WORKING HOURS, WORK INTENSITY, AND CROSS-COUNTY WELFARE

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Abstract. Workers' effective labor input is the product of hours worked times work intensity. The existing evidence suggests that differences across countries and over time in average work intensity can be substantial and have a large impact on relative TFP and welfare. Long run differences in work intensity are typically assumed to be an exogenous cultural trait (*industriousness*). This paper provides a simple theory predicting that higher wages lead to higher work intensity (which increases as hours worked decrease). The model helps understand an important difference in the way of life between modern industrial societies, in which leisure is linked to consumption, and traditional societies, in which leisure is mostly associated to activities such as socializing that to some extent can also be carried out in the workplace. A calibrated version of the model shows that the recent cross-country welfare comparisons that do account for differences in leisure time but do not for differences in work intensity are likely to significantly overstate welfare inequality between rich and poor countries.

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1. Introduction

Workers' effective labor input is the product of hours worked times work intensity (pace and attentiveness or effort). Although the latter component is difficult to estimate, the existing evidence (see below) indicates that long run differences in average work intensity across countries and over time can be substantial (Denison 1962, Clark 1987a and 1987b). Why do different communities work with different average intensities? What are the implications for relative TFP and welfare? Cross-country differences in work intensity are typically explained as an exogenous local cultural trait: *industriousness*. However, this explanation has several difficulties. First, local culture and social norms certainly shape the effort that is considered fair value for the wage rate being paid and can strongly influence individuals' incentives to exert effort. Complementarities in production also affect these incentives and increase the social component and inertia of work intensity. However, it is unlikely that cultural traits that have a substantial economic impact, such as industriousness, are completely independent of the economic environment in the long run.[1] Second, as income per capita increases, work intensity appears to increase while hours worked decrease (Bick, Fuchs-Schündeln, and Lagakos 2018). As both hours worked and work intensity are complementary dimensions of industriousness, it is unclear how an cultural differences in industriousness can explain that they move in opposite directions. Third, average work intensity also appears to increase over time as a country develops, which suggests that work intensity evolves endogenously changing in response to economic changes.

This paper provides a simple theory explaining differences in average work intensity across countries and over time based on rational behavior facing different economic environments. The theory (i) predicts higher work intensity in richer countries, (ii) is consistent with hours and intensity moving in opposite directions, (iii) has significant implications for cross-country welfare comparisons. The model in this paper is parameterized and calibrated to provide a new perspective on the recent calculations that include data on cross-countries differences in hours worked (i.e., Jones & Klenow 2016; Bick, Fuchs-Schündeln & Lagakos 2018).

[1]In fact, there is growing evidence of a long-run connection between culture and the economic environment; see Fernandez (2011) for a survey of the literature. In Raquel Fernandez's concluding words, "...cultural preferences and beliefs have a life of their own in the sense that, even when removed from the environment in which they originated, they continue to exercise influence over individual outcomes. The evidence also shows, however, that there is some convergence over time both in economic outcomes and in attitudes. This indicates, not surprisingly, that culture changes in response to a new environment."

Assessing differences in work intensity is difficult because it requires comparing the output of workers performing an identical task, having identical skills, and using identical technology. The standard reference is Clark (1987a), who compares productivity in cotton mills across countries in 1910 while controlling for differences in inputs, technology, management, and workers' training or inherent abilities. He finds that one worker in New England performed as much work as 1.5 British, 2.3 German, and nearly 6 Greek, Japanese, Indian, or Chinese workers. Similarly, Clark (1987b) documents very large differences in productivity across Europe in wheat threshing and reaping among workers using an almost identical technology (which had been nearly unchanged for centuries), with many of them being hired and paid piece rates. He concludes that differences in the pace of work represented the major cause of productivity differences.

Comparisons of productivity across multinationals' *twin plants* located in different countries can also provide particularly useful evidence on cross-country differences in work intensity. Ashenfelter (2012) reports prices and wage rates collected from McDonald's restaurants in over 60 countries, which operate with a highly standardized technology and protocol for employee training and work. He provides data on Big Macs per Hour Worked (BMPH), which is the hourly wage of a crew member at McDonald's divided by the price of a Big Mac. Because differences in BMPH across countries cannot be explained by differences in skills, physical capital, or overall management capacity, if labor and product markets are competitive and the relative price of Big Macs with respect to the inputs needed to produce them is not substantially different across countries, then cross-country differences in BMPH will reflect differences in the per hour physical productivity of a worker (i.e., work intensity).[2] Ashenfelter (2012) shows that cross-country differences in BMPH are large and highly correlated with the countries' per capita income. For example, for 2007, the ratios of the BMPH in Canada, Russia, South Africa, China, Mexico, and India relative to its US value were 0.91, 0.49, 0.34, 0.24, 0.22, and 0.15, respectively.

