The Effects of Quiet Quitting in a Stochastic Dynamic Model

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Abstract

A fundamental tradeoff in economics is allocating time between work and leisure. The COVID-19 pandemic disrupted conventional work patterns, prompting individuals to reconsider how they had previously allocated their time. A modest but growing body of literature has identified a structural shift in the labour market, termed “quiet quitting.” The term quiet quitting refers to disengaging from one’s job and completing only the minimum required work, driven by a desire for greater work-life balance. Since 2020, this phenomenon has emerged as a key topic in research, with studies focusing on its impact and the urgent need for employers to address it. This structural shift has been particularly evident along the intensive margin, as individuals engaged with quiet quitting do not exit the labour force. Despite the growing body of literature, there is a lack of research quantifying quiet quitting and measuring its impact on the economy, particularly using dynamic stochastic models. This paper explores the impact of quiet quitting on economic activity using the Hansen (1985) real business cycle model with indivisible labour. I identify two key parameters of the model that influence both aggregate and individual-level hours and conduct a series of experiments by introducing exogenous shifts into these parameters. The model effectively captures key features of quiet quitting and its impact on key economic variables, including output, consumption, capital and investment. The results show that when quantifying quiet quitting by the drop in hours between 2019 and 2022, output, consumption, investment and the capital stock decrease by 3.0-4.3 percent. The findings also demonstrate that with quiet quitting, output, investment, hours and the capital stock become less volatile.

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1 Introduction

Most economies underwent substantial shifts in the wake of the COVID-19 pandemic, fundamentally altering conventional work patterns and prompting a reevaluation of how individuals allocate their time between work and leisure. The labour force encountered numerous challenges, ranging from waves of layoffs to the widespread adoption of work-from-home arrangements. Data on the U.S. labour force revealed significant changes at the intensive margin and in aggregate hours worked. A particularly notable shift in the post-pandemic era is the rise of "quiet quitting." Although not a new concept, quiet quitting has gained renewed attention due to recent disruptions in the labour market. This term refers to workers who subtly disengage from their jobs, fulfilling only the minimum requirements to maintain their positions. However, these workers do not officially exit the labour force, thereby impacting the intensive margin rather than the extensive margin.

The rise of quiet quitting has sparked considerable interest in exploring its implications for both the labour market and the broader economy. Numerous hypotheses have been proposed to explain the emergence of this phenomenon, which will be reviewed in greater detail in Section 2. The act of subtly disengaging from work and prioritizing work-life balance can significantly influence the number of hours individuals are willing to work, potentially reshaping employment patterns and productivity levels. Despite the increasing relevance of quiet quitting in today's workforce, it remains an understudied phenomenon, with limited research examining its broader economic impact and long-term consequences. This gap in the literature highlights the need for more focused studies to better understand its role in shaping modern labour dynamics.

To investigate the potential impact that quiet quitting may have on the economy, I employ Hansen's (1985) model with indivisible labour as the foundational framework for my analysis. This widely recognized model is particularly well-suited for examining such dynamics due to several key attributes that make it both analytically and computationally tractable. One of its primary strengths is that it features both the extensive and intensive margins of hours worked. By leveraging these features, I am able to adjust the model to specifically account for the quiet quitting phenomenon, targeting changes in the number of hours worked as a central variable of interest.

In this study, I identify two key parameters within Hansen's (1985) model that are linked to the phenomenon of quiet quitting or a reduction in hours worked. These parameters, known as the disutility of labour and the work unit—denoted as A and h_0 in Hansen's original work—form the basis for three primary experiments.

The first experiment examines how increasing the disutility of labour can reduce hours worked, while the second explores the impact of adjusting the work unit. Although each parameter can reduce aggregate hours, neither alone suffices to decrease per-worker hours among the employed. This limitation leads to a third experiment, where both parameters are adjusted simultaneously, resulting in reduced hours at both the aggregate and individual levels.

The analysis combines both theoretical and quantitative components, moving beyond steady-state comparisons to also explore how shifts in work hours influence the economy's response to a technology shock.[1] This comprehensive approach provides valuable insights into the economic implications of reduced work hours associated with quiet quitting.

The remainder of the thesis is organized as follows. Section 2 reviews the relevant literature and synthesizes findings on changes in the labour supply from 2019 to 2023, emphasizing their differences from long-term trends and exploring the implications for economic growth. Section 3 outlines the primary objective and the roadmap of the analysis. Section 4 presents Hansen's (1985) model with indivisible labour. Section 5 presents a theoretical analysis of how the key parameters of the model affect aggregate hours. Section 6 examines the impact of the disutility of labour, represented by the parameter A in Hansen (1985), while Section 7 focuses on the impact of the work unit, represented by the parameter h_0. Section 8 adjusts both A and h_0 simultaneously and explores its implications. Section 9 offers concluding remarks, discusses the limitations of the analysis, and suggests directions for further research. The appendix offers additional quantitative details, replicates the results of Hansen (1985), and presents the impulse response functions for the versions of the model considered in the analysis.

