly different from the case of production inducement. By far the largest negative effect is still observed in manufacturing (3.3 trillion won). Again the negative effect is slightly larger in wholesale and retail trade, hotels and restaurants (659 billion won) than in finance, insurance, real estate and business activities (626 billion won). In this instance electricity, gas and water supply and transport, storage and communications are the least affected industries like in the production effect.

<Table 9> Effects on Value-Added by Industry

Industry	Coefficients			Total Amount (Billion won)
	Indirect effect	Direct effect	Total effect	
2	0.26	0.66	0.92	-94.65
3	0.13	0.29	0.42	-3,307.49
4	0.14	0.46	0.60	-62.51
5	0.36	0.48	0.84	-409.22
6	0.30	0.62	0.92	-659.36
7	0.15	0.56	0.71	-89.24
8	0.10	0.71	0.81	-626.24

Finally, Table 10 shows the effects on imports. The effects are again largest in manufacturing, followed by construction, then by wholesale and retail trade, hotels and restaurants, and by electricity, gas and water supply.

<Table 10> Effect on Import by industry

Industry	Coefficients			Total Amount (Billion won)
	Indirect effect	Direct effect	Total effect	
2	0.05	0.01	0.06	-5.72
3	0.01	0.06	0.07	-545.14
4	0.04	0.21	0.25	-26.35
5	0.12	0.03	0.15	-74.51
6	0.05	0.01	0.06	-44.41
7	0.05	0.09	0.14	-17.46
8	0.03	0.00	0.03	-25.41

## V. Remarks

In this paper we estimated the short-run production effect of reducing legal working hours. However, these estimates are based on restrictive assumptions about productivity and production functions, and they also neglect changes in final demand stimulus resulting from increased leisure time as well as the effects of increased wage premiums for overtime work. Therefore, in order to put these estimates in a more realistic context, we offer some remarks in this section.

First, the lump-of-labor fallacy can be cited to question the result that a reduction in legal working hours will generally increase employment.<sup>17</sup> For example, Nam (1999) claims that a

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<sup>17</sup> Some people believe that the solution to high unemployment lies in spreading existing work more evenly among the labor force. For example, Europe in the 1990s suffered extremely high unemployment, and many labor leaders and politicians suggested that the solution was to reduce the



reduction in work-hours not only results in cost increases, but also produces a productivity decrease and employment reduction.<sup>18</sup> Here it is important to note that our analysis focuses on the effect of giving workers an additional day off, rather than on work sharing, making the lump-of-labor fallacy less relevant in this context. Nonetheless, further research into this problem is necessary.

Second, in this paper we measured the total changes of production, value added, and imports, including measures of indirect inter-industry effects calculated with Korean input-output tables for 1998. However, we did not measure the welfare changes of workers and entrepreneurs that resulted from fewer legal working hours and related changes in consumption and leisure activity. Although, measuring such effects explicitly is beyond the scope of this paper, our input-output analysis highlights how these effects are likely to be an important factor offsetting the negative indirect effects measured here.

Third, we also neglect the fact that increased leisure time is likely to lead to increases in consumption and investment, and thus aggregate demand. This is another factor that would mitigate the negative effects observed here. A general equilibrium model or a multivariate time series model is desirable to deal with this issue and should be used to supplement the analysis provided here.

Fourth, one important issue being discussed between labor unions and management regarding the reduction in legal working hours is how to determine the wage premium for overtime work. Below we give a simple explanation of the theoretical principles underlying this discussion. Because the reduction in legal working hours imposes additional costs on employers, it is reasonable for them to ask workers to share the increased cost burden and one way to do this is to lower the wage premium for overtime from the current 50 percent. Put another way, the reduction in legal working hours from 44 to 40 per week is equivalent to increasing