On the differences over time, the historical evidence on the sources of US growth supports the idea that hours and work intensity follow divergent paths. Building on a long string of case studies, Denison (1962), one of the founders of growth accounting,

[2]To see this, denote by p_j^{BM}, w_j, and p_j^m, respectively, the price of a Big Mac, the hourly wage, and the price of intermediate inputs in country j. Consider the following price equation in which the price of a Big Mac is given by a mark up μ_j over marginal cost: $p_j^{BM} = \mu_j \left(bw_j/i_j + ap_j^m\right)$, where b is the amount of effective labor and a is the input of intermediates needed to produce one Big Mac. Then, the ratio of country j's BMPH relative to its US value is given by $\frac{BMPH_j}{BMPH_{US}} \equiv \frac{w_j/p_j^{BM}}{w_{US}/p_{US}^{BM}} = \frac{i_j\left[(1/\mu_j)-a\left(p_j^m/p_j^{BM}\right)\right]}{i_{US}\left[(1/\mu_{US})-a\left(p_{US}^m/p_{US}^{BM}\right)\right]}$. Therefore, if markups and the relative price of intermediates are similar in the US and country j, then the BMPH ratio reflects the relative work intensities i_j/i_{US}.

argued that the initial hours reductions from the six-day, sunup to sundown, standard that took place between the latter half of the 19$^{\text{th}}$ century to 1929 occasioned no loss in total output and might probably increased it. For instance, according to his calculations, the 0.34% annual reduction in worked hours that took place between 1909 and 1929, was matched by a 0,35 increase in work intensity, leaving output unchanged. Moreover, Denison estimated that between 1929 and 1957, two thirds of the reduction in hours (0.73% per year) was offset by work intensity gains. Pencavel (2015) provides some illustrative cases of the offsetting of hours reduction by work intensity increases, at the firm level. Matthews et al. (1982) offers a similar assessment for the UK. According these estimations, increasing intensity of work fully offset the reduction in hours of work in the UK before 1914. This offset diminished thereafter until it was after WWII.

This paper argues that rational choice can also explain this pattern: at early stages of development and with long working hours, if consumption opportunities are expanding (and if work intensity is not near its physical limits), then workers should be willing to increase the pace of work in exchange for reduced hours.

Technological change affects the optimal combination of working hours and intensity from both the labor demand and labor supply sides. For example, from the labor demand side, more capital-intensive technologies demand relatively higher work intensity (Leamer (1999)). From the labor supply side, different technologies provide different consumption opportunities that can change the optimal combination of leisure and work intensity. This paper focuses on the latter determinant: the labor supply. It provides a simple theory explaining long run differences in work intensity across countries and over time (even when performing a similar task with a similar technology) as a result of the workers' rational response to different consumption opportunities.[3] Crucially, while an *exogenous industriousness* would predict that hours worked and work intensity move in the same direction (hours worked and work intensity are two similar dimensions from the point of view of the attitude towards work), this paper's model is consistent with the empirical evidence suggesting that these two variables move in opposite directions: workers in richer societies tend to work fewer hours but more intensively.

The two key assumptions of the theory are that consumption requires time (Becker (1965); e.g., individuals need time to listen to a concert, travel for pleasure, or play with a video game) and that much of consumption can only be carried out outside the workplace. Labor supply choices involve comparing the disutility of working more hours with that of exerting more effort per hour, taking into account that working more hours

[3]The relationship between wages and work intensity over the business cycle (Lazear, Shaw, and Stanton 2016) appears to be different from the relationship in the long run.

also has an opportunity cost in terms of leisure. Hence, because of the complementarity between consumption and leisure, in richer societies, it is optimal to substitute a higher work intensity for long working hours.

The model highlights the different nature of leisure in rich and poor countries and how this affects labor productivity. While in rich countries, leisure is mostly associated with the consumption of goods and services, in poor countries, leisure is mostly associated with socializing and relaxing.[4] Now, while most goods and services can only be consumed outside the workplace, socializing and relaxing can, to some extent, also be enjoyed in the workplace, though at the cost of reduced work intensity. Therefore, in poorer countries, there is less incentive to work at high intensity to be able to leave the workplace sooner, thereby preferring longer working hours and lower intensity. Put it somewhat differently, because working at high intensity is increasingly painful, it is optimal to combine work with *leisure in the workplace* (e.g., chatting with coworkers or relaxing having a coffee or smoking a cigarette) as long as leisure in the workplace has a similar quality to leisure outside the workplace. However, this condition is unlikely to hold in rich countries where workers can afford to combine out-of-workplace leisure with the consumption of many more goods and services.[5]

The simple theory has two important additional implications. First, optimal work intensity choices reinforce the impact of the more *fundamental forces* determining productivity, such as geography and institutions. Greater work intensity not only increases TFP but, as explained by Leamer (1999), also further stimulates industrialization by raising the profitability of capital and, thereby, attracting more capital.[6] Second, the analysis is relevant for cross-country welfare comparisons, which is the subject of a growing literature that accounts for determinants of welfare other than income and

[4]For example, between 1965 and 2003, the leisure time allocated to socializing decreased in the US by 2.8 hours for the least educated individuals and by 5.4 hours for the most educated, as income and consumption increased (Aguiar and Hurst 2007).

[5]Interestingly, a number of innovative companies such as Google are exploring ways to increase the opportunities for leisure and consumption in the workplace by building *play areas* (see “Looking for a Lesson in Google’s Perks,” *The New York Times*, March 15, 2013, http://www.nytimes.com/2013/03/16/business/at-google-a-place-to-work-and-play.html?).