2 Literature

The idea of a work-life balance and notions like working to live, not living to work, are not new phenomena. The average number of hours worked has decreased over the past 200 years. Greenwood and Vandenbroucke (2005) have observed changes in how individuals allocate their time to different markets. The findings of their paper reveal that a downward trend in hours worked and an uptick in leisure hours has been unfolding for years. The downward trend in aggregate work hours is explained by a number of reasons, including an increase in real wages, housework requiring less time and greater value being placed on leisure. Notably, they argue work hours have decreased not just at home but also in the market due to an increase in real wages, i.e., the income effect. Godbey and Robinson (1997)

1. While the work of Fitzgerald (1998) provides some insight into the impact of reduced hours, it focuses on a static model.

and Aguiar and Hurst (2005) reach a similar conclusion that in addition to a reallocation of labour from the home into the market, leisure time is on the rise.

As for more recent labour dynamics, Abraham and Rendell (2023) report a decrease in the average number of hours worked starting at the beginning of the COVID-19 outbreak in the U.S. Specifically noting that by the end of 2022, hours worked had still not recovered to their pre-pandemic level. They argue that pre-pandemic factors can account for the average 0.2 percentage point annual decline along the extensive margin since the trend was underway before the outbreak. However, pre-pandemic factors and a variety of new hypotheses can not explain a majority of the decline along the intensive margin between 2019-2022. Resulting in speculation by Abraham and Rendell (2023), Formica and Sfodera (2022) of a shift towards greater work-life balance and whether this will be a permanent change.

Reflecting a shift towards work-life balance, Faberman, Mueller, and Şahin (2022) identified a highly persistent decrease in the number of desired work hours during the pandemic. By the end of 2021, desired work hours in the U.S. had decreased by 4.6 percent since February 2020. In contrast with the decline in the labour force participation rate, which Faberman, Mueller, and Şahin 2022 report was approximately half the magnitude of the decline in desired work hours. Arriving at the same conclusion as Abraham and Rendell (2023), changes to the labour supply are underestimated by the labour force participation rate, and the intensive margin is proving to play an important role in current labour supply dynamics.

Forsythe et al. (2022) demonstrate that the employment rate had initially dropped at the beginning of the outbreak of COVID-19 but recovered within two years. Unlike Abraham and Rendell (2023), Forsythe et al. (2022) argue that key U.S labour force indicators about the extensive margin have returned to their pre-pandemic levels. By ignoring the intensive margin, they incorrectly assume that the labour supply has returned to pre-pandemic levels. Reiterating the insight made by Abraham and Rendell (2023) and Lee, Park, and Shin (2023) that intensive margin changes are the reason why the labour market was tighter than expectations based on extensive margin indicators.

To understand precisely the role of intensive and extensive margin changes, Lee, Park, and Shin (2023) decomposed the decrease in U.S. aggregate hours worked to identify the source of the change. Before the outbreak of COVID-19, they estimated the labour force participation rate to have been 62.9 percent; fast forward to April of 2023, the participation rate had nearly recovered and was estimated to be 62.6 percent. Before the pandemic, annual hours worked per capita were estimated to be 1,229 hours according to the Current Population Survey (Lee, Park, and Shin 2023).[2] Additionally, Lee, Park, and Shin (2023)

2. This estimate is based on actual hours worked reported by the respondent.

identify that between 2019-2022, there was a 12-hour decline in annual hours worked, which transpired for three consecutive years. This results in a total decline of approximately 36 annual hours per employed worker between 2019-2022. Consequently, annual hours worked per worker had fallen to 1,193 by 2022. These facts demonstrate that the decline in aggregate work hours is not solely the result of a decrease in the labour force participation rate since the participation rate nearly recovered, whereas the number of hours continued to decline. Lee, Park, and Shin (2023) conclude that more than half of the decline is due to changes at the intensive margin.

Lee, Park, and Shin (2023) also argue that these recent labour supply dynamics between 2019-2022 are different from previous events. Specifically, the 2007-2008 financial crisis in which approximately 87 percent of the decline in annual hours worked came from a decrease in the employment rate. In contrast to 2019-2022, only 48 percent of the decrease in annual hours originated from the extensive margin, according to Lee, Park, and Shin (2023). Underscoring the significance of the intensive margin in recent labour supply dynamics.

As to how many people may be quiet quitting, Formica and Sfodera (2022) argue that in 2022 at least 50 percent of the U.S. workforce should be considered quiet quitters. They also observed the employee engagement rate to be the lowest it has been in ten years. In January 2020, before COVID-19-related lockdowns, employee engagement levels were reported to be 36 percent by Formica and Sfodera (2022). By February of 2024, employee engagement had declined to 30 percent. Simultaneously, they found the level of actively disengaged employees rose from 14 percent to 17 percent. A report by Robert Half, an HR consulting firm, echoed a similar sentiment finding that 42 percent of Canadians felt burnt out in 2023 (Adair 2023). The number of Canadians feeling burnout is up from a reported 36 percent in 2022. In 2023, Statistics Canada found that nearly half of Canadians who were planning to retire said they would prefer to reduce their hours now but delay their retirement and continue to work. As for the younger generations, the Robert Half survey (2023) found that rates of burnout are highest amongst millennials (55 percent), generation Z (51 percent) and Generation X (32 percent).

Several hypotheses have examined the factors driving the decrease in average hours worked from 2019 to 2022 and the reasons for the partial recovery. Moisoglou et al. (2024) discussed the health effects due to having COVID-19 and the fear of contracting the virus at the workplace. Abraham and Rendell (2023) proposed that federal-issued stimulus has negatively affected willingness to supply labour. In addition, inflated housing prices, which enabled older individuals to retire earlier, led to an exodus from the labour force. Harter (2022) argues that the three main drivers of quiet quitting are a lack of feeling cared about, opportunities to learn and grow and lastly, a disconnection from their organization's purpose. Formica and Sfodera (2022) also add a failure to recognize performance and a lack of professional fulfillment as a driver for quiet quitting.