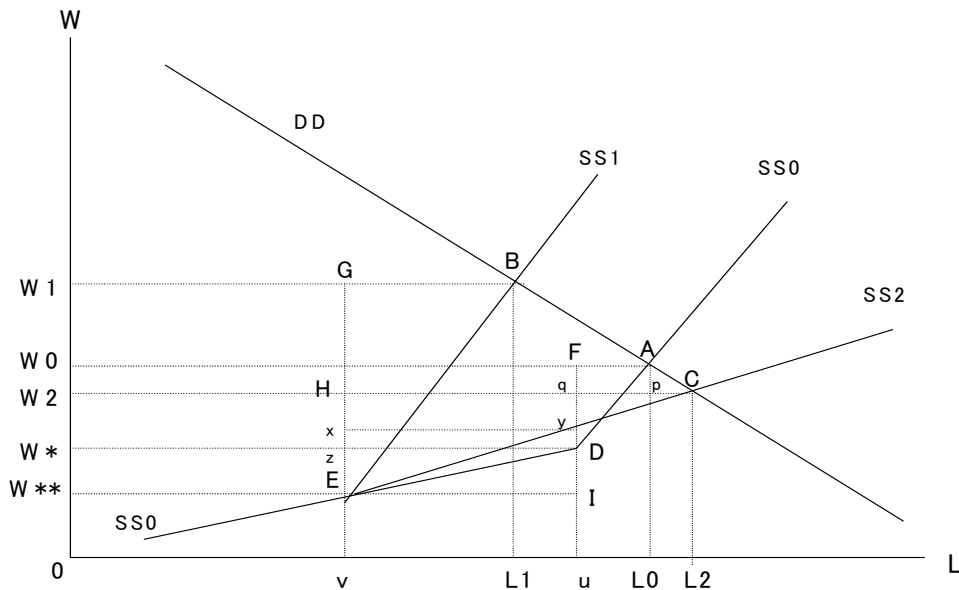
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workweek so that the same number of hours would be worked by all the workers. This view - that the amount of work to be done is fixed - is called the lump-of-labor fallacy.

<sup>18</sup> Nam, S.I. (1999), "Can Shorter Work-hours Resolve Unemployment?" *CFE Opinion Leaders' Digest*, April 12, Seoul, Korea.

overtime hours by 4 per week if total working hours remain unchanged. What is the optimal way to share the increased cost this implies between workers and employers?

<Figure 2> Labor Market Equilibrium Under Premium Wage Rate for Overtime Hours



To illustrate how this problem might be solved, we build a simple model of the labor market in Figure 2, which shows labor market equilibrium under different premium wage rates for overtime hours. DD is the labor demand curve, SS0 is labor supply curve, L is the quantity of labor, and W is the wage rate. ‘L=u’ denotes the quantity of labor equal to legal working hours. Because there is a wage premium for overtime hours, the slope of the supply curve SS0 becomes steeper when the quantity of labor exceeds u. The initial labor market equilibrium is at point A where the equilibrium wage rate is W0 and the equilibrium quantity of labor is L0. Total wage payments to workers are indicated as the sum of the areas of  $OuDW^*$  and  $uL0AF$  because the normal wage rate is applied when the quantity of labor equals u.

Now let us suppose that legal working hours are reduced to the level where the quantity of labor equals v and the same wage premium is maintained. Then the labor supply will shift to SS1, which is concurrent with SS0 where the quantity of labor is equal to or less than v. Since

the supply curve shifts leftward, the new labor market equilibrium is obtained at point B where the equilibrium wage rate  $W_1$  is higher and the amount of labor  $L_1$  is lower than at the previous equilibrium A. Total payments to workers are now the sum of  $OvEW^{**}$  and  $vL_1BG$ . If we compare total wage payments under at these two equilibria, it is uncertain which is bigger, with the result depending on the elasticity of labor demand and the size of the reduction in legal working hours. It is clear, however, that total production and employment will decrease markedly.

The reduction of legal working hours lowers the employment level unless the wage premium changes. More specifically, if the wage premium falls, the employment level could increase. For example, a new labor supply curve  $SS_2$  can be drawn under the assumption of the same number of legal working hours and a lower wage premium. In this case, labor market equilibrium is at point C, where the equilibrium employment is  $L_2$  and the equilibrium wage rate is  $W_2$ . The total wage payment is now the sum of  $OvEW^{**}$  and  $vL_2CH$ . It is again unclear whether total wage payments rise or fall because this depends on the elasticity of the labor demand curve. However, total employment and production under the lower premium wage rate increase.