[6]Leamer (1999)’s analysis refers to *effort*, defined as the product of hours worked times work intensity. However, his analysis appears to be particularly relevant for differences in work intensity, rather than in hours worked, because fewer hours per worker can usually be compensated for by increasing the number of shifts using a particular machine, whereas lower work intensity can rarely be compensated for by increasing the number of workers per machine. A notable historical example in this respect is the Ford Motor Company, which in 1914 moved from having two nine-hour shifts to three eight-hour shifts to run the factory continuously (see http://www.nytimes.com/learning/general/onthisday/big/0105.html#article). In fact, later in the paper, Leamer assumes that hours worked are constant across workers and, thus, all of the variation in work effort is due to differences in work intensity.

consumption, such as life expectancy, inequality, and leisure (e.g., Nordhaus and Tobin (1973), Becker, Philipson and Soares (2005), Fleurbaey and Gaulier (2009), and Jones and Klenow (2016)). The analysis is this paper suggests that accounting for differences in work intensity would likely reduce measured welfare inequality across countries. In particular, the lower average pace and stress in the workplace in the less developed countries can compensate, at least to some extent, for the longer working hours.[7] Unfortunately, we lack the information needed to assess cross-country differences in average work intensity and their welfare implications. Nevertheless, it is possible to develop an illustrative quantitative example using Denison (1962)'s assessment of the simultaneous large reduction in hours worked and increase in work intensity that occurred in the US between the last third of the 19$^{\text{th}}$ century and the middle of the 20$^{\text{th}}$ century. The model in this paper is calibrated to match this historical experience and used to show that cross-country differences in work intensity could in some cases be important for welfare comparisons, similar to the importance of differences in leisure, which Jones and Klenow (2016) have shown to be considerable.

The remainder of the paper is organized as follows. Section 2 presents the model and derives the main result. Section 3 considers some additional interpretations and implications. First, this section discusses the different nature of leisure at different stages of development and the reinterpretation of work intensity as the reciprocal of leisure in the workplace. Second, it discusses the implications of the model assuming that working hours are set exogenously and workers can only choose work intensity. Third, it develops a quantitative model to demonstrate the potential importance of accounting for work intensity differences in cross-country welfare comparisons. Section 4 concludes.

2. The Model

2.1. **Setting.** Individuals are endowed with one unit of time, which is allocated between hours at work (denoted $h \in [0, 1]$) and leisure (denoted ℓ, $\ell = 1 - h$). There is a single good that can only be consumed outside the workplace.[8] Production depends on the *effective labor* input, which is the product of hours worked and work intensity (denoted $i \in [0, 1]$), i.e., effective labor $= h \cdot i$. Work intensity is observable, and the wage w^e refers to the pay per unit of effective labor (thus, the wage per unit of time is equal

[7]Nevertheless, the dispersion of work intensity across occupations in poor countries may be larger than that in more developed countries. Therefore, at the individual level, the highest levels of work intensity in poor countries could be greater than the highest levels in rich countries, even if average work intensity is lower.

[8]It would be enough to assume that consumption provides more utility if enjoyed outside the workplace.

to $w^e \cdot i$). Denoting consumption by $c \geq 0$ and taking the price of the good as the *numeraire*, the individual's budget and time constraints are, respectively,

$$c \leq h \cdot i \cdot w^e, \tag{1}$$

$$\ell + h = 1. \tag{2}$$

Consumers' utility is given by a C^2 strictly concave function $U(c, \ell, h, i) : \mathbb{R}_+ \times [0, 1]^3 \rightarrow \mathbb{R}$. For any two arguments z and v in the utility function, I use the following notation: $U_z \equiv \partial U/\partial z, U_{zv} \equiv \partial^2 U/\partial z \partial v$, $\eta_z \equiv \frac{z}{U} U_z$, $\rho_z \equiv -zU_{zz}/U_z$. Utility satisfies the following assumptions:

Assumptions:
A1: $U_\ell > 0, U_h < 0, U_i < 0$; $U_{cc} \leq 0, U_{\ell\ell} \leq 0, U_{hh} \leq 0, U_{ii} \leq 0$;
A2: $U_{ch} = U_{ci} = U_{\ell h} = U_{\ell i} = 0$; $U_{c\ell} > 0, U_{hi} \leq 0$;
A3: **a)** $U_c(0, \ell, h, i) > -U_i(c, \ell, h, 0) > 0$, $U_c(0, \ell, h, i) > -U_h(c, 1, 0, i) + U_\ell(c, 1, 0, i) > 0$; **b)** $-U_i(c, \ell, h, 1) > U_c(c, \ell, h, i)$, $-U_h(c, 0, 1, i) + U_\ell(c, 0, 1, i) > U_c(c, \ell, h, i)$;
A4: $iU_i + i^2 U_{ii} < hiU_{hi} - chU_{c\ell}$, $\quad U_h + hU_{hh} + hU_{\ell\ell} - U_\ell < iU_{ih}$;
A5: $-chU_{c\ell} + hiU_{hi} < (\rho_c - 1)\, cU_c$.