While the literature has well-documented the decline in average hours worked, there is a notable gap in research regarding the potential impacts of this phenomenon. Specifically, how a sustained decline in hours worked may affect the economy. There is a single paper by Fitzgerald (1998) that researched the effects of fewer hours worked per week. In this paper, Fitzgerald (1998) simulated a policy that forcibly lowered the number of weekly hours worked by employed individuals in the economy to observe the impact on output. He finds that under such a policy, labour productivity must sufficiently increase to offset the decline in hours to maintain the same output level. If labour productivity does not increase enough to offset the decline in hours, output will have a significant negative impact. However, Fitzgerald (1998) applies a static model to explore the impact of reducing hours. Therefore, the impact on capital accumulation and investment remains unstudied.

3 Brief Outline of the Analysis

In Hansen's (1985) model of indivisible labour, two key variables represent hours worked: aggregate hours and per-worker hours. Consequently, these two variables form the primary focus of the analysis in this thesis. The study examines four distinct economies, labeled $\mathcal{E}_0$, $\mathcal{E}_1$, $\mathcal{E}_2$, and $\mathcal{E}_3$. Specifically, $\mathcal{E}_0$ represents the benchmark economy, while the remaining three economies correspond to the following three main exercises:

1. The first exercise investigates whether a shift in preferences that increases the disutility associated with working can account for "quiet quitting" in a manner consistent with the data.

2. The second exercise examines the effect of the parameter that stands for per-worker hours (also referred to as the work unit).

3. The third exercise aims to capture quiet quitting fully by adjusting both preferences and the per-worker hours.

The quantitative evaluation of the model focuses on two distinct levels of average annual hours worked, which are based on estimates provided by Lee, Park, and Shin (2023). According to their research, the average annual hours per employed worker in the U.S. was 1,229 in December 2019. Over the subsequent three years, Lee, Park, and Shin (2023) observed a decrease of 12 hours annually, leading to an average of 1,193 hours per year per employed worker by December 2022. The target levels are detailed in Table 1. The model is calibrated to reflect these estimates of annual hours worked, with the analysis including steady-state comparisons and assessing the impact on the business cycle.

4 Model

4.1 Environment

This paper builds upon the environment described in Hansen (1985) to model a single-sector, stochastic growth economy. The economy experiences random shocks to technology, denoted as λ_t. Technology follows an autoregressive process of order one ($AR(1)$), specified as:

$$\ln \lambda_t = \gamma \ln \lambda_{t-1} + \epsilon_t, \tag{1}$$

where $0 < \gamma < 1$ represents the persistence of past technology, and $\epsilon_t \sim \mathcal{N}(0, \sigma_\epsilon^2)$ is a white noise technology shock with mean zero and variance σ_ϵ^2.

This economy has a unit mass of infinitely lived, identical households and a single firm. The firm uses a Cobb-Douglas production function with inputs including capital (k_{t-1}), labour (h_t), and technology (λ_t). The firm operates in a perfectly competitive market and makes zero profit at equilibrium. The output produced by the firm is either consumed or invested. Households own the capital and rent it to the firm, receiving the rental rate (r_t) in return. (In the remainder of the paper, I will use "household" and "individual" interchangeably.)

The labour supply in this model is indivisible, meaning that individuals cannot vary their hours of work. They can either work full-time (h_0) or not work at all. Despite this indivisibility, the labour market clears because the amount of labour demanded by firms (h_t) equals the amount supplied, $\alpha_t h_0$. All fluctuations in labour supply are thus reflected in changes along the extensive margin. There is also perfect unemployment insurance, ensuring that all households receive the same wage regardless of whether they are selected to work in period t.

4.2 Preferences

In each period, an individual can be either employed or unemployed. Let α_t denote the probability of an individual being employed at time t. The probability of being unemployed is $(1 - \alpha_t)$. In each period, an individual divides one unit of time between leisure and work. When employed, the number of hours a household is committed to supply is h_0. Therefore, among the employed, time allocated for leisure is $(1 - h_0)$. If a household is unemployed, time spent on leisure is 1.

Given these probabilities and leisure values, the household's preferences are given by the following function:

$$u(c_t, h_t) = \ln\, c_t + A\, \left[\alpha_t\, \ln(1 - h_0) + (1 - \alpha_t)\, \ln(1)\right], \tag{2}$$

where c_t is the consumption at time t and A is a positive constant. Below, I will refer to the parameter A as the *disutility of labour*.