The above discussion leads us to another important policy issue regarding the optimal premium wage rate in Korea. If the government is successful in changing the legal working hours to 40 hours per week from 44 hours and if employers request extra work beyond 40 hours per week, they have to pay for overtime hours at a premium. Under the new labor law, if a regular worker works 44 hours a week, he should be paid the regular wage for 40 hours and the premium rate for the additional 4 hours. As we have already shown in the results above, the economic effects on production and employment depend on the wage premium. The natural question of which premium is optimal follows.<sup>19</sup>

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<sup>19</sup> The terminology 'optimal' is used in a loose sense. If we use a general equilibrium model for our analysis, the optimal premium rate can be determined on the basis of minimization of a given loss function. Since our model is a partial equilibrium model, the concept of 'optimal' premium rate is used to express the equal sharing of the cost

The current unemployment rate in Korea is around 3 percent, which is considered to be full employment. Since the elasticity of labor demand is low around the full employment level, a lower premium wage leads to lower wage payments. In these circumstances labor unions are not likely to accept a large decrease in the premium for overtime. However, if we consider the problem as part of the reduction in legal working hours, we can find a key to resolving the issue.

Let us assume that the labor supply curve has been changed from  $SS_0$  to  $SS_2$  because of the new labor law. For the overtime hours between  $v$  and  $u$ , which were considered normal working hours prior to the reduction, the increased wage compensation is 'zDyx'. This can be considered as the additional wage payment resulting the changes in the labor law. If the premium for overtime is lowered, the reduction of wage compensation could be  $pAFq-L_0L_2Cp$ . In this case, the net increase in wage compensation is denoted by the area  $zDyx-(pAFq-L_0L_2Cp)$ . Because the size of this area depends on the wage premium, we propose that the optimal wage premium could be determined as the wage rate that makes this additional net gain zero, or minimizes the net gain in cases when net gain is positive for all wage premiums.

## VI. Conclusion

Korea experienced a severe financial crisis in 1997 and a rapid increase in the unemployment rate. Korean employees work more hours than those in any other OECD country. It is natural that the Korean government and labor unions have considered work sharing as a necessary, if not sufficient, condition for combating the unemployment problem and enhancing the quality of life. Recently they have pursued a reduction of the legal 44-hour working week to 40 hours.

This paper examined the short run production effects of a reduction in legal working hours on Korean industries using a two-stage approach. We estimated the effect of the reduction in

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burden of the legal working hours reduction.

legal working hours by industry. Our empirical results show that the direct effect of a reducing legal working time by 4 hours (from 44 to 40) reduces production across all industries by an average of 1.52 percent. Production in each individual industry also declines, with the largest relative declines being observed in mining and quarrying (5.06 percent) and manufacturing (4.12 percent). In contrast direct effects were smallest in transport, storage and communications, and in electricity, gas and water supply, with declines of 0.32% and 0.63%, respectively.

Using an input-output analysis table, we then estimate the absolute size of the direct effect for 2002 by industry, using the estimates described above and economic forecasts for 2002. The reason for estimating the figures for 2002 is that we assume that the Korean government will introduce a reduction in legal working hours during this year. The reduction in production is largest in manufacturing, where production is estimated to fall by 7.8 trillion won.

The input-output analysis then shows that the negative indirect effect on production is also largest in manufacturing, followed by wholesale and retail trade, hotels and restaurants, then finance, insurance, real estate and business activities industries. Indirect effects on value added and imports are negative and largest in manufacturing. This implies that the manufacturing industry should be the last industry to introduce the reduction in legal working hours. This seems reasonable because there are lots of small- and medium-sized firms in manufacturing, which cannot afford to decrease production in the short term. Because electricity, gas and water supply and mining and quarrying are the least affected industries, it is preferable to introduce the reduced legal working hours in these industries first.

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