Is Productivity on Vacation? The Impact of the Digital Economy on the Value of Leisure

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Abstract

National accounts exclude the value of non-market production. Many of the recent innovations, such as smart phones, augment the value of leisure time so the full value of such innovations may not be captured by GDP. Therefore, the productivity impact of such innovations will be understated. I examine this question accounting for all uses of time: market, household production and leisure. I develop the theoretical foundations of how to measure the value of leisure when it is produced using time and recreational durable goods. I then apply this framework to estimate the value of U.S. leisure from 1950 to 2014. While the value of leisure is large, there is a stable relationship between measured GDP and unmeasured leisure. The stock of internet devices owned by households is small relative to the overall economy. Household digital goods do not have a quantitatively important effect on productivity.

JEL classification: E2, J2

Keywords: Leisure; Consumer durables; Total income; Household production; Productivity.

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1 Introduction

National accounts exclude the value of non-market production, largely for practical reasons. Previous work has shown that household production would change output and productivity significantly if it were included in output (Bridgman 2013). Leisure, though it is the largest single category of time use, has not been studied in the same detail.

Some economists have argued that this exclusion contributes to the "missing productivity" of the digital economy. These technology optimists argue that GDP have difficulty measuring the impact of the digital economy (Ahmad & Schreyer 2016). Therefore, the recent slow growth of productivity is a measurement problem. A facet of this argument is that many recent high tech innovations, such as smart phones, augment the value of leisure time. They require a great deal of a consumer's time, an aspect sometimes referred to as the "attention economy" (Brynjolfsson & Oh 2012). Therefore, the full value of such innovations may not be captured by the national accounts.

There is an opposing force to this argument. People may trade off market produced leisure services for non-market leisure. Under this scenario, some GDP growth would reflect the reallocation of non-market to market activity (Cruz & Raurich 2016). Costa (1997) documents a long run increase in market purchases of leisure goods and services. This marketization has been an important force in household production, another non-market use of time (Bridgman, Duernecker & Herrendorf 2015).

This paper examines the value of all uses of time – market, household production and leisure – a concept Becker (1965) referred to as total income. I use this framework to evaluate the full welfare value of recreational innovations. I begin by using the Diewert & Schreyer (2014) framework to develop the theoretical foundations of how to measure the value of leisure when it is produced using time and durable recreational goods. I show that the theoretically correct returns needed to impute the value of leisure can be found in the market. I solve a model assuming that leisure is produced by market firms to find the market prices that correspond

to the returns to the factors of production. Using these theoretical results, I calculate value of leisure for the United States from 1950 to 2014.

I find that leisure is a large portion of total income. However, total income grows at nearly the same rate as GDP. Its share has been relatively constant over time, so the value of leisure is roughly proportional to GDP. So while GDP misses a great deal of the level of welfare, it has a small effect on growth rates.

The productivity impact of leisure durables is relatively small. Despite increasing capital usage in leisure production, it is a very labor intensive activity. This capital deepening occurred between 1965 and 1980, prior to the digital economy. Even if the stock of internet devices were underestimated, the degree of mismeasurement would have to be unrealistically large to have a quantitative effect on productivity. Even with significant quality adjustment, the stock of internet devices owned by households is small relative to the overall economy.

This paper is part of a literature on the measurement of well-being outside of GDP. There is concern that welfare comparisons based only on GDP may give misleading answers (Stiglitz, Sen & Fitoussi 2009, Diewert & Schreyer 2014, Jones & Klenow 2016). Part of this literature examines the digital economy specifically. Soloveichik (2014) analyze the measurement challenges of services that are provided for free. Goolsbee & Klenow (2006) examine the value of the internet by including non-market time.

A number of papers have included leisure production. Ngai & Pissarides (2008), Vandenbroucke (2009) and Bridgman (2016*b*) examine changes in hours using models with leisure production. Other papers have considered the value of leisure as a combination of time and goods. Goolsbee & Klenow (2006) use such a framework to examine the value of using the internet. Kaplow (2010) examines taxation of market goods that are complements to leisure. Soloveichik (2014) examines the value of "free" entertainment. Gronau & Hamermesh (2006) examine the time and goods intensity of household activities. Gonzalez-Chapela (2007) and Gonzalez-Chapela (2011), which estimates the elasticity of labor supply with respect to recreational goods prices for men and women respectively. Earlier work in this vein include Owen

(1971) and Abbott & Ashenfelter (1976).

2 Model

This section lays out the methodology for the estimating the value of leisure. I present a model that shows the theoretical justification for the imputations used in the estimation and describe how the estimates were constructed.

2.1 Environment

The representative household's preferences over market and home consumption goods (C_t^m and C_t^h respectively) and leisure l_t are represented by $u(C_t^h, C_t^m, l_t)$.

The household has a unit of time that it can allocate to market, home or leisure production. The share of time devoted to each activity given by H_t^j for $j \in \{m, h, l\}$:

$$H_t^h + H_t^m + H_t^l \leq 1 \tag{2.1}$$

Market time earns a wage w_t^m.

Leisure is produced using leisure production time H_t^l and leisure capital K_t^l:

$$l_t = F^l(K_t^l, L_t^l) \tag{2.2}$$

The home consumption good is produced using home hours H_t^h and home capital K_t^h:

$$C_t^h = F^h(K_t^h, L_t^h) \tag{2.3}$$

The laws of motion for the capital stocks K_t^j for $j \in \{l, h, m\}$ is given by:

$$K_{t+1}^j = K_t^j(1 - \delta_j) + X_t^j \tag{2.4}$$

where X_t^j is investment and δ_t^j is depreciation. The rates of return are given by R_t^j.

Market consumption and both types of investment are produced by a market technology

$$C_t^m + X_t^m + X_t^h + X_t^l = F^m(K_t^m, H_t^m) \tag{2.5}$$

There are one period bonds B_t. Bonds purchased in period $t-1$ pay the return $1+R_t^b$ in the next period.

The returns to market capital and bonds are taxed at the rate τ^k and market wages at the rate τ^l.

2.2 Equilibrium

To find the equivalent prices for the returns to the factors of production for leisure, I solve the model assuming it is market good produced by market firms using market prices.

Under this ownership structure, leisure firms hire labor L_t^l at wage W_t^h and rent leisure capital K_t^l at rate R_t^l. Its problem is

$$\max p_t^l F^l(K_t^l, L_t^l) - W_t^l L_t^l - R_t^h K_t^h \tag{2.6}$$

where p_t^l is the leisure price. The price of market firm output is numeraire. The market consumption and investment firms' problem is to maximize

$$F^m(K_t^m, L_t^m) - W_t^m L_t^m - R_t^m K_t^m \tag{2.7}$$

The household's budget constraint is

$$c_t^m + X_t^m + X_t^h + X_t^l + p_t^l C_t^h + B_{t+1} = (1-\tau_t^l) W_t^m L_t^m + (1-\tau_t^k) R_t^m K_t^m + W_t^l L_t^l + R_t^l K_t^l + B_t(1+(1-\tau_t^k) R_t^b) \tag{2.8}$$

It includes the market income from leisure work and capital as well as the market purchases of leisure.

An equilibrium for given government policy $\{B_t, R_t^b\}$ is prices and allocations such that the stand-in household chooses consumption, investment and labor to maximize utility subject to the budget constraint (Equation 2.8) and its resource constraints (Equations 2.1, and 2.4), the market and leisure firms solve their problems (Equations 2.7 and 2.6), and .

The definition of equilibrium is standard.