Assumption A1 is straightforward. The equalities in Assumption A2 are a simplifying assumption separating the utility impact of consumption and leisure from the disutility of hours worked and work intensity. Assumption $U_{c\ell} > 0$ conveys the complementarity between consumption and leisure, whereas $U_{hi} \leq 0$ implies that the disutility of hours worked may increase as work intensity increases (and vice versa). Assumption A3.a implies that consumers always prefer to consume something rather than to consume nothing and work with zero intensity or zero hours (while allocating to leisure all their time); while Assumption A3.b implies that, rather than working at their physical maximum (in terms of intensity or hours, i.e., $i = 1$ or $h = 1$), consumers always prefer to consume somewhat less and work below their physical maximum. This assumption guarantees that the solution to the utility maximization problem is an interior point. Assumptions A4 and A5 impose several mild requirements on the curvature of utility that are sufficient to guarantee the comparative statics results that follow. Primarily, Assumption A4 requires that the cross effects U_{hi} and $U_{c\ell}$ are sufficiently small (relative to the own effects), whereas a sufficient condition for A5 is $\rho_c \geq 1$ (but not a necessary condition, as $U_{c\ell} > 0$ and $U_{hi} < 0$), which is a relatively common assumption in macroeconomics.

2.2. **Equilibrium and comparative statics.** Note that the utility function is strictly concave, the feasible set given by (1) and (2) is compact and convex, and Assumption A3 guarantees that the consumers would never choose $c = 0$, $h = 0$, $\ell = 1$, $i = 0$, $h = 1$, $\ell = 0$, or $i = 1$. Therefore, for any $w^e > 0$, there exists a unique and strictly positive interior solution to the utility maximization problem. Moreover, the budget constraint is always satisfied with equality because working fewer hours or with less intensity always increase utility. Thus, the optimal values of c, ℓ, h, and i are given by the solution to the system of equations formed by the budget and time constraints (with equality) together with the following first-order conditions:

$$\eta_i = \eta_h - \eta_\ell \frac{h}{1-h}, \tag{3}$$

$$-\eta_i = \eta_c, \tag{4}$$

where $\eta_c = \eta_c(c, \ell)$, $\eta_\ell = \eta_\ell(c, \ell)$, $\eta_h = \eta_h(h, i)$ and $\eta_i = \eta_i(h, i)$. Equation (3) balances out the negative effects of the two available alternatives for raising income: increasing intensity or hours. Increasing either intensity or hours by 1 percent increases income by 1 percent. However, increasing intensity by 1 percent reduces utility by η_i-percent, whereas increasing hours by 1 percent directly reduces utility by η_h percent and decreases leisure time by $h/(1-h)$ percent, which implies an additional reduction in utility of $\eta_\ell \cdot h/(1-h)$ percent. Equation (4) balances out the utility impact of increasing work intensity and consumption.

We can analyze this consumer equilibrium as follows. Using the time and budget constraints (with equality) to substitute for ℓ and c, respectively, in (3) and fully differentiating yields

$$\begin{aligned}(5)\quad & \left(iU_i + i^2U_{ii} - hiU_{hi} + chU_{c\ell}\right) di/i \\ &= \left(U_h + hU_{hh} - iU_{hi} + hU_{\ell\ell} - U_\ell - cU_{c\ell}\right) dh - chU_{c\ell}\, dw^e/w^e.\end{aligned}$$

Note that $U_i + iU_{ii} - hU_{hi} + h^2w^eU_{c\ell} < 0$ (see Assumption A4). Thus, by the Implicit Function Theorem, I can define a mapping $i = \mu(h, w^e)$, such that for any $w^e > 0$ and $h \in [0, 1]$, the pair $(h, \mu(h, w^e))$ satisfies (3) and the budget and time constraints. Moreover, Assumptions A2 and A4 imply $\mu_h > 0$ and $\mu_{w^e} > 0$. Note that the complementarity between consumption and leisure $U_{c\ell} > 0$ is crucial for $\mu_{w^e} > 0$ and, therefore, for the comparative statics that follow. Similarly, using the budget and time constraints to substitute for c and ℓ in (4) and fully differentiating yields

$$\left[\rho_c cU_c - i^2U_{ii}\right] di/i = \left[(1-\rho_c)\, cU_c - chU_{c\ell} + ihU_{hi}\right] dh/h + (1-\rho_c)\, cU_c\, dw^e/w^e, \tag{6}$$

Thus, by the Implicit Function Theorem, I can define a mapping $i = \phi(h, w^e)$, such that for any $w^e > 0$ and $h \in [0, 1]$, the pair $(h, \phi(h, w^e))$ satisfies (4) and the budget and time constraints. Moreover, Assumption A5 implies $\phi_h < 0$, whereas we have $\phi_{w^e} \leq 0$ if and only if $\rho_c \geq 1$. Figure 3 depicts the mappings $i = \mu(h, w^e)$ and $i = \phi(h, w^e)$. For a wage $w_0^e > 0$, these two mappings determine the equilibrium pair (h_0, i_0).

