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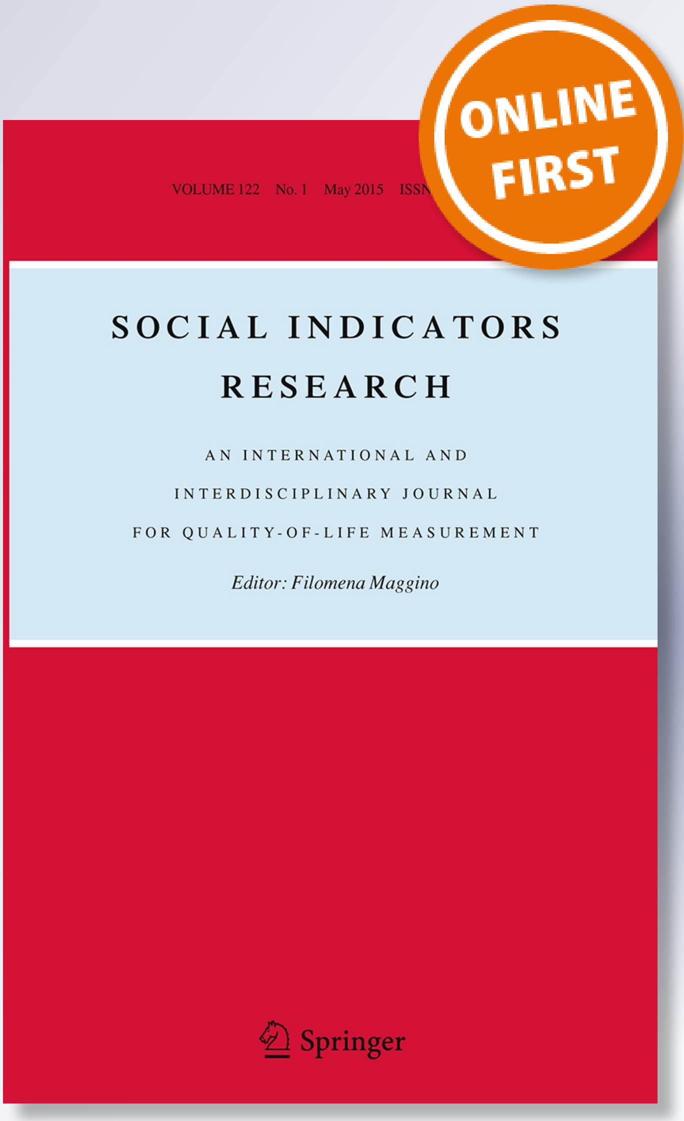

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How Does Leisure Time Affect Production Efficiency? Evidence from China, Japan, and the US

Xiang Wei[1,5] · **Hailin Qu**[2,3] · **Emily Ma**[4]

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Abstract Labor efficiency is a central concept in economics. Although investigators have studied the influence of some variables (e.g., education time and physical capital) on labor efficiency, most studies overlook the impact of leisure time. This investigation examines the relationship between leisure time and labor efficiency in the world's three largest economies: China, the US and Japan. Results revealed a significant correlation between leisure time and labor efficiency, and demonstrate that active leisure participation can improve productivity. The findings also demonstrate that, in contrast to the US and Japan, China, as a typical developing country, has seldom seen an apparent positive effect of leisure time on efficiency, which may partially explained by the type of leisure participation (active or passive).

Keywords Efficiency · Leisure time · Production · Leisure participation · Cross comparison

✉ Emily Ma
emily.ma@griffith.edu.au

Xiang Wei
weixiang@bisu.edu.cn

Hailin Qu
h.qu@okstate.edu

1 International Studies University, National School of Development, Peking University, Beijing, People's Republic of China

2 Regents Professor and William E. Davis Distinguished Chair, School of Hotel and Restaurant Administration, Oklahoma State University, Stillwater, OK 74078, USA

3 Business School, Sun Yat-Sen University, Guangzhou, People's Republic of China

4 Office 0.27, N72 Business 2, School of Tourism, Leisure, Hotel and Sport Management, Griffith University, Nathan Campus, Nathan, QLD 4111, Australia

5 China Leisure Economy Research Centre, Beijing, People's Republic of China

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1 Introduction

Over the past 30 years, most countries in the Organization for Economic Co-operation and Development (OECD) have strongly emphasized attaining a higher standard of living, and increased leisure time has accompanied their enormous economic growth (Fogel 2000). These developments call for more research attention to the impact of leisure time on economic growth and efficiency. Unfortunately, however, most economic theories have overlooked the effect of leisure on efficiency. For example, concerning work–leisure choices, neoclassical economists consider that from the perspective of the elasticity of inter temporal substitution, leisure time and work time are perfect substitutes (Kydland and Prescott 1982; Mankiw et al. 1985; Ioannides and Taub 1992). As a result, many economic forecasts have been misleading, in that they took into account only the increase in leisure time and did not consider the differences in how leisure time was spent (Nordhaus and Tobin 1972; Fogel 2000). In general, economic theories put great emphasis on the aggregate goal of the economy but put less weight on the individual's standard of living, including, for example, leisure time (Ortigueira 2000; Kenc 2004; Georg 2008).

Fortunately, sociologists have documented the positive side of leisure. Investigators have suggested that individuals' happiness and efficiency would increase through various activities in leisure time as a result of improved self-esteem, self-awareness, and creativity (Csikszentmihalyi 1981; Hills and Argyle 1998; Galit 2007). As a result, some economists, enlightened by sociologists' insights regarding the benefits of leisure time, have studied the positive effects of leisure on economic development (Fogel 2000; Gómez 2009), and have found that leisure participation can improve labor efficiency through the accumulation of human capital (Fogel 2000; Lee 2001).

Integrating theories from both the sociology and economics disciplines would seem to offer a fruitful approach to better understanding the relationship between efficiency and leisure time. Leisure time, according to Robinson and Godbey (1997), include every moment that one is not at work. Leisure activities can generate ongoing, transforming development throughout adulthood and is intrinsically rewarding that increase extrinsic economic value (Beatty and Torbert 2003). Leisure time has been calculated based on the Theory of the Allocation of Time (Becker 1965). However, variations in the calculation methods of leisure times exist across different nations and regions (Table 1) due to differences in contexts. OECD countries normally calculate leisure time by deducting work and personal care time from total time available. While Gronau (1977) suggested that leisure time should be calculated by deducting work and home production time from the total time available, while home production time is relatively constant. Due to these variations and considering the focus of our study (three countries), to keep consistency, we calculated leisure time by deducting work time and school time from the total time available. This way of calculation has been known as focusing more on the quantity of time (Ramsay and Francis 2009).

The purpose of this study is to examine the positive effect of leisure on efficiency through an economic analysis from the sociological perspective. Specifically, we explored such effects by cross-comparing the economies of China, the US, and Japan, which are the three largest economies with different modes of development.

2 Literature Review

Generally speaking, leisure participation affects the formation and accumulation of human capital (Ladrón-de-Guevara et al. 1999; Mullahy and Robert 2010). Human capital is about the quality of population and it refers to all useful skills and knowledge that individual

Table 1 Variations in calculating leisure time

Author(s) and year of publication	Region	Sample size	Leisure calculated/defined
Ryder et al. (1976)	US	N.A.	Leisure time = total time − work − training
Gronau (1977)	US	1281 individual	Leisure time = total time − work − home production (relatively stable)
OECD (2009)	International	25 countries of the OECD in 2006	Leisure Time = total time − work − personal care sleeping and eating)
Ramsay and Francis (2009)	US	105 years panel data	Leisure time = total time − work − school − home production
Sevilla et al. (2012)	US	38 years panel data	Leisure is defined as "hours per week devoted to all activities that we cannot pay somebody else to do for us and that are not biological needs" (p. 942)
Aguiar and Hurset (2007)	US	38 years panel data	Leisure time = total time − work − non-market production − child care

deliberate invest to improve their quality and competence (Schultz 1961). In addition to its known impacts in improving human capital, leisure also plays an important role in influencing people's perceived Quality of Life (Lloyd and Auld 2002). Many studies have documented the positive relationship between participating in leisure activities and improved Quality of Life (e.g. Baldwin and Tinsley 1988; Foong 1992; Cracolici et al. 2010). Improved Quality of Life would in turn affect economic growth in a positive manner (Ryder et al. 1976; Ortigueira 2000; Suri et al. 2011). In addition, leisure participation directly influences an individual's working efficiency through her/his work–leisure choice in the labor market (Maguire 2008; Podor and Halliday 2012). The following section reviews in detail the influence of leisure time on human capital, economic growth, and labor efficiency.

2.1 Leisure Time and Human Capital

Most economists assume that human capital has no influence on the quality of leisure time, and that leisure participation has a negative impact on income (Hendee 1971; Buchanan 1994). For example, Ladrón-de-Guevara et al. (1999) structured a model in which human capital had no influence on the quality of leisure, but an individual's productivity would improve when the time spent on education increases. This improvement occurs because education can enhance individuals' competence, which is an important measure for human capital. Following this logic, individuals would need to reduce their amount of leisure time if they want to increase their income, because they would need to spend more time on education and work. This logic represents a typical paradigm in mainstream research in economics.

However, this view has obvious flaws. First of all, scholars have demonstrated that, in reality, human capital does affect the quality of leisure. For instance, Ortigueira (2000) used "qualified leisure"(QL)[1]in an endogenous economic growth model to indicate how leisure can positively influence economic growth. In addition, Harris (2012) found that

[1] Qualified leisure refers to the leisure time that can be influenced by human capital (Ortigueira 2000).

scholarly activity in elite universities was strongly associated with the quality of leisure time and lifelong learning activities through tension relief. A positive correlation has been observed between education and sports, an important form of leisure activity, with highly educated people choosing to exercise more, according to a large-scale survey in Finland (Borodulin et al. 2008). Additionally, research showed that better-educated individuals are likely to allocate more time to physical activities than less-educated individuals (Mullahy and Robert 2010). In other words, different levels of human capital engage in different qualities of leisure participation.

Second, leisure participation has effects on the formation and accumulation of human capital. Although formal education strongly benefits improvement of human capital, the fact that leisure time and leisure activities contribute to enhance human capital should not be overlooked (Chen and Chevalier 2008). For example, exercise breaks at work can enhance a company's identity by increasing the quality of human capital of employees (Pichot and Pierre 2009). Additionally, an individual's competency and work performance can be improved through increased consumption of leisure, with "conspicuous leisure" having a positive effect on the quality of human capital (Weder 2004). Furthermore, an individual's work–leisure choice can influence the individual's health status (Neanidis 2012), and health is an important factor of human capital.

The above perspectives imply that work and leisure are to some extent complementary (Walsh 1982), and that leisure time and leisure activities may have positive effects on individuals' well-being, work performance, and human capital[2] (Walsh 1982; Lu and Argyle 1994; O'Boyle 2011). As individuals with higher hourly wages tend to work fewer hours, they acquire more leisure time. In return, more leisure enjoyment will lead to higher job satisfaction and happiness in life(Zhang and Thomas 2003).

2.2 Leisure Time and Economic Growth

In the 1960s, many researchers began to analyze the relationship between economic growth and time spent in education (leisure time was defined as non-working hours, so education time was counted as a kind of leisure time) (Chase 1967; Ryder et al. 1976). Applying are presentative agent model, several investigators analyzed the effects of leisure time on economic growth (Lucas and Rapping 1969; Kydland and Prescott 1982; Mankiw et al. 1985; Ioannides and Taub 1992). However, the representative agent model analysis had deficiencies, which called for further research. First, the model hypothesized that for all consumers, leisure has a common implicit price (Rubinstein 1974; Eichenbaum et al. 1985), which is not the case in real life. Second, the usual assumption was that the same level of leisure would bring the same level of utility to consumers (Fujita 1989). However, utility disparities are the result of many factors, such as differences in personalities, educational levels, climates, and wage interactions. Third, a further assumption was that human capital does not affect the quality of leisure time (Ladrón-de-Guevara et al. 1999), but in reality human capital will always interact with the quality of leisure time (Pichot and Pierre 2009; Neanidis 2012).

To overcome the above shortcomings, researchers have developed several new theories and methodologies (Gómez 2009; Varvarigos 2011; Kačerauskas 2012). Notably, the real business cycle theory created a formal framework to deal with leisure time in an economy. The classic real business cycle model assumed that technological shock has a strong

[2] Human capital refers to the stock of competencies, knowledge, creativity, social attributes, and personality that are embodied in the ability to produce economic value (Simkovic 2012).

negative effect on leisure time (Kydland 1995; Pintea 2010). In particular, technical progress can lead to the increase of leisure time in the short run, while aggregate production has a notable negative correlation with leisure time in the long run (Gali 1999). In particular, in an economy with overlapping generations, individuals' welfare finally declines as successive generations increase labor effort at the expense of leisure (Varvarigos 2011).

In sum, the literature in the traditional economics discipline reflects the view that leisure time is a "crash out" for working time and will decrease production in the long run. Following this logic, economic growth is explained by work-related activities only, such as production (Barro 1991; Jones 1995) and education (Romer 1986; Lucas 1988),while the positive role of leisure time is degraded. However, empirical studies have found a positive relationship between leisure participation and economic growth and efficiency (e.g., Beatty and Torbert 2003; Maguire 2008). For example, a study of 103 Italian provinces between 2001 and 2006 showed a positive effect of the provision of leisure amenities on regional economic growth (Piergiovanni et al. 2009). Other research also found a positive and statistically significant relationship between leisure consumption and economic growth (Duernecker 2008). Looking at the issue from a different angle, Rau and Triemer (2004) studied the relationship between mood and working overtime in a sample of 117 women and 126 men who were assessed over 24 h using computerized diary and ambulant monitoring. This study found that working overtime with less leisure time significantly harmed people's ability to recover and lowered their work efficiency.

2.3 Leisure Time and Efficiency

Research in psychology has shown that the psychological state of "flow" brings happiness to people (Csikszentmihalyi 1997). The flow experience usually occurs in leisure time(Harris 2012) or during leisure activities (Stebbins 2000). Hence, some leisure participation could improve happiness. For instance, Lyng (1990) found that free-fall parachute jumping—a highly risky leisure activity—can bring participators particular pleasures. Shilling (2004) also suggested that certain kinds of leisure participation could improve individuals' work efficiency and quality of life through the generation of happiness.

Additionally, leisure pursuits can serve as a compensation for work (Maguire 2008). Studies have suggested that leisure activities after work (Drive, Brown and Peterson 1991) or during work (Defrance and Pociello 1993) can enhance employees' job satisfaction and work performance (Ragheb 1993).

Finally, active participation in leisure activities such as community involvement and joining a sports club can enhance individual's social capital by expanding one's social network (Putnam 1995), thus further enhancing people's job performance (Maguire 2008). According to Bourdieu (1986), social capital is aggregate of actual or potential collectively owned resources that could link to benefits to individual members. Despite all the positive influence that leisure can have, the positive effects of leisure on work efficiency are under some constraints, as Ruiz-Contreras et al. (2012) found that neither diversity nor frequency of leisure activities affected working memory efficiency.[3]

The above literature review suggests a need to explore the relationships between leisure and efficiency. In undertaking this exploration, we first studied the labor efficiency

[3] Working memory efficiency refers to the ability (i.e., speed, scale, and level) in brain metabolism responses. Please see the working memory assessment in Ruiz-Contreras et al. (2012, p. 92).

differences in different countries. We found that for the US and Japan, which have similarly sized economies, labor efficiency is about 30 times that of China, and the average annual leisure time of the US and Japan is about 700 h more than that of China (The World Bank 2012). These statistics raise two questions: Why does an efficiency gap exist among countries with similarly sized economies, and would the amount of leisure time offer an explanation? With these questions in mind, and drawing on theories from both economy and sociology, we propose a theoretical framework and test it using empirical data from the 4 countries.

3 Theoretical Model

As leisure has positive effect on human capital, growth, and labor efficiency, we introduce leisure into a theoretical model to demonstrate such an effect and its results.

According to Lucas (1988), working time can be divided into time for producing consumer goods and time for producing human capital or education time. Correspondingly, leisure time is non-working time, which includes the time for rest and housework or the time for travel and entertainment.

Labor efficiency can be achieved by way of two avenues. The first avenue is through technical progress advanced during the working period. The second avenue lies in the possibility of the individual's self-fulfillment and self-realization through activities during leisure time, which are likely to have positive effects and potentially motivate productivity (Fogel 2000; Maguire 2008; Monte 2008; Palmer 2008; Sankey 2008). Therefore, to better understand the role of leisure in the development of human capital and efficiency, we include leisure time as an input in the production function in Lucas's framework, which is commonly applied to deal with human capital in economics.

Therefore, we specify the following production function

$$Y = \bar{A}K^{\beta}H^{1-\beta} \tag{1}$$

where Y denotes aggregate production, $\bar{A}$ represents an exogenous technical level, K is aggregate capital,[4] β represents the elasticity of K to Y, and H denotes human capital. L denotes the averaged leisure time of a country.

When considering the process called "learning by doing" (Romer 1986) and the process about positive effect from leisure, $\bar{A}$ could be functional as

$$\bar{A} = AK^{\alpha}l^{1-\alpha} \tag{2}$$

where A denotes an exogenous technology level, a is the elasticity of K to $\bar{A}$, and $(1 - a)$ is the elasticity of l to $\bar{A}$.

Normally, as human capital is determined by education time (Mankiw et al. 1992), human capital H is treated as follows:

$$H = uL \tag{3}$$

where u denotes education time (here, total time is normalized into 1) and L denotes aggregate labor force.

[4] Throughout the paper, the capital letters denote total amount and the lower-case letters denote per-capita amount, unless otherwise specified.

Take Eqs. (2) and (3) into Eq. (1), and divide it by $(1 - u - l)$ L, then process the natural logarithm. The determinant frame of labor efficiency with leisure will be decided as in Eq. (4).

$$\ln \hat{y} = c + (\alpha + \beta) \ln k + (1 - \beta) \ln u - \ln(1 - u - l) \tag{4}$$

where $\hat{y}$ denotes GDP per capita per (working) hours, the measure of labor efficiency; k denotes physical capital per capita, u denotes education time per capital, which is the Proxy Variable of human capital, and c is the constant term including technical level and population level.

Equation (4) is a theoretical (economic) model showing that labor efficiency is determined by physical capital (k), human capital (u), and leisure time (l) in the form of natural logarithm. Equation (4) reveals that leisure time might have dual effects on efficiency. That is, leisure time may have both a positive or negative effect on efficiency. This is because leisure time has a known positive effect on human capital and working efficiency, as indicated above. On the other hand, leisure time has a negative effect on education time and working hours, thus would lead to a decline of production and pose a negative effect on efficiency.

In other words, labor efficiency is determined by factors such as capital, education time, and leisure. Nevertheless, our intent is to further explore the relative importance of these determinants, especially the role of leisure time. In the following section, we examine and compare the determinants of efficiency in three countries—China, the US, and Japan—to explore the effect of leisure time on labor efficiency.

4 Methods

4.1 Data Sources

For this study, we relied on secondary data mainly from the following sources, including the World Bank, the Organization for Economic Cooperation and Development Library (OECD), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the National Bureau of Statistics of China and China's Ministry of Human Resources and Social Security. Details on specific sources used in model testing are provided in the following text.

This study used 31 years (1980–2011) of time series data of the three countries. GDP per capita is usually used to measure the level of economic development, and therefore reflects the richness of an economy (Solow 1957; Romer 1986;Lucas 1988; Aghion and Howitt 1992; Gómez 2009), but it cannot be used to gauge the efficiency of a country. Labor efficiency indicates the growth potential of a nation and relates to the concept of time.

In this paper, the measure of an explained variable and explanatory variables is as follows. First, the explained variable, ($\hat{y}$) (GDP per capita per hour), is defined as per capita GDP divided by annual average working hours, where the data for GDP and gross population were obtained from the website of the World Bank (The World Bank 2014a). The website has database which contains key economic indicators, such as GDP, population and income level of 213 counties.

Second, per capita capital k is estimated by fixed capital formation per capita. In fact, constructing capital stock from investment data is a quite difficult and complicated task.

Here, we take no account of Capital Depreciation, and then it is suitable to construct capital stock by capital formation under Perpetual Inventory Method (Meinen et al. 1998; Bierens 1997a, b). The data of fixed capital formation is drawn from the website of the World Bank (The World Bank 2014b). The website also provided key economy and growth indicators such as GDP per capita, inflation and gross capital formation.

Third, education time u is gauged by average schooling hours of the population over 25 years divided by life expectancy of the same population group. Here the data for average hours of schooling are taken from the education databased provided by the Data Centre of the UNESCO website (2014) and the life expectancy data are taken from the World Bank website (The World Bank 2014c).

Fourth, as accurate data for leisure time are difficult to find, leisure time l is obtained by subtracting average working hours and education time from total hours of a year. The data of annual average working hours in the US and Japan are taken from the Organization for Economic Cooperation and Development Library (OECD 2014), where average annual hours actually worked of 38 countries (including US and Japan) are included. The data of annual average working hours in China is taken from the website of China's National Bureau of Statistics (2014) and Ministry of Human Resources and Social Security (2014).

Taking into account the impact of market exchange rate and price deflator, the production data of GDP is estimated using the Prices and Purchasing Parties (PPP) and the data of fixed capital formation is in the form of the constant 2005 US dollar. Here the production PPP GDP is gross domestic product converted to constant 2011 international dollars using purchasing power parity rates. All data and adjustment methods are based on World Development Indicators (The World Bank 2014d).

4.2 Data Analysis

Equation (4) shows that labor efficiency was determined by not only capital factors (e.g., physical capital k and human capital h) but also time factors (e.g., education time u and leisure time l). The data analysis consisted of three stages. The first stage excluded extreme outliers. Then, as time series data, working hours, and leisure time were not recorded every year, especially in China, the second stage treated missing data using within-group mean method (Downey and King 1998; Walker 2009). In the third stage, the regression models [see Eq. (5)] at the level of three countries were estimated respectively.

The statistic estimation model in linear regression is as followed

$$\hat{y} = c + \alpha_1 k + \alpha_2 u + \alpha_3 l + \varepsilon \tag{5}$$

here, c is intercepted, α_1–α_3 denotes the estimated coefficients, and ε is the stochastic error based on the assumption of a white noise process.

This model assessed the relationship between labor efficiency and its determinants (physical capital k, education time u and leisure time l). Equation (5) is the econometric model derived from Eq. (4)—the theoretical (economic) model. The model was tested using data from 1980 to 2011 in a time series. Normally, time series data may introduce the problem of serial correlation, so we first applied the least squares method (OLS) to estimate the three models. If the problem of serial correlation occurred in OLS, two-stage least squares (TLS) and the Newey–West method (1987) were employed to estimate the models. If serial correlation still existed in regression residuals, we introduced first and/or second auto regression [AR(1), AR(2)] into the regression. Fair (1970) proved that auto regression could be added into the regression to improve TLS with the problem of serial correlation.

He further pointed out that the lagged explained variable and lagged explanatory variables must be included in the list of instrumental variables to obtain the consistent estimate.

5 Results

The purpose of this study was to examine the determinants of labor efficiency and to determine, through transnational comparison, how leisure time would influence efficiency.

Table 2 reports the means and standard deviations for $\hat{y}$, k, u and l of three countries, using per-hour GDP per capita, $\hat{y}$, as a proxy of labor efficiency. Table 1 indicates that China had a much lower efficiency with the mean value of about 0.5 (dollar/h),which was 1/32 of Japan (M = 15.5702 dollars/h) and 1/34 of the US (M = 16.3799 dollars/h). It is surprising that China, as the world's largest economy, has such a low efficiency.

Table 2 also demonstrates the labor efficiency decided by three factors according to Eq. (5): physical capital (whose proxy variable is k), human capital (whose proxy variable is u), and social capital (whose proxy variable is l).

As for l, China's average leisure time is 5023.051 h, which is 2.63 % $\left(=\frac{5155.578-5023.051}{5023.051}\right)$ less than that of the US and 5.58 % $\left(=\frac{5303.374-5023.051}{5023.051}\right)$ less than that of Japan. These percentages mean that a Chinese worker has to work 132 and 280 h per year more than their American and Japanese counterparts respectively to reach the same level of production output. This gap will be expanded if we take the difference in leisure quality between China and the US into account, because Chinese people tend to engage in more passive leisure activities (Yin 2005). For example, 84 % of Mainland Chinese university students reported that their most frequent leisure activities were passive (Jackson and Walker 2006), a percentage little changed from that of the 1990s (Yu and Berryman 1996).

In other words, as Table 2 shows, the labor efficiency of the US was the highest among the three countries, followed by Japan. Of the three countries, China ranked last in terms of labor efficiency and also fell behind in leisure time.

Regression analysis helped structurally to figure out the reasons for these results. Three models (Model 1 for China, Model 2 for the US, and Model 3 for Japan) were regressed according to Eq. (5).

Unfortunately, the Durbin–Watson test revealed serial correlation in all OLS regression process for three models. Thus, the first-order autoregressive item [AR(1)] and the second-order autoregressive item [AR(2)] were added into the models to remove the serial correlation (Fair 1970) and problems of serial correlation were removed from Model 1 and Model 3. Here, lag truncation was equal to three and convergence was achieved after nine

Table 2 Summary statistics for efficiency $\hat{y}$, physical capital k, education time u, and leisure time l in three countries (1980–2011)

Variables	China		US		Japan	
	Mean	SD	Mean	SD	Mean	SD
$\hat{y}$ (dollar/h)	0.4842	0.5710	16.3799	6.4313	15.5702	6.6069
k (dollar)	465.9124	611.2212	5387.3647	1995.1623	7399.1039	2556.1761
u (h)	1175.6004	114.5482	1785.8284	57.7787	1538.6263	49.8029
l (h)	5023.051	162.3753	5155.578	55.79294	5303.374	96.86694

Table 3 Regression results of efficiency for four countries (1980–2011)

China (Model 1)				US (Model 2)			Japan (Model 3)		
Variables	Coefficient	t statistic	SE	Coefficient	t statistic	SE	Coefficient	t statistic	SE
c(*Intercept*)	−0.9230	−7.6004***	0.121449	−550.6292	−3.1603***	174.2281	−105.87	−5.0451***	20.9853
k	0.0009	56.017***	1.63E−05	0.001951	6.4860***	0.000301	0.0018	20.250***	9.14E−05
u	0.0001	2.0555**	8.24E−05	0.108047	4.5045***	0.023986	0.0075	0.6567	0.0114
l	0.0001	6.2487***	2.50E−05	0.070537	2.6595***	0.026522	0.0174	4.6744***	0.0037
AR(1)	0.6411	4.1961***	0.152803	0.717946	2.9903***	0.240085	1.9371	9.5348***	0.2031
AR(2)	−0.9564	−5.2593***	0.181850	−0.114929	−0.5142	0.223501	−0.9065	−4.9550***	0.1829
Adjusted R^2	0.998312			0.986665			0.994598		
S.E. of regression	0.023805			0.781247			0.496978		
Durbin–Watson	2.035233			1.932895			1.557973		
F-statistic	3431.864			358.5716			883.6992		

$*$ $p < .10$, $**$ $p < .05$, $***$ $p < .01$; Model 1 and 3 were estimated by OLS and the Model 2 was estimated by TLS with the Newey–West method to further alleviate the problem of serial correlation iterations for Model 1 and after 193 iterations for Model 3. To mitigate the serial correlation in Model 2, TLS with Newey–West Method was employed for the model (see Table 3).

Table 3 indicates the structural relationships among variables. First, the Ramsey test of statistics (Ramsey 1969) showed that the three models had a proper functional form as the F-test was passed (i.e., F = 3431.864 for Model 1; F = 358.5716 for Model 2; F = 883.6992 for Model 3). The estimations had high degrees of fit (adjusted $R^2 = 0.998312$, 0.986665, and 0.994598 respectively). Durbin–Watson test statistics (2.035233 for Model 1, 1.932895 for Model 2, and 1.557973 for Model 3) were acceptable,[5] and serial correlation was not a major problem for the three models.

We gradually added the autoregressive items to adjust the residual error of regression so as to minimize the Akaike information criterion and the Schwartz criterion as well as simultaneously controlling the residual error at an acceptable level. Additionally, the estimate coefficients of independent variables were relatively small because the range of values for the dependent variable was much less than that of the independent variables.

Second, for physical capital k, significant positive coefficients were at the level of $p < .01$ (China, t = 56.017; the US, t = 6.4860; Japan, t = 20.250). These results show that a higher level of physical capital, k, was significantly associated with a higher level of labor efficiency, $\hat{y}$.

Human capital u played a positive role in labor efficiency of China at the level of $p<.05$ (t = 2.0555). A higher u was significantly associated with a higher efficiency level for the US (t = 4.5045, $p < .01$). However, the effect of human capital on labor efficiency was not significant (t = 0.6567). As Table 3 shows, Japan's average hours of education 1538.6263 h, was much less 247 h than that of the US. As Japan, like the US, is a developed country, Japan's education time might be not adequately high or qualified to significantly contribute to its labor efficiency.

Third, the level of leisure time l contributes very slightly to labor efficiency for China (t = 6.2487, $p < .01$) as the coefficient of l is just 0.0001 which is surprisingly 0.14 % $\left(=\frac{0.0001}{0.0705}\right)$ of the US and 0.57 % $\left(=\frac{0.0001}{0.0174}\right)$ of Japan. The cases of the US and Japan demonstrated a different pattern in leisure effect: leisure time significantly contributes much more strongly to the efficiency than that of China (t = 2.6595, $p < .01$ for the US; t = 4.6744, $p < .01$ for Japan).

6 Discussion

This investigation demonstrates the important role of leisure time in labor efficiency. Results of this study reveal that different economies have different average leisure time, which in turn has different effects on labor efficiency.

As a developing country, China has relatively less leisure time and leisure time has little effect on efficiency, whereas the US, as a developed country, has more leisure time and leisure time has a relatively stronger positive effect on labor efficiency. Japan falls in the middle of China and the US in terms of leisure time and its effect on efficiency.

Figures 1 and 2 demonstrate above description. As Fig. 1 shows, Chinese annual leisure time experienced a steady growth from 1980 to 2011 (especially from 1995 to 2001when the central government promoted the 5-workday week policy in 1999 and the Golden

[5] Statistically, the problem of serial correlation could be ignored in the statistical experience if Durbin-Watson test statistics are significantly greater than 1.5 and less than 2.5 (Durbin and Watson 1971).

Week Holiday in 2000), but China's labor efficiency remained almost constant during the same period (see Fig. 2). These findings imply that an increase in leisure time did not contribute to China's labor efficiency. In contrast, a slight increase in leisure time of Japan brought a much stronger increase in its labor efficiency. Namely, Japan's labor efficiency saw a rapid growth as a result of a rapid increase in leisure time.

Why do different economies show different labor efficiencies in relation to leisure time? Generally, according to the theoretical model in this paper, labor efficiency is mainly determined by physical capital (k), human capital (u), and social capital (denoted by leisure time l), so it is natural for China to have much less labor efficiency than the US and Japan as$k$, u and l of China were all less than those of the US and Japan (see Table 2).

6.1 Proof Analysis

What limited leisure time's contribution to labor efficient in China? Why Leisure time cannot contribute to labor efficiency as much as the US and Japan in China?

First, the passive leisure participation of Chinese people might be the main reason for the relationship between labor efficiency and leisure time. Passive leisure participation would lead to individual's low energy level and low productivity. For example, watching TV watching is considered as a typical type of passive leisure participation (Lu and Hu 2005) because people who watched a lot of TV experienced lower leisure satisfaction, less happiness and lower work satisfaction more often (Lu and Argyle 1994). Another literature revealed that a passive leisure lifestyle (such as smoking and high body mass index) has an effect on Leukocyte Telomere Length (LTL) and may accelerate the aging process. Unfortunately, a number of studies indicated that Chinese people would like to engage in passive leisure activities. Yu and Berryman (1996) found that leisure activities of Chinese students were mostly unorganized, passive, and solitary. The passive participation pattern in leisure of Chinese people is partially explained by the Confucianism culture (Schutte and Ciarlante 1998), under which, leisure was undervalued, leading to the predominantly passive leisure activities in Chinese leisure time (Li 2009). As a result, the increase in leisure time did not have a positive effect on China's labor efficiency.

Second, the amount of active leisure participation of the US and Japan could result to higher labor efficiency.

On the one hand, positive leisure activities do help to increase individual's productivity. Walsh(1982) found that active leisure participation prepares workers to be more productive. In fact, a true leisure-inclusive welfare index indicated the compensatory change in wage rates (labor efficiency) (Kokoski 1987). It is indicated that more educated people exercise more, which further enhance the human capital(Biddle and Hamermesh 1990; Mullahy and Robert 2010; Podor and Halliday 2012).

On the other hand, generally speaking, Americans and Japanese engaged more in active leisure activities. In the case of the US, Americans gradually increased participation in diverse leisure activities. In 1970s, the top-ranked leisure activities (from highest to lowest) were watching TV, playing with children, visiting with friends, entertainment outside the home, reading, hobbies and games, shopping, participating in sports, and attending sports events as a spectator (Arndt et al. 1980). In 2011, the top-ranked leisure activities (from highest to lowest by participation rate) were fitness walking, collecting, going to movies, going to the beach, outdoor activities in public parks, reading, social networking, travel, and watching TV (*Leisure Market Research Handbook* 2012). Overall, the most popular leisure activities in the US are steadily becoming more diverse. While this improvement is

Fig. 1 Leisure time of three countries, 1980–2011

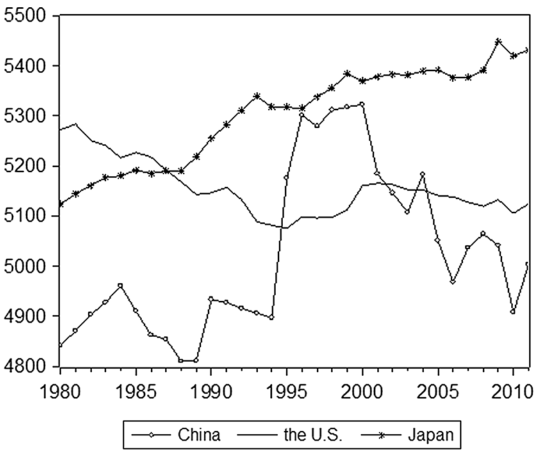
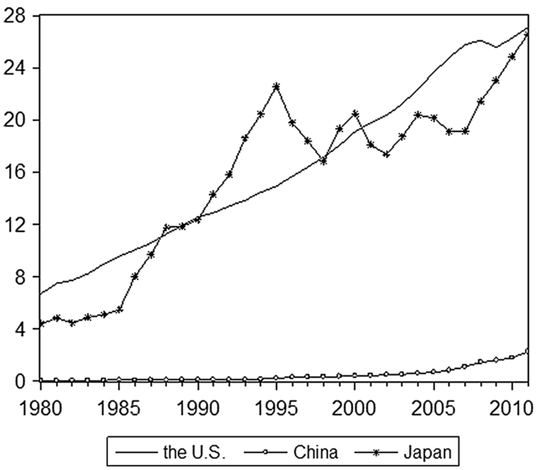


Fig. 2 Efficiency (per hour GDP per capita) for three countries, 1980–2011



modest, it indicates that Americans are moving in the right direction as they focus on getting in better physical shape to enhance productivity.

In Japan's case, the Japanese government began to increase leisure time and emphasize a more leisurely lifestyle in 1988. Leisure became the most important aspect of national life, exceeding housing and food (Harada 1994). Beginning in the 1980s, sports and recreation became significant parts of young Japanese people's lives, as Japanese people strongly encouraged their children to participate in group activities and outdoor sports to cultivate a spirit of discipline, cooperation, and voluntary service (Culkin 1989). As a result, Japan's labor efficiency was enhanced, accompanied by the increase in leisure time (Harada 1994).

Like Japan, most developed countries have experienced a positive relationship between leisure and efficiency (Barnett 2006). Since the1980s, most OECD countries have achieved very high GDP per capita with the increase of leisure time (Fogel 2000).

6.2 Practical Implications

Apparently, active participation in leisure time improved the quality of human capital and further improved labor efficiency in the US and Japan. China, however, has not fully captured the positive effect of leisure on labor efficiency owing to relatively less leisure time and, more importantly, a negative participation pattern in leisure activities. The results of this study have several practical implications.

First, although China has witnessed a growth in leisure time, the results of the study suggested that the Chinese government must continually increase people's quality of leisure time to fully benefit from the positive effect of leisure time on labor efficiency. The total number of official days off in China has grown steadily, from 62 days in 1978 to 114 days in 1996 and 115 days in 2008 (Wei et al. 2010). This increase will unquestionably help to facilitate the positive effect of leisure time on labor efficiency.

Second, in line with the increase of leisure time, Chinese workers also need to change the way they participate in leisure activities. Researchers suggest that passive leisure activities, such as television viewing and internet surfing, are negatively correlated with people's well-being (Argyle 2001; Shaw and Gant 2002), while active leisure activities, such as exercise and travel, are positively associated with greater well-being (Hills and Argyle 1998). Therefore, people should be encouraged to participate in more active leisure pursuits in their free time. The government should also provide more space and facilities to encourage active sports and leisure activities in the short run. In the long run, support should be given to improving the quality of the infrastructure and the environment.

Third, a recent survey by the Chinese magazine *Qiushi* in 2012 showed that 82.8 % of the respondents felt they were overworked, which is consistent with the findings of Roberts(2013)'s study. Furthermore, 66.8 % felt their health conditions were poor, and 78.6 % reported that young friends, colleagues, or peers had died or experienced incurable illnesses in the last year. Stress, long working hours, and difficulty sleeping are the three biggest health concerns, suggesting that despite the steady increase in leisure time, overwork is still a common issue among Chinese people. Particularly for the younger generation, being the only child in the family results in additional pressure. Therefore, it is sensible for employers to encourage the younger generation to focus less on working overtime and more on improving work efficiency, which could be accomplished through better time allocation and active participation in physical/leisure activities.

7 Conclusions and Limitations

Since the publication of Torstein Veblen's *Theory of the Leisure Class* in 1899, the field of leisure studies has been well developed by economists, sociologists, and psychologists. However, a paucity of cross-cultural comparative leisure research has led investigators to advocate the integration of anthropological research into leisure studies (Dong and Chick 2012). This study partly responds to this call by comparing three economies—the US, China, and Japan—from the perspective of leisure study.

These three largest economies in the world have large population sizes: the US has 310 million people, China has more than 1.3 billion people, and Japan has 130 million people. No previous study has attempted to look into the impact of leisure time using a comparative approach. This study used 31 years (1980–2011) of longitudinal data of the three countries, and generates interesting findings and makes contributions to the existing literature. This study revealed that the US and Japan, as typical developed countries, enjoyed higher labor efficiency from longer leisure time and more active leisure participation. China, however, as a typical developing country, increased leisure time did not show such an effect, in large part because Chinese leisure participation is mostly more passive than American and Japanese leisure participation.

As a single study, this study is not free of limitation. Due to the accessibility limit, only 35 years of data were included. According to Phillips (2004), developing an econometric model that can help understanding an economic phenomena based on available observation is a fundamental challenge. The simplification from the economic model to the econometric model may blur the real nonlinear relationship between education time (u), leisure time (l) and the explained variable ($\hat{y}$, GDP per capita per hour). Fortunately, our simplification model passed through all statistic tests in this paper's sample pool. Future research may consider using a panel data regression to test the effect of leisure on efficiency as a whole. This may yield interesting findings. If data available, including one or two more developed countries repeat the analysis may reveal some interesting comparisons between developed countries and developing countries. A more specific look into type of leisure participation (positive or negative) may provide more explanation on why leisure time did not contribute to the labor efficiency in China as expected.

Appendix: Raw data

See Tables 4, 5, 6, 7, and 8.

Table 4 GDP per capita per hour for China, US and Japan (1980–2011)

Year	China	US	Japan
1980	0.068457616	6.717903	4.388420
1981	0.069267435	7.497886	4.849182
1982	0.071517985	7.736079	4.481404
1983	0.079114748	8.241805	4.875398
1984	0.088105555	8.998576	5.117071
1985	0.103417423	9.579962	5.478130
1986	0.09906459	10.08057	8.050679
1987	0.089048004	10.58035	9.711644
1988	0.099619563	11.27009	11.75563
1989	0.10915854	11.91954	11.83853
1990	0.116528284	12.58216	12.37008
1991	0.12173591	12.89508	14.28467
1992	0.133428134	13.41272	15.78303
1993	0.136946428	13.84731	18.60960
1994	0.171249468	14.46802	20.45042
1995	0.247758804	14.94532	22.57010
1996	0.306821578	15.67976	19.77890
1997	0.336686142	16.40392	18.38869
1998	0.35552108	17.16525	16.81177
1999	0.376077464	18.04664	19.33636

Table 4 continued

Year	China	US	Japan
2000	0.414552501	19.10780	20.47870
2001	0.444916156	19.79732	18.08536
2002	0.481763586	20.34223	17.37241
2003	0.538017331	21.23597	18.72759
2004	0.628189697	22.35977	20.39256
2005	0.694553599	23.63335	20.15844
2006	0.839028377	24.79036	19.11559
2007	1.11749636	25.77815	19.10078
2008	1.46784942	26.09350	21.44113
2009	1.60844237	25.57552	23.02997
2010	1.80884552	26.26632	24.84890
2011	2.27257605	27.10776	26.56405

Table 5 Leisure time (hours) per year/person for China, US and Japan (1980–2011)

Year	China	US	Japan
1980	4841.411	5271.881	5123.343
1981	4871.061	5283.671	5144.156
1982	4903.844	5250.981	5160.728
1983	4928.223	5240.920	5177.035
1984	4961.259	5216.334	5179.883
1985	4910.707	5226.915	5191.221
1986	4862.537	5217.882	5185.009
1987	4854.667	5191.566	5189.668
1988	4810.155	5168.212	5189.494
1989	4810.584	5142.799	5218.001
1990	4933.734	5146.205	5255.015
1991	4927.662	5156.999	5282.317
1992	4916.194	5132.230	5311.167
1993	4906.760	5088.516	5338.417
1994	4897.208	5081.193	5317.714
1995	5176.244	5075.316	5317.039
1996	5300.934	5098.521	5314.428
1997	5279.068	5096.007	5338.258
1998	5311.338	5097.746	5355.266
1999	5317.442	5112.683	5384.069
2000	5322.965	5160.192	5369.267
2001	5183.928	5165.341	5378.104
2002	5145.669	5162.923	5383.155
2003	5107.071	5152.662	5381.696
2004	5182.826	5152.089	5389.111
2005	5051.346	5140.857	5391.387
2006	4968.084	5138.021	5376.223

Table 5 continued

Year	China	US	Japan
2007	5037.214	5127.639	5375.933
2008	5064.375	5119.425	5391.115
2009	5041.500	5132.793	5447.824
2010	4907.912	5105.378	5420.248
2011	5003.702	5124.597	5431.664

Table 6 Education time per year/person for China, US and Japan (1980–2011)

Year	China	US	Japan
1980	1099.004	1675.119	1515.657
1981	1069.355	1672.329	1509.844
1982	1039.456	1708.019	1495.272
1983	1009.901	1699.080	1487.965
1984	980.6569	1705.666	1472.117
1985	1027.964	1697.085	1475.779
1986	1079.250	1714.118	1477.991
1987	1104.452	1735.434	1474.332
1988	1129.436	1754.788	1478.506
1989	1132.504	1768.201	1471.999
1990	1127.946	1782.795	1473.985
1991	1123.613	1785.001	1479.683
1992	1124.676	1807.770	1483.833
1993	1123.705	1842.484	1516.583
1994	1122.852	1841.807	1544.286
1995	1144.980	1840.684	1558.961
1996	1167.439	1826.479	1553.572
1997	1180.667	1817.993	1556.742
1998	1139.761	1816.254	1562.734
1999	1143.217	1800.317	1565.931
2000	1147.390	1763.808	1569.733
2001	1234.872	1780.659	1572.896
2002	1257.474	1787.077	1578.845
2003	1285.643	1807.338	1579.304
2004	1204.674	1805.911	1583.889
2005	1216.226	1820.143	1593.613
2006	1325.559	1821.979	1599.777
2007	1350.286	1834.361	1599.067
2008	1370.053	1848.575	1597.885
2009	1387.715	1860.207	1598.176
2010	1401.373	1876.622	1606.752
2011	1367.112	1848.403	1600.336

Table 7 Fixed capital formation per capita for China, US and Japan

Year	China	US	Japan
1980	56.15372	2487.402	2936.868
1981	53.47382	2725.458	3120.920
1982	56.88315	2653.843	2768.673
1983	64.52280	2809.335	2834.174
1984	73.95517	3254.956	2950.022
1985	86.47088	3463.711	3158.988
1986	85.30807	3573.853	4644.190
1987	78.57001	3650.599	5774.421
1988	87.82160	3827.419	7369.512
1989	79.97277	4007.390	7626.860
1990	81.31692	4019.662	8029.710
1991	91.89798	3820.840	9013.924
1992	114.7266	3962.747	9418.687
1993	140.7990	4240.937	10350.95
1994	168.5415	4590.196	10958.11
1995	207.5758	4886.998	11800.24
1996	237.5601	5235.454	10531.33
1997	254.6318	5623.916	9454.044
1998	277.8517	6065.165	7994.053
1999	294.3662	6554.616	8919.809
2000	323.7868	7025.032	9399.754
2001	358.6380	6950.231	7949.378
2002	411.7084	6715.684	7147.120
2003	501.5944	6953.964	7579.210
2004	607.0248	7575.683	8087.112
2005	694.8647	8299.026	7993.668
2006	841.4014	8789.801	7732.993
2007	1036.810	8787.602	7695.395
2008	1392.243	8334.266	8520.276
2009	1723.020	6894.708	8209.927
2010	2013.156	6881.856	8650.326
2011	2412.548	7733.320	8150.676

Table 8 Annotations for equations

Letters	Annotations
Equation (1) $Y = \bar{A}K^{\beta}H^{1-\beta}$	Y denotes aggregate production, $\bar{A}$ represents an exogenous technical level, K is aggregate capital, β represents the elasticity of K to Y, and H denotes human capital. L denotes the averaged leisure time of a country
Equation (2) $\bar{A} = AK^{\alpha}l^{1-\alpha}$	A denotes an exogenous technology level, a is the elasticity of K to $\bar{A}$, and (1 – a) is the elasticity of l to $\bar{A}$

Table 8 continued

Letters	Annotations
Equation (3) $H = uL$	u denotes education time and L denotes aggregate labor force
Equation (4) $\ln \hat{y} = c + (\alpha + \beta)\ln k + (1 - \beta)\ln u - \ln(1 - u - l)$	$\hat{y}$ denotes GDP per capita per (working) hours, the measure of labor efficiency; k denotes physical capital per capita, u denotes education time per capital, which is the Proxy Variable of human capital, and c is the constant term including technical level and population level
Equation (5) $\hat{y} = c + \alpha_1 k + \alpha_2 u + \alpha_3 l + \varepsilon$	c is intercepted, denotes the estimated coefficients, and ε is the stochastic error based on the assumption of a white noise process

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