Definition 2.1. *An equilibrium for given government policy* $\{B_t, R_t^b, \tau_t^k, \tau_t^l\}$ *is sequences of prices* $\{p_t^l, W_t^m, W_t^l, R_t^m, R_t^l\}$ *and quantities*
$\{C_t^m, C_t^h, l_t, K_t^j, X_t^j, L_t^j\}$ *such that, given prices and policy,*

1. *Households choose* $\{C_t^m, C_t^h, l_t, K_t^j, X_t^j, H_t^j\}$ *to solve their problem;*
2. *Market firms choose* $\{C_t^m, K_t^m, X_t^j, L_t^m\}$ *to solve their problem;*
3. *Leisure firms choose* $\{l_t, K_t^l, L_t^l\}$ *to solve their problem;*
4. *The resource constraints (Equations 2.3, and 2.5) are satisfied.*

2.3 Imputation

The value of leisure is equal to the value of its inputs:

$$p_t^l F^l(K_t^l, L_t^l) = W_t^l L_t^l + R_t^l K_t^l \tag{2.9}$$

Therefore, we need measures of home wage and return to capital to value leisure. I will show that prices observable in the market are the correct prices for imputing the income to the factors of production.

Let $u_j(t)$ be the partial derivative of the utility function with respect to consumption type $j \in \{m, h, l\}$ and let $F_k(t)$, $F_l(t)$ $G_k(t)$, and $G_l(t)$ be the parallel objects for the leisure and market consumption production functions respectively.

To make the household willing to save both by holding home capital and bonds, the net returns of both assets must be the same: $1 + R_t^l - \delta_l = 1 + R_t^b(1 - \tau_t^k)$. Therefore, the gross return to household capital is bond returns plus the depreciation of leisure capital.

$$R_t^l = (1 - \tau_t^k)R_t^b + \delta_l \tag{2.10}$$

For the household to allocate hours to both leisure and market work, the marginal returns to both activities are equalized. Therefore, in equilibrium $W_t^l = (1 - \tau_t^l)W_t^m$.

Finally, the model generates a price of leisure. In equilibrium, the ratio of marginal utilities to market consumption and leisure is equal to the price ratio. Since the price of market consumption is numeraire, we have $p_t^l = u_l(t)/u_m(t)$.

These price equations are derived from the solution to the problem where leisure is produced in the market, which is not how leisure works in reality. However, the solution is the same whether leisure is produced in the market or by the household. It is easy to show that the allocation in the market leisure equilibrium is equivalent to that with non-market leisure. (This is parallel to a equivalence result for household production in Bridgman (2013).) Therefore, the market prices used to impute leisure are correct.

2.4 Estimates

Based on the above analysis, we need estimates of the factors of production and their returns for leisure production that is not currently included in GDP.

I need to allocate time to the three uses in the model: market work, home production and leisure. I use market hours from BEA NIPA Table 6.9. For home production, I use the output and hours estimates of Bridgman, Dugan, Lal, Osborne & Villones (2012), Bridgman (2013) and Bridgman (2016*a*). I set per capita leisure hours to 5200 less market work and household production hours. I use 5200 since working age people typically have 100 of non-sleep or personal care hours per week in a broad set countries, including the United States (Bridgman et al. 2015).

To measure household production, I use estimates from Bridgman (2013). I use the restrictive definition of home production that excludes recreational capital and the portion of autos used for market work commuting to avoid double counting. I use the market services PCE deflator to obtain real home output.

The capital in household production is the net stock of consumer recreational durables, drawn from BEA's fixed asset tables. The net rate of return for durables is the rate of return on household financial assets. Specifically, it is personal interest and dividend income drawn from

the NIPAs divided by household financial assets from the Federal Reserve's Financial Accounts of the United States.

To value leisure, I need a market wage. I use NIPA labor compensation divided by total market hours. To get the gross return, I add the value of depreciation from the fixed asset tables. I use the tax rates from McDaniel (2011). I set the labor tax rate equal to $(1 - 1.6 * \tau_i - \tau_{ss})/(1 + \tau_c)$, where τ_i, τ_{ss} and τ^c are income, social security and consumption taxes respectively. Following Prescott (2004), I scale up income taxes by 1.6 to account for the difference in average and marginal tax rates.