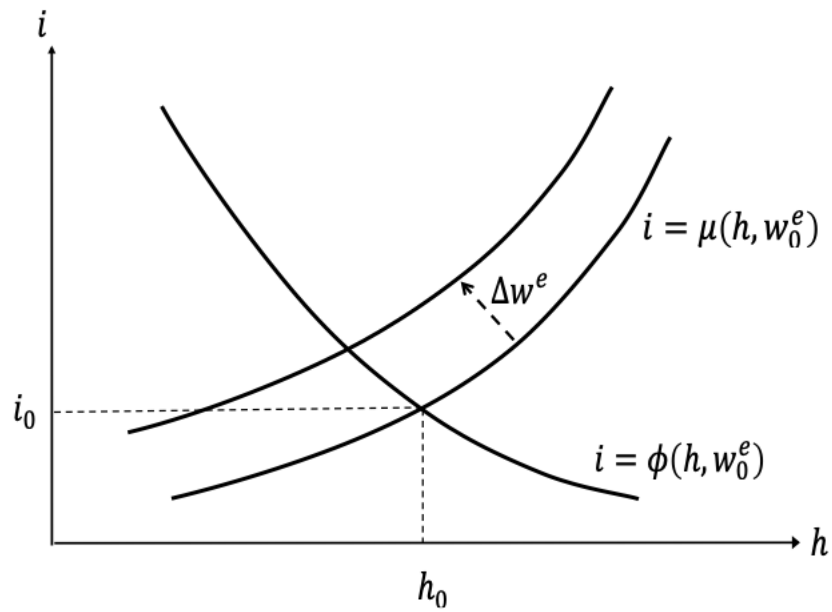

FIGURE 3: HOURS WORKED AND WORK INTENSITY

Now consider the impact of a wage increase. This always shifts the $\mu(h, w^e)$ schedule upwards and to the left in Figure 3. In turn, as already noted, the impact on $\phi(h, w^e)$ depends on the curvature of utility with respect to consumption (a wage increase shifts the $\mu(h, w^e)$ schedule to the left if and only if $\rho_c > 1$). As a benchmark, consider the case $\rho_c = 1$, which is not an uncommon assumption in macroeconomics. Then $\phi(h, w^e)$ is not affected by changes in w^e and, therefore, the increase in w^e leads to a new equilibrium with lower hours worked and higher work intensity. More generally, if the impact of a wage increase on hours worked is positive or moderately negative (i.e., if hours worked in the new equilibrium are sufficiently close to h_0), then a higher wage leads to greater work intensity, as it is apparent in Figure 3. Formally, because $di/dw^e = \mu_{w^e} + \mu_h (dh/dw^e)$, if dh/dw^e is positive or sufficiently small in absolute terms, then $di/dw^e > 0$. This result can be summarized as follows:

Proposition. *Let Assumptions A1-A5 hold. If the long-run impact of wages on hours worked is positive or moderately negative, then higher wages lead to higher work intensity.*

The empirical literature tends to find a small negative long-run relationship between men's hours worked and wages (see Pencavel 1986, Ramey and Francis 2009, and Ashenfelter, Doran, and Schaller 2010), which is also the pattern that holds across countries (Bick Fuchs-Schündeln & Lagakos 2018).[9] If the negative impact of wages on hours is sufficiently small, the model predicts that hours worked and work intensity move in opposite directions.

Now, note that the exogenous variable used in the analysis is the wage per unit of effective labor w^e because this wage reflects the exogenous changes in labor productivity. However, w^e is not directly observable. Notwithstanding, if higher w^e leads to greater work intensity, then the hourly wage $w^h = w^e \cdot i\,(w^e)$ increases if and only if w^e increases ($dw^h/dw^e = i + w^e \cdot \partial i/\partial w^e > 0$). Therefore, work intensity increases with the (observable) hourly wage.

2.3. **Work intensity with exogenous hours.** In the short run, hours worked and work intensity may differ from the optimal combination analyzed in Section 3 due to factors such as legislation and adjustment costs that exogenously fix working hours. Although the focus of this paper is the long run equilibrium in which hours and intensity adjust to an optimal combination, it is interesting to briefly consider how work intensity (and, therefore, labor productivity) endogenously responds to exogenous changes in working hours. In this respect, Pencavel (2015) among others documents that each individual's per hour productivity decreases as the number of weekly hours increases.[10] Similarly, Burda, Genadek, and Hamermesh (2016), note that "Whether because of boredom, fatigue or something else, the marginal effect of additional work time on non-work activities is increasing for most employees as the workday lengthens."

The model, in fact, predicts that each worker's output per hour decreases with exogenous increases in work hours. The reason is that longer hours lead to lower work intensity. To check this prediction, note that the first order condition of the utility maximization problem with respect to work intensity, given an exogenous number of

[9]For example, the unconditional elasticity of hours worked with respect to per capita PPP GDP using the last available year (2011) in the Penn World Table 8.1 (Feenstra, Inklaar, and Timmer (2015)) is -0.09, with a 95 percent confidence interval of $[-.14, -.033]$. This PWT 8.1 provides data on hours worked for 52 countries.

[10]Note that this decreasing marginal productivity at the individual level is unrelated to the standard analysis of a decreasing aggregate marginal productivity of labor, which is usually explained in terms of adding decreasingly productive jobs or decreasingly skilled workers.

hours, is again given by equation (4). Therefore, the mapping $i = \phi(h, w^e)$, where $\phi_h < 0$, also describes the response of work intensity to exogenous changes in work hours. Hence, having to work more hours induces a reduction in work intensity.[11][12] In other words, if working hours are exogenously given, workers choose intensity, and they are paid according to their actual productivity, then when the number of hours is increased, output per hour decreases.

2.4. **Low work intensity as leisure in the workplace.** Economic analysis makes a sharp distinction between work and leisure and assumes that all time spent in the workplace is work. However, a non-trivial fraction of the time spent in the workplace –at least, in some occupations and communities– is not allocated to real work but to leisure activities such as chatting with coworkers, checking personal e-mail, dealing with personal issues and chores, having a coffee or a cigarette, relaxing, loafing, and other forms of *not working at work*. Using the American Time Use Survey, which has a battery of questions about what workers are doing while at work, Burda, Genadek, and Hamermesh (2016) find that the fraction of *work time not working* significantly increases with the length of the workweek. They also find that, conditional on hours of work, those with higher weekly earnings spend a smaller fraction of their time at the workplace in non-work. These patterns arise as a natural implication of the model in this paper.

Within this paper's model, it is straightforward to analyze the optimal allocation of time at the workplace between *real work* and *work time not working* (or *leisure in the workplace*) by means of a reinterpretation of the work intensity variable. Let s, $0 < s < 1$, be the share of the time in the workplace that is allocated to leisure activities (such as chatting, having a coffee or checking personal e-mail). Now, rewrite the expressions in the model by substituting $1 - s$ for i. Thus, the utility function is $U(c, \ell, h, [1-s]) : \mathbb{R}_+ \times [0,1]^3 \to \mathbb{R}$, the effective labor input is equal to the product $h\cdot(1-s)$, and the budget constraint is $c \leq h\cdot(1-s)\cdot w^e$. A key point is that, even if

[11]The possibility that firms could keep output almost unchanged while reducing hours worked (with no changes in technology) has sometimes been explained by an automatic mechanical impact on productivity: having fewer hours worked leads to lower fatigue and fewer accidents.
For example, Pencavel (2015) analyzes data on munitions workers during WWI whose weekly hours could exceed 90 hours. He shows that beyond a certain threshold number of hours, output would be less than proportional to hours worked due accidents and fatigue. However, this evidence on the determinants of labor productivity appears to correspond to extreme time and working circumstances in which decreasing labor productivity was a matter of physical human limits.
[12]The reasons are are embodied in Assumption A5: longer hours makes effort increasingly painful ($U_{hi} < 0$), and the marginal utility of consumption decreases fast (ρ_c is high), especially if leisure time is made shorter due to the increase in working hours ($U_{c\ell} > 0$).

a fraction of the time spent in the workplace is allocated to leisure, there is a crucial difference between *leisure in the workplace* and *regular leisure*: most consumption goods and services cannot be consumed at the workplace even when not working. Thus, the complementarity between consumption and leisure is restricted to leisure outside the workplace (i.e., $U_{c\ell} > 0$ but $U_{cs} = 0$). Then, the same arguments used to prove the proposition in the previous section now imply that workers with higher wages prefer to shift leisure from the workplace to outside the workplace (i.e., they reduce their *work time not working*). Moreover, if wages have a moderately negative effect on the labor supply, then hours worked and leisure in the workplace will be positively correlated as found by Burda, Genadek, and Hamermesh (2016). As explained in the next section, if workers cannot choose the length of the workweek but hours worked are exogenously determined, then the model also implies a positive correlation between hours worked and leisure in the workplace.

This interpretation of low work intensity as leisure in the workplace also provides a interesting perspective on the relationship between work and leisure at different stages of development. In low-income countries, much of the leisure time outside the workplace is spent on activities such as socializing and relaxing that, to some extent, can also be enjoyed in the workplace. Hence, because non-stop work is increasingly painful (i.e., the marginal disutility of work intensity is increasing), it is rational to combine small spells of work and leisure in the workplace (which leads to staying at work for longer hours) instead of shifting all of one's leisure time to outside the workplace. Combining multiple spells of work and leisure in the workplace reduces the disutility of supplying a given amount of effective labor, albeit at the cost of less leisure outside the workplace. However, as communities become richer and consumption opportunities expand, the value of leisure outside the workplace increases due to its complementarity with consumption. Therefore, richer communities prefer to reduce leisure in the workplace to increase regular leisure.[13]

Notwithstanding, some recent developments could reshape the interaction among consumption opportunities, hours spent in the workplace, and work intensity in the

[13]As Stigler (1976) noted in his critique of Leibenstein (1966)'s X-efficiency, apparent managerial inefficiency and non-maximizing behavior can sometimes be explained by differences in motivations that include factors other than output and income. In this respect, it is interesting to recall the experience of the International Labour Office's Productivity Demonstration Missions conducted circa the 1950s, which taught firm managers in developing countries more efficient ways to organize work. Despite the large productivity gains that could be obtained by applying the new techniques, they did not spread in the areas where they were taught. In fact, in a number of cases, the international officers found a reversion to the former, less efficient practices when demonstration projects were revisited after a year or more; that is, managers and workers agreed that they preferred the less productive organization of work (Kilby 1962).

future. For example, the availability of the Internet in the workplace increases the opportunities for consumption there (U_{cs} becomes positive) and can lead to lower work intensity (and longer hours in the workplace). By opening new possibilities for working from home, the Internet also improves the scope for alternating between work and leisure. Moreover, as noted in the Introduction, a number of leading innovative companies such as Google are increasing the opportunities to combine consumption and leisure in the workplace.

3. Calibration and welfare comparisons

As shown by the literature cited in the Introduction, a number of dimensions other than income are relevant for cross-country welfare comparisons (e.g., life expectancy, inequality, and leisure). Could differences in average work intensity also be relevant? If working hours and work intensity move in opposite directions, could accounting for differences in leisure time but ignoring differences in work intensity lead to larger errors in cross-country welfare comparisons than ignoring both of these two dimensions of welfare? We currently lack the information needed to assess the welfare implications of cross-country differences in work intensity. However, it is possible to use Denison (1962)'s historical assessments of the US economy to calibrate a quantitative model and show that differences in work intensity can be as important as differences in leisure in cross-country welfare comparisons.

Going back to the full model of simultaneous choice of work intensity and hours, consider the following utility function:

$$U\left(c,\ell,h,i\right) = \beta c + \frac{1}{1-\alpha}\left(\frac{\ell}{c}\right)^{1-\alpha} + \ln(1-h) + \varepsilon\ln(1-i),$$

where $\beta > 1$, $\alpha > 2$, $\varepsilon > 0$, and $\beta > c^{\alpha-2}\ell^{1-\alpha}$ (this latter condition requires that the units in which consumption is measured be sufficiently large). The second term in this expression embodies the complementarity between consumption and leisure: if leisure ℓ is constant, the marginal utility of consumption decreases (note that ℓ/c is the leisure available to enjoy each unit of consumption). Maximization with respect c, ℓ, h, and i subject to (1) and (2) yields the following first-order conditions:

$$\beta c - c^{\alpha-1}\left(1-h\right)^{-\alpha} = \frac{h}{1-h},$$

$$\frac{1}{i} = 1 + \frac{\varepsilon}{h}\frac{\left(1-h\right)^{\alpha}}{\left(1-h\right)^{\alpha-1} + c^{\alpha-1}}.$$

Now consider two economies L and H with per capita incomes such that the ratio c_L/c_H roughly matches the ratio between the US per capita income in the mid-19$^{\text{th}}$ and mid-20$^{\text{th}}$ centuries. The parameters β, α, and ε are calibrated, and the values of c_L and i_L are fixed (these two values can be seen as fixing the units in which consumption and work intensity are measured) such that the ratios of hours worked and work intensity between these two economies broadly match the corresponding ratios between the mid-19$^{\text{th}}$ and mid-20$^{\text{th}}$ century US economy. Specifically, the model is calibrated to deliver $c_L/c_H = .223$, $h_L/h_H = 3/2$, and $i_L/i_H = 2/3$. This c_L/c_H ratio corresponds to Maddison (2001)'s estimates of the US income per capita at constant prices in 1870 and 1955 ($2,435 and $10,897, respectively). The h_L/h_H ratio corresponds to the 63 average weekly hours worked in manufacturing in 1870 according to the Aldrich Report (see Whaples (2001)) and the 41 weekly hours in 1955 reported by the US Bureau of Labor Statistics. The ratio $i_L/i_H = 2/3$ is a simple scenario that is not inconsistent with Denison's appraisal that increases in work intensity could have offset the reduction in hours more than proportionally before 1929 and by no less than 50% between 1929 and 1957 (Denison 1962, p.42).[14] Less important, as the weekly time available after sleeping and basic care can be estimated at approximately 105 hours (= 7 days*15 hours) and is normalized to be equal to 1 in the time constraint (2), h_L is set as $h_L = 63/105 = 0.6$. Table 1 summarizes the calibration's targets and the calibrated parameters. The first finding generated by this exercise is that the huge simultaneous adjustment in hours worked and work intensity that took place in the US between the second half of the 19$^{\text{th}}$ century and the mid-20$^{\text{th}}$ century can be explained by the model as the workers' optimal response to the increase in income that occurred over that period.

Table 1. Calibration and welfare

Targets			Parameters						Cons. equivalents	
c_L/c_H%	h_L/h_H	i_L/i_H	h_L	c_L	i_L	β	α	ε	c_1/c_H%	c_2/c_H%
22.3	3/2	2/3	.6	.242	.4	8.7	3.8	2.8	17.1	29.7

Note: the values of c_n used to calculate the consumption-equivalent percentages of c_n/c_H, $n = 1, 2$, satisfy $U(c_n, h_n, i_n) = U(c_L, h_L, i_L)$ for each of the following scenarios: $(h_1, i_1) = (0.4, 0.4)$, $(h_2, i_2) = (0.4, 0.6)$.

[14] Interestingly, 32% of the 167 countries whose statistics are reported in the Maddison-Project (2013) still had in 2008 a GDP per capita below that in the US in 1870, and only 28% of these 167 countries had a GDP per capita in 2008 above that in the US in 1955. It is an open question how many countries will carry out (and how many countries have already carried out) a transition from a regime of long hours and relatively low work intensity to a regime of shorter hours and high work intensity, similar to the one suggested by Denison (1962) for the US.

Next, I conduct a consumption-equivalent welfare comparison between economies L and H in the same spirit as in Jones and Klenow (2016).[15] I consider three alternative scenarios of working hours and intensity: $(h_1, i_1) = (0.6, 0.6)$, $(h_2, i_2) = (0.4, 0.4)$, $(h_3, i_3) = (0.4, 0.6)$. From the perspective of economy L, the first scenario can be seen as increasing work intensity to the level in H, the second as reducing hours worked to the level in H, and the third as adjusting both hours worked and work intensity to the level in H. For each scenario, I calculate the consumption level c_n, $n = 1, 2, 3$, that would render utility identical to that enjoyed in economy L. That is, I calculate the values of c_n that satisfy $U(c_n, h_n, i_n) = U(c_L, h_L, i_L)$. Table 1 reports the ratios c_n/c_H, $n = 1, 2, 3$. Consider scenario 1: the numbers in Table 1 imply that to compensate a worker from L for working with the intensity prevalent in H, her consumption should be multiplied by 1.67. Thus, accounting for differences in work intensity (but ignoring the differences in hours worked), economy L's consumption-equivalent welfare is 37% of that of economy H (to be compared with the ratio in terms of income, which is 22.3%). The literature on cross-country welfare comparisons shows that differences in leisure entail substantial differences in welfare. Considering scenario 2, I find that workers in economy L would be indifferent between reducing hours worked to the level in H and reducing their consumption by 23%. Thus, accounting for the differences in hours worked (and income) but ignoring the differences in work intensity, economy L's consumption-equivalent welfare is only 17% that of H (notably below the 22.3% and, therefore, increasing measured welfare inequality as emphasized by the cross-country welfare literature, e.g., Nordhaus and Tobin (1973), Fleurbaey and Gaulier (2009), and Jones and Klenow, (2016)). Finally, scenario 3 is the most complete and, thus, interesting one to compare welfare between L and H. To compensate a worker from L for working under identical conditions to those in H, her consumption should be multiplied by 1.33. This means that economy L's consumption-equivalent welfare is 30% of economy H's. Note that because productivity tends to drive work intensity and hours in opposite directions, considering only one of these two dimensions when conducting cross-country welfare comparisons (in particular, considering only leisure, which is what scenario 2 does) could lead to larger errors than omitting both dimensions.[16]

[15]The theoretical framework here is extremely simple in comparison to that in Jones and Klenow (2016), who conduct consumption-equivalent comparisons across 152 countries and over time taking into account differences in mortality, consumption to income ratios, leisure, and within-country inequality.

[16]However, other determinants of work intensity and hours, such as the marginal income tax, could affect these two variables in the same direction.

In sum, although the specific numbers I consider are only illustrative, this quantitative exercise strongly suggests that taking into consideration cross-country differences in average work intensity is important. Accounting for them would likely reduce measured welfare inequality across countries.

4. Concluding Comments

Differences in work intensity across countries and time can be large and significantly affect relative TFP. Why do different communities work with different average intensity? Is low work intensity a cause of low economic development, a consequence, or both? Can working at a slow pace have a significant welfare value? Is work intensity an isolated feature of each culture or one of a series of complementary aspects that constitute their *way of life* (e.g., *industrious consumerism* versus *idle socializing*)? Can rational behavior and differences in economic opportunities help explain differences in work intensity? The very simple model in this paper provides a new perspective on these important and complex questions and should be seen only as a first step into a topic that deserves detailed future empirical work.

Work ethics are strongly affected by local culture and social and legal norms that feature long-lasting inertias. However, it is unlikely that cultural traits that have considerable economic impact are entirely independent of the economic environment. Moreover, it is difficult to explain differences in work intensity in terms of an exogenous cultural trait that determines the inclination to work, given that hours worked and work intensity move in opposite directions (even when comparing similar tasks using similar technologies). This paper shows that rational choice when facing different economic opportunities can help explain the apparent positive correlation between income and work intensity across countries and over time, as well as the negative correlation between hours worked and work intensity. In particular, when working hours are long and consumption opportunities are expanding at early stages of development, workers should be willing to accept an increase in the pace of work in exchange for reduced hours. The reason is that as communities become richer, they increasingly link leisure to the consumption of goods and services, most of which can only be enjoyed outside the workplace. Thus, they draw a sharper distinction between the time and place for work and the time and place for leisure. Interestingly, the Internet and some pioneering companies are providing new opportunities for combining work, leisure, and consumption that could somewhat reverse this pattern in the future. By introducing new ways to consume and socialize in the workplace, new technologies may change in the future the way to combine actual work and leisure in the workplace.

Work intensity choices have important consequences for output and welfare. On the one hand, they reinforce the output impact of other more *fundamental determinants of productivity* such as geography and institutions because higher fundamental productivity leads to higher work intensity. On the other hand, as work intensity tends to increase with income, accounting for the differences in intensity would likely reduce measured welfare inequality across countries. Accounting for these differences appears to be particularly important in welfare comparisons that already incorporate differences in hours worked.

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