Since $\ln(1) = 0$, the utility function is simplified to

$$u(c_t, h_t) = \ln\, c_t + \alpha_t\, A\, \ln(1 - h_0). \tag{3}$$

Since there is a unit mass of identical households, the total labour supply in the economy at time t is

$$h_t = \alpha_t\, h_0. \tag{4}$$

Inserting the last equation into equation (3) for α_t, the utility function becomes

$$u(c_t, h_t) = \ln\, c_t + \frac{A\, \ln(1 - h_0)}{h_0}\, h_t. \tag{5}$$

Define the following constant:

$$B = \frac{A\, \ln(1 - h_0)}{h_0}. \tag{6}$$

Since $0 < h_0 < 1$ and $A > 0$, it follows that $B < 0$. Then, combining equations (5) and (6), one can arrive at

$$u(c_t, h_t) = \ln\, c_t + \, Bh_t. \tag{7}$$

4.3 The Social Planner's Problem

The social planner's problem with indivisible labour supply is defined as

$$\max_{c_t, h_t} \sum_{t=0}^{\infty} \beta^t \left[\ln c_t + Bh_t\right] \tag{8}$$

subject to

$$
\begin{aligned}
c_t &= y_t + (1-\delta)k_{t-1} - k_t, &(9)\\
k_t &= (1-\delta)k_{t-1} + i_t, &(10)\\
y_t &= \lambda_t k_{t-1}^{\theta} h_t^{1-\theta}, &(11)\\
\ln \lambda_t &= \gamma \ln \lambda_{t-1} + \epsilon_t. &(12)
\end{aligned}
$$

The following conditions determine the rental rate of capital and the wage rate:

$$
r_t = \frac{\partial y_t}{\partial k_{t-1}} = \theta \left(\frac{y_t}{k_{t-1}} \right), \tag{13}
$$

$$
w_t = \frac{\partial y_t}{\partial h_t} = (1-\theta) \left(\frac{y_t}{h_t} \right). \tag{14}
$$

The Bellman equation is as follows:

$$
\begin{aligned}
V_t(k_{t-1}, \lambda_t) = \max_{k_t, h_t} \{ & \ln \left(y_t + (1-\delta)k_{t-1} - k_t \right) \\
& + B(1-h_t) + \beta\, E_t \left[V_{t+1}(k_t, \lambda_{t+1}) \right] \},
\end{aligned} \tag{15}
$$

subject to constraints given by equations (9) to (12), where E_t denotes the expectation operator given the information available at t.

4.4 First-order conditions

The first-order conditions with respect to k_t and h_t are as follows:

$$
\frac{\partial V_t}{\partial k_t} : \quad (-1) \left[\frac{1}{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta} + (1-\delta)k_{t-1} - k_t} \right] + \beta E_t \left[\frac{\partial V_{t+1}}{\partial k_t}(k_t, \lambda_{t+1}) \right] = 0, \tag{16}
$$

$$
\frac{\partial V_t}{\partial h_t} : \quad (1-\theta) \left[\frac{1}{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta} + (1-\delta)k_{t-1} - k_t} \right] (\lambda_t k_{t-1}^{\theta} h_t^{-\theta}) - B = 0. \tag{17}
$$

4.5 Euler equations

The Euler equation is derived from the first-order condition in equation (16). By rearranging equation (16) we get,

$$\frac{\partial V_t}{\partial k_{t-1}} = \frac{1}{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta} + (1-\delta)k_{t-1} - k_t} \left(\theta \lambda_t k_{t-1}^{\theta-1} h_t^{1-\theta} + (1-\delta)\right). \tag{18}$$

To find $\frac{\partial V_{t+1}}{\partial k_t}$, we use the Benveniste-Scheinkman envelope theorem. First, we calculate the partial derivative of V_t with respect to k_{t-1}:

$$\frac{\partial V_t}{\partial k_{t-1}} = \frac{1}{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta} + (1-\delta)k_{t-1} - k_t} \left(\theta\, \lambda_t k_{t-1}^{\theta-1} h_t^{1-\theta} + (1-\delta)\right). \tag{19}$$

Shifting this derivation forward by one period, we get:

$$\frac{\partial V_{t+1}}{\partial k_t} = \frac{1}{\lambda_{t+1} k_t^{\theta} h_{t+1}^{1-\theta} + (1-\delta)k_t - k_{t+1}} \left(\theta \lambda_{t+1} k_t^{\theta-1} h_{t+1}^{1-\theta} + (1-\delta)\right). \tag{20}$$

Substituting this result into equation (19), we obtain:

$$\frac{1}{\lambda_{t+1} k_t^{\theta} h_{t+1}^{1-\theta} + (1-\delta)k_t - k_{t+1}} = \beta E_t \left[\frac{\theta \lambda_{t+1} k_t^{\theta-1} h_{t+1}^{1-\theta} + (1-\delta)}{\lambda_{t+1} k_t^{\theta} h_{t+1}^{1-\theta} + (1-\delta)k_t - k_{t+1}}\right]. \tag{21}$$

The left-hand side of the above equation can be simplified utilizing equation (9). Specifically, we substitute $c_t = y_t + (1-\delta)k_{t-1} - k_t$ for the denominator. Furthermore, using equation (13), $r_t = \theta \frac{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta}}{k_{t-1}}$, we find that $r_{t+1} = \theta \frac{\lambda_{t+1} k_t^{\theta} h_{t+1}^{1-\theta}}{k_t}$. Thus, the numerator on the right-hand side is replaced with $r_{t+1} + (1-\delta)$. Simplifying the denominator using c_t and $c_{t+1} = y_{t+1} + (1-\delta)k_t - k_{t+1}$, we obtain the Euler equation:

$$\frac{1}{c_t} = \beta E_t \frac{r_{t+1} + (1-\delta)}{c_{t+1}}. \tag{22}$$

Next, the labor-leisure condition is derived from the first-order condition with respect to h_t, as given in equation (17). Isolating B in equation (17), one can get

$$(1-\theta)\left[\frac{1}{\lambda_t k_{t-1}^{\theta} h_t^{1-\theta} + (1-\delta)k_{t-1} - k_t}\right](\lambda_t k_{t-1}^{\theta} h_t^{-\theta}) = B. \tag{23}$$