3 Value of Leisure, 1950-2014

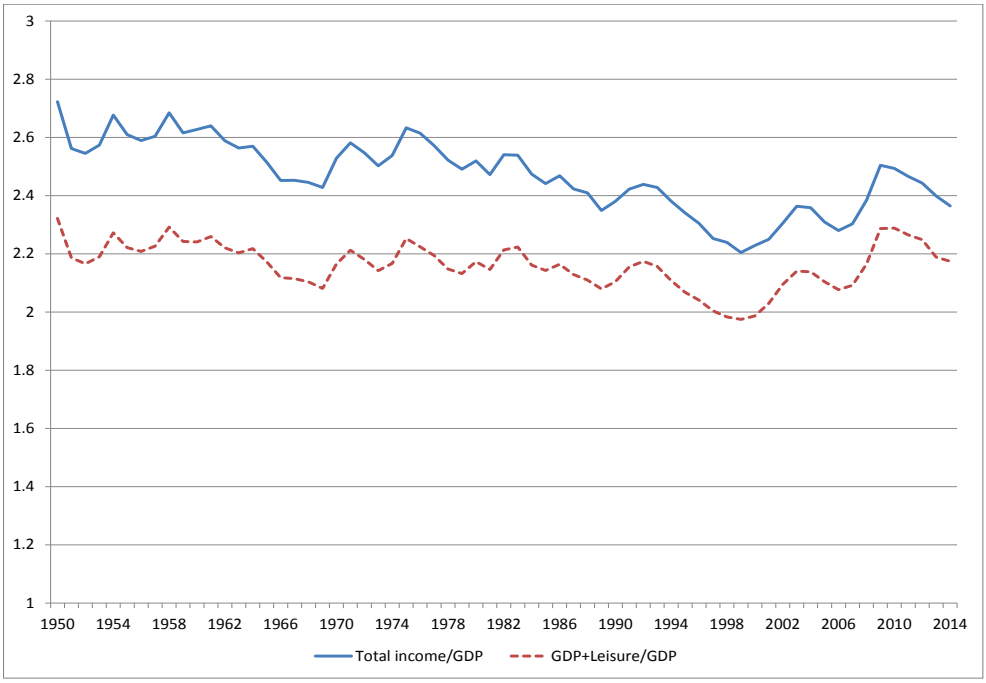
The estimates allow us to examine the value to total income, the economic value of all uses of time (Becker 1965). Total income combines the value of market activity, captured in GDP, with non-market time uses, leisure and home production. Figure 1 reports the ratio of U.S. total income to GDP. The value of non-market time is large compared to GDP, more than twice as large. This ratio has declined. Most of the decline is due to the decline in home production. The ratio of the value of leisure plus GDP to GDP is much more stable. While excluding the value of leisure leaves out a great deal of value, there is a relatively stable relationship between measured GDP and unmeasured leisure.

There was an increase in the relative importance of leisure coincident with the 2007-09 recession. This effect has been declining, suggesting that it may have been a cyclical effect.

Most work, such as Aguiar & Hurst (2007) and Ramey & Francis (2009), looks only at hours. While the number of those hours and their total value are correlated, there are some differences. Figure 2 compares leisure's shares of both total income and hours. There is a slow increase in leisure hours share while the value share is more constant. Both are grow to historic highs in the 2000s, accelerating with the 2007-09 recession.

The value of leisure is likely to be an upper bound. Non-participants in the labor market

Figure 1: Ratio of Total Income and Leisure to GDP, 1950-2014

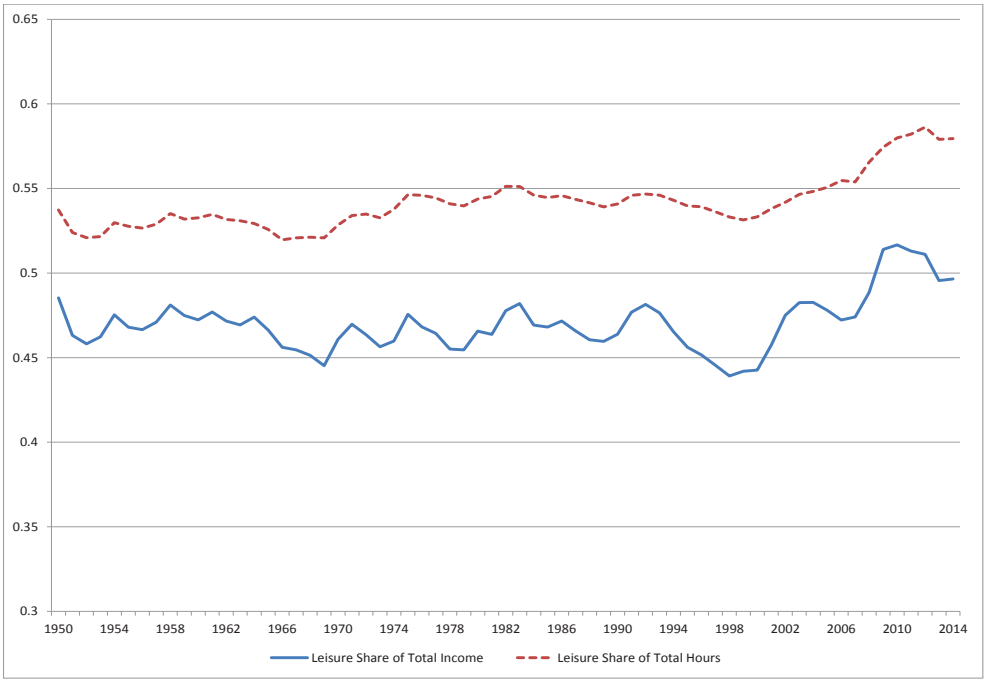


are likely to have lower wages than participants. If there is a disutility of market work, part of the market wage is compensation for this disutility. Therefore, the correct wage would be lower (Byrne, Fernald & Reinsdorf 2016). While there may be measurement issues that may underestimate the value of leisure, on balance it appears that leisure is overvalued.

4 Role of Leisure Goods

Productivity growth has been slower recently despite some significant innovations related to computer and communications technology. A literature has suggested that GDP does not fully

Figure 2: Leisure Shares of Total Income and Hours, 1950-2014



capture the benefits of these innovations, understating productivity growth. Part of the benefit of these technologies is they make leisure more enjoyable, which will not be captured by GDP.

I do not find a strong effect of including leisure on productivity. The value of nominal total income per hour grows slower than nominal GDP per hour. GDP averaged 5.0 percent versus 4.8 percent for total income from 1950 to 2014.

Leisure production is very labor intensive. Capital share averages 1.4 percent. There is capital deepening, but the major movements occur prior to the introduction of computers and other high tech goods to the household. The share of recreational goods in total household consumer durables increases from 14 percent in 1955 to 21 percent in 1975. After this period,

recreational goods share is flat to slightly increasing. It was 23 percent in 2014. While part of this increase is due to television, sporting equipment and recreational vehicles also show major increases.

This definition of recreational goods is restrictive. In particular, it excludes telephones. However, including communications equipment and luggage has little effect. The average capital share only increases to 1.6 percent and the pattern is largely unchanged. We could further expand the stock of leisure capital to include some portion residential capital. This would significantly increase capital share since residential capital stock are large. However, these services are already in GDP so do not have a productivity effect on total income. Further, the productivity optimists' argument focusses on new internet goods, not houses.

It is possible that the stock of internet devices were underestimated, as it is an industry with rapid change and many new goods. Increasing this stock would increase output since capital income is the stock multiplied by the rate of return. However, internet devices are already given significant quality adjustment and the stock of owned by households is small relative to the overall economy. The degree of mismeasurement would have to be unrealistically large to have a quantitative effect on productivity. The results are consistent with the more pessimistic view in work such as Gordon (2015), Byrne et al. (2016), and Syverson (2016).

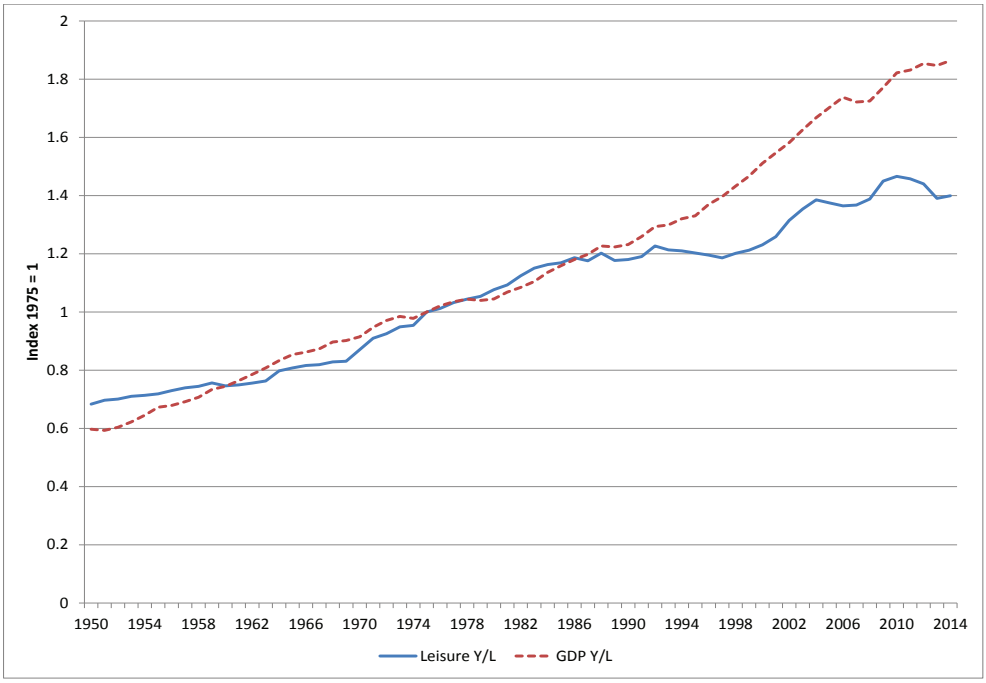
4.1 Leisure Productivity

The above analysis only looks at nominal changes. To measure productivity, we need to deflate the imputed nominal household output to put it in real terms. As shown in the theory section, the market does not provide an exact analogue for output price. There is an unobserved wedge between market and leisure prices. The strategy I use to get around this problem is to select a price that is as close as possible to minimize that wedge. I use the recreation services PCE deflator.

Figure 3 shows labor productivity for the market and leisure sectors. The two grow at a similar rate until the 1990s, when leisure productivity growth flattens out. It begins to grow

again in the 2000s, but remains does not make up the gap. There is not a significant impact of the high tech revolution on leisure productivity.

Figure 3: Market and Leisure Labor Productivity, 1950-2014



5 Conclusion

National accounts exclude the value of non-market production. Many of the recent innovations, such as smart phones, augment the value of leisure time so the full value of such innovations may not be captured by the national accounts. Therefore, the productivity impact of such innovations will be understated. I examine this question examining all uses of time: market,

household production and leisure. I develop the theoretical foundations of how to measure the value of leisure when it is produced using time and recreational durable goods. I then apply this framework to estimate the value of U.S. leisure from 1950 to 2014. While the value of leisure is large, there is a stable relationship between measured GDP and unmeasured leisure. The stock of internet devices owned by households is small relative to the overall economy. Household digital goods do not have a quantitatively important effect on productivity.

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