Using equation (9), equation (23) can be simplified to

$$(1-\theta)\left[\frac{1}{c_t}\right](\lambda_t k_{t-1}^{\theta} h_t^{-\theta}) = B. \tag{24}$$

After rearranging, we obtain the following simplified labor-leisure choice:

$$(1-\theta)\frac{y_t}{h_t} = Bc_t. \tag{25}$$

5 Theoretical analysis

The parameters defining the utility function are at the heart of the analysis. For clarity purposes, we rewrite the utility function in equation (5) in the following way:

$$u(c_t, h_t) = \ln\, c_t - \,|B|h_t. \tag{26}$$

where

$$B = \frac{A\,\ln(1-h_0)}{h_0} < 0. \tag{27}$$

Equation (26) implies that any change in the two underlying parameters, A and h_0, that increases the absolute value of B will reduce the hours of work.

Equation (26) implies that the composite parameter B is determined by the two underlying parameters: A and h_0. Therefore, any shift in the two underlying parameters, A and h_0, that affects B will influence the hours of work. The following two statements highlight the nature of these effects on the hours of work.

Claim 1 (Impact of the underlying parameters)**.** *An increase in A and h_0 raises the absolute value of B, meaning that*

$$\frac{\partial |B|}{\partial A} > 0 \quad \forall A > 0,\ \forall h_0 \in (0,1), \tag{28}$$

$$\frac{\partial |B|}{\partial h_0} > 0 \quad \forall A > 0,\ \forall h_0 \in (0,1). \tag{29}$$

Proof. The proof consists of two parts.
1. Proof of inequality (28).

$$\frac{\partial |B|}{\partial A} = \frac{\partial}{\partial A}\left(-\frac{A\,\ln(1-h_0)}{h_0}\right) = -\frac{\ln(1-h_0)}{h_0}. \tag{30}$$

For $0 < h_0 < 1$, $\ln(1-h_0) < 0$. Then, it follows that

$$\frac{\partial |B|}{\partial A} > 0 \quad \forall A > 0,\ \forall h_0 \in (0,1). \tag{31}$$

2. Proof of inequality (29).

$$\frac{\partial |B|}{\partial h_0} = \frac{\partial}{\partial h_0}\left(-\frac{A\,\ln(1-h_0)}{h_0}\right) = \frac{A\,(h_0 + (1-h_0)\ln(1-h_0))}{h_0^2(1-h_0)}. \tag{32}$$

This equation shows that the sign of $\dfrac{\partial |B|}{\partial h_0}$ is determined by the sign of the numerator. Since $A > 0$, the sign is determined by the sign of $h_0 + (1-h_0)\ln(1-h_0)$. Let us denote

$$G(h_0) = h_0 + (1-h_0)\ln(1-h_0). \tag{33}$$

The function G satisfies the following conditions:

1. The function G is continuous on the half-open interval $[0, 1)$.

2. $G(0) = 0$.

3. $\lim\limits_{h_0 \to 1^-} G(h_0) = \infty$.

4. $\left.\frac{dG(h_0)}{dh_0}\right|_{h_0=0} = 0$ and $\frac{dG(h_0)}{dh_0} > 0$ for $0 < h_0 < 1$.

These properties imply that as h_0 increases over the interval $[0, 1)$, $G(h_0)$ strictly increases over the interval $[0, \infty)$. Consequently,

$$G(h_0) > 0 \quad \forall h_0 \in (0, 1). \tag{34}$$

Inequality (34), along with equation (32), implies inequality (29). □

Remark 1 (The slope of an indifference curve for $|B|$)**.** *An immediate implication of Claim 1 is that an indifference curve for $|B|$, defined as the set of pairs (A, h_0) that yields a constant level of $|B|$, is negatively sloped:*

$$\left.\frac{dh_0}{dA}\right|_{d|B|=0} = -\frac{\dfrac{\partial |B|}{\partial A}}{\dfrac{\partial |B|}{\partial h_0}} < 0 \quad \forall A > 0,\ \forall h_0 \in (0, 1). \tag{35}$$

The negative slope of an indifference curve for $|B|$ in Remark 1 will be useful for motivating specific aspects of the quantitative analysis presented below. Figure 1 in the appendix depicts two indifference curves.

After establishing how the parameters A and h_0 influence the composite parameter B, the analysis now turns to examining the impact of B on aggregate hours in the steady state.

Claim 2 (Impact of $|B|$). *At steady state, an increase in the absolute value of B reduces the number of hours, meaning that*

$$\frac{\partial h}{\partial |B|} < 0 \quad \forall A > 0,\ \forall h_0 \in (0,1), \tag{36}$$

Proof. Recall the equation for the labour-leisure choice, i.e., equation (25):

$$(1-\theta)\frac{y_t}{h_t} = Bc_t. \tag{37}$$

In the steady state, $c_t = c_{t+1} = c$ and $y_t = y_{t+1} = y$. Therefore, the labour-leisure choice becomes

$$(1-\theta)\frac{y}{h} = Bc. \tag{38}$$

By rearranging, we can isolate for h as follows:

$$h = -\frac{1-\theta}{\beta} \times \frac{y}{c} \tag{39}$$

To express h as a function of exogenous parameters, we need to substitute the variables (y),(c), and (r). Using the fact that at the steady state, $c_t = c_{t+1} = c$, $y_t = y_{t+1} = y$ and $k_{t-1} = k_t = k$, equation (9) becomes

$$c = y - \delta k. \tag{40}$$

Applying the same notion to equation (13) at the steady state, and rearranging to isolate y on the left-hand side, we obtain

$$y = \frac{r}{\theta} \times k. \tag{41}$$

Furthermore, at the steady state equation (22) becomes

$$r = \frac{1}{\beta} - 1 + \delta. \tag{42}$$

As the next step, by substituting c and y in equations (40) and (41) into equation (39), we obtain the following expression for h:

$$h = -\frac{1-\theta}{\beta} \times \frac{rk/\theta}{y - \delta k}. \tag{43}$$

We proceed by substituting y from equation (41) in the denominator of equation (43) and obtain the following:

$$h = -\frac{1-\theta}{\beta} \times \frac{r}{r - \delta\theta}. \tag{44}$$

By inserting equation (42) into equation (44) for r, we express h in terms of the model parameters:

$$h = -\frac{1-\theta}{|B|} \times \frac{\frac{1}{\beta} - 1 + \delta}{\frac{1}{\beta} - 1 + \delta - \theta\delta}. \tag{45}$$

Using equation (45), the derivative of h with respect to $|B|$ is given by

$$\frac{dh}{d|B|} = -\frac{d}{d|B|}\left(\frac{1-\theta}{|B|}\right) \times \frac{\frac{1}{\beta} - 1 + \delta}{\frac{1}{\beta} - 1 + \delta - \theta\delta} = \frac{1-\theta}{B^2} \times \frac{\frac{1}{\beta} - 1 + \delta}{\frac{1}{\beta} - 1 + \delta - \theta\delta}. \tag{46}$$

Collecting the terms, the equation becomes

$$\frac{dh}{d|B|} = \frac{1-\theta}{B^2} \times \frac{\frac{1}{\beta} - 1 + \delta}{\frac{1}{\beta} - 1 + \delta(1-\theta)}. \tag{47}$$

In equation (47), $1 - \theta > 0$, $\delta > 0$, $\frac{1}{\beta} > 1$, and $B^2 > 0$. Therefore, inequality (36) will follow from equation (47), implying that an increase in $|B|$ leads to a decrease in aggregate hours worked h. □

Remark 2 (Impact of A and h_0 on aggregate hours)**.** *Claims 1 and 2 imply that an increase in A or h_0 leads to fewer* aggregate *hours of work.*

The analysis in the subsequent sections explores these effects quantitatively. For clarity and ease of reference, the following terminology will be used throughout this paper:

- The parameter A will be referred to as the "disutility of labour."
- The parameter h_0 will be referred to as the "work unit."

6 Disutility of Labour

In this section, I explore the impact of labour disutility (i.e., the parameter A) on aggregate work hours and the business cycle while holding hours per employed household fixed. Hours per employed household, h_0, is equal to 0.53 for now, remaining consistent with the original value used in Hansen (1985). The relationship between h_t and h_0 is mediated by parameter (B), with $|B|$ determined by the values of labour disutility A and the work unit h_0 as indicated in equation (27). I will examine two distinct levels of labour disutility, labeled as "low" and "high." The low labour disutility case will serve as the benchmark economy, while the high disutility case represents an economy experiencing quiet quitting. These disutility levels correspond to the two work-hour targets presented in Table 1. The benchmark case targets 5.136 daily work hours, which translates to $h = 0.2142$ in this model, as 5.136/24 hours = 0.2142. The high disutility case aims for 4.968 daily hours, equating to $h = 0.2078$ as 4.968/24 hours = 0.2078. Section 6.1.1 will provide further details on the calibration of the benchmark case and Section 6.1.2 for the high-disutility case.

6.1 Calibration

6.1.1 Benchmark case

Based on Current Population Survey data for actual hours worked, Lee, Park, and Shin (2023) report average annual hours to be 1,229 per employed worker before the outbreak of Coronavirus in 2019. Assuming that individuals work 48 weeks a year and five days a week, 1,229 annual hours correspond to approximately 5.136 daily hours worked per employed household. For more information about the estimates of hours worked between 2019 and 2022 see Appendix A. To calibrate the model to have a steady state number of hours consistent with 1,229 annual hours, the disutility of labour parameter, A, is set to 2.82. Meanwhile, the work unit is fixed at $h_0 = 0.53$. The parameter values discussed here are also visible in Table 2. The value of the disutility of labour parameter was selected to meet the targeted number of hours $h = 0.2142$ or 5.134 hours a day. The steady state hours, as shown in Table 3, are now consistent with pre-pandemic data of 1,229 annual hours worked per employed worker. This low disutility case will be referred to and used as a benchmark economy for the rest of the paper.

6.1.2 High disutility case

By 2022, Lee, Park, and Shin (2023) found that average annual hours had fallen from $1,229$ to $1,193$ per worker in the U.S. Under the same assumptions in the benchmark case, if individuals work 48 weeks a year and five days a week, $1,193$ annual hours equals 4.968 daily hours per employed household. To achieve 4.968 daily hours at the steady state, the disutility of labour parameter increases from $A = 2.82$ to 2.92, making this the high disutility case. In the model, when A increases, $|B|$ increases, which consequently leads to a decrease in aggregate hours. As reported in Table 3, when A increases to 2.92, $h = 0.2078$, which is equal to 4.986 daily hours. Therefore, the choice of $A = 2.92$ for the updated disutility of labour parameter is because it effectively produces a steady state level of hours that is consistent with the targeted annual hours worked for 2022 (i.e., 1,193), which are displayed in Table 1.

6.2 Comparison of the steady states

When the disutility of labour increases between the benchmark and high case, several variables exhibit declines at the steady state. As reported in Table 4, consumption decreases from 0.5900 to 0.5725, exhibiting a 2.97 percent reduction. Similarly, output declines from 0.7936 to 0.7699, reflecting a 2.99 percent decrease. The steady state level of hours worked also decreases from 0.2142 to 0.2078, resulting in a 2.98 percent reduction. Capital declines by 2.99 percent, from 8.1390 to 7.8961. Investment also decreases by 2.99 percent, from 0.2035 to 0.1974. Between the benchmark and high disutility case, productivity, the equilibrium wage, and the interest rate remain constant. This is consistent with the prediction of Fitzgerald (1998) that in order to prevent output from contracting when hours worked decline, productivity must increase in order to compensate. As seen in Tables 3 and 4, productivity remains constant, and thus, output decreases as hours decline.

6.3 Business cycle predictions

To observe the impact of an increase in labour disutility on the business cycle, estimates of the mean and standard deviation for output, consumption, investment, capital, hours, and productivity are displayed in Table 5. The associated impulse response functions can also be viewed in Appendix C. The values in Table 5 were obtained using Dynare in Matlab. Simulations of the model were run using the command `stoch_simul` with the following specifications: first-order approximation (`order`=1), impulse response functions for 20 periods (`irf`=20), Hodrick-Prescott filter set to 1600 (`hp_filter`=1600), 100 simulation replications (`simul_replic`=100), and for 115 periods (`periods`=115). The simulated variables were used to calculate the first and second moments displayed in Table 5 for both the benchmark and high disutility case. The results show that the standard deviation decreases for every variable except consumption and productivity as disutility increases. The standard deviation of productivity remains constant, as does consumption, as this variable is generally smooth over time. To summarize the impact of higher disutility on the business cycle, as the disutility of labour increases and aggregate hours decrease, output, investment, and capital become less volatile.

7 Work Unit

In the first exercise, to obtain the annual hours reported in the data, the disutility of labour parameter increases to depict a growing dissatisfaction with working, a key aspect associated with quiet quitting. In the following exercise, I increase the work unit that households are committed to supplying instead of adjusting the disutility of labour. The work unit, h_0, increases in order to reach the number of hours worked in 2022 as previously referenced in Table 1. This adjustment increases the burden on employed households by requiring them to commit more hours. In the model, an increase in h_0 increases $|B|$. Consequently, aggregate hours worked in the economy decrease and align more closely with annual hours reported following the emergence of quiet quitting. Specific details about the target number of hours and the calibration of h_0 are discussed in Section 7.1.

7.1 Calibration

As reported by Lee, Park, and Shin (2023), by December of 2022, average annual hours worked had fallen by thirty-six hours, from $1,229$ to $1,193$. To induce a lower level of hours worked consistent with $1,193$ annual hours, the work unit increases from $h_0 = 0.530$ to 0.570, making this the high work unit case. In this case, the value of A remains unchanged from the benchmark economy at $A = 2.82$. For reference, the values of h_0, A and the implied value of B are displayed in Table 2. The results for this case show that when h_0 increases, the steady state level of hours is $h = 0.2061$, which is equal to 4.944 daily hours. This quantity of hours is close to the 2022 target of 4.968 daily hours ($1,193$ annual hours as shown in Table 1), though not an exact match. This result, along with the steady state values for the other variables, can be found in Table 6.

7.2 Comparison of steady states

Changes in the steady state values and the percentage difference between the benchmark and high work unit case are documented in Table B.2. Consumption decreases by 3.65 percent from 0.5892 to 0.5677. Output falls by 3.63 percent, from 0.7923 to 0.7635. Hours decrease by 3.64 percent from 0.2139 to 0.2061. Investment also decreases by 3.64 percent, from 0.2032 to 0.1958, and capital also drops by 3.63 percent from 8.1262 to 7.8307. The wage rate, interest rate, and productivity parameter remain unchanged from an increase in the work unit.

7.3 Business cycle predictions

To observe the impact of an increase in the work unit on the business cycle, estimates for the mean and standard deviation are derived for output, investment, capital, hours and productivity. The values can be referenced in Table 8. Consistent with the results from the first experiment, the standard deviations for output, investment, capital and hours decrease. Whereas the standard deviations for consumption and productivity remain unchanged, highlighting the tendency for consumption to be smooth. To summarize the effect of a higher work unit on the business cycle, as the work unit increases and aggregate hours decrease, output, investment, capital, and hours become less volatile.

In both exercises, the standard deviations decrease for all variables except consumption and productivity. This indicates that in the first exercise, as labour disutility rises and aggregate hours decrease, the business cycle becomes less volatile with respect to output, investment, capital and hours. Similarly, in the second exercise, increasing the work unit, which reduces aggregate hours, leads to a similar reduction in business cycle volatility. These findings imply that quiet quitting dampens business cycle volatility.

8 Dual Adjustment

Up to this point, I have considered two experiments.

- In the first exercise, to target the annual hours reported in the data, the disutility of labour parameter A increases to depict a growing dissatisfaction with working associated with quiet quitting. This first experiment successfully decreases aggregate hours, reflecting the outcome of quiet quitting.

- In the second exercise, the work unit h_0 that households are committed to supply increases, while the disutility parameter A is held constant. The second approach depicts an increasing demand on employed households as they are asked to commit more hours h_0 with probability α_t. This second exercise successfully achieves the outcome of quiet quitting by causing aggregate hours to decrease. An increase in h_0 increases $|B|$, leading aggregate hours to fall and reach the targeted aggregate hours for 2022 displayed in Table 1.

Both experiments provide insights into the impact of decreasing aggregate hours on the economy, which is a key feature of quiet quitting. However, the limitation of the first and second exercises is that although aggregate hours are consistent with quiet quitting, hours per employed person are not entirely consistent with quiet quitting. As shown in Table 9, the first exercise keeps the work unit constant, so employed individuals are working the same number of hours *each period* as in the benchmark economy, which is not consistent with quiet quitting. The second exercise increases the work unit, which also does not reflect quiet quitting since the work unit should be moving in the opposite direction.

Given these shortcomings of the economies considered in these two experiments, I consider the third experiment where the disutility of labour A is increased, and the work unit h_0 is decreased to more precisely capture the notion of quiet quitting along both the aggregate hours and per-worker hours. This third experiment is referred to as the dual adjustment.

Figure 1 provides a diagrammatic representation of the three experiments. In the figure, the value of the work unit h_0 is on the vertical axis, the value of A on the horizontal axis, with the heavy lines representing two indifference curves for $|B|$. The benchmark case $\mathcal{E}_0$ is on an indifference curve closest to the origin with the lowest $|B|$. The high disutility case increases the value of A and subsequently the $|B|$, which places this case $\mathcal{E}_1$ on a higher indifference curve and to the right of the benchmark case $\mathcal{E}_0$. In the high work unit case, h_0 is increased while A is held constant, which subsequently increases $|B|$, placing this case $\mathcal{E}_2$ on an indifference curve vertically above the benchmark case. As shown in the diagram, the direction of h_0 is not consistent with quiet quitting in economies $\mathcal{E}_1$ and $\mathcal{E}_2$; therefore, economy $\mathcal{E}_3$ offers a more accurate depiction of how quiet quitting will impact the economy. In the third experiment, the dual adjustment case involves increasing the value of A and decreasing the work unit h_0 such that this case $\mathcal{E}_3$ is also on a higher indifference curve. All three experiments increase $|B|$ and cause aggregate hours to decrease, although the dual adjustment case $\mathcal{E}_3$ most accurately depicts quiet quitting.

8.1 Calibration

In this final exercise, the disutility of labour, A, increases from 2.82 in the benchmark to 3.21. Concurrently, the work unit, h_0, decreases from 0.53 to 0.43. As a result, $|B|$ increases from 4.024 to 4.196. For the dual adjustment case, the values for A and h_0 were selected to increase labour disutility while reducing individual work hours (i.e., the work unit), all while targeting the annual hours worked in 2022. With this approach, the direction of change for labour disutility and the work unit is consistent with quiet quitting. The dual adjustment achieves a steady state level of hours, $h = 0.2051$, as detailed in Table 6, which equates to 4.920 daily hours per employed household. Recall that the targeted number of work hours is $1,193$ annually or 4.968 daily hours, making this case close to the target.

8.2 Comparison of steady states

The remaining steady state results from the dual adjustment case are reported in Table 10. A side-by-side comparison of the benchmark and dual adjustment cases can be found in Table 10 along with the percentage changes. Consumption decreases by 4.25 percent from 0.5900 to 0.5649. Output decreases by 4.27 percent from 0.7936 to 0.7597. Hours fall by 4.24 percent, from 0.2142 to 0.2051. The capital stock declines from 8.1390 to 7.7918, reflecting a 4.26 percent decrease, and investment decreases by 4.27 percent from 0.2035 to 0.1948. Like the first two experiments, the wage rate, interest rate and productivity did not change.

8.3 Business cycle predictions

Consistent with the results from previous experiments, the dual adjustment case shows a decrease in standard deviations of most variables. For reference, the business cycle predictions are detailed in Table 11. Compared to the benchmark case, standard deviations in this dual adjustment case are lower for output, investment, capital stock and hours. As observed in the first and second exercises, the standard deviation for consumption and productivity remain unchanged. These findings reflect the same sentiment that volatility decreases as aggregate hours decrease. As shown in Table 12, the standard deviations decrease in all three cases relative to the benchmark (i.e., high labour disutility, high work unit and dual adjustment case). Notably, the dual adjustment case provides the most substantial evidence that quiet quitting dampens the business cycle as it more accurately captures the key aspects of quiet quitting.

9 Discussions and Concluding Remarks

Adjusting the disutility of labour and the work unit in the Hansen (1985) model with indivisible labour effectively incorporates critical aspects of quiet quitting. The results from the three experiments reveal that a decline in hours worked, without a corresponding increase in productivity, negatively affects output, capital, investment, and consumption. This reduction in labour supply, as evidenced by the drop in hours worked between 2019 and 2022, also leads to less volatility in these economic variables. By integrating quiet quitting into the dynamic stochastic general equilibrium framework and introducing a stochastic model for analyzing reduced hours worked, this paper advances the literature, improving upon Fitzgerald's (1998) static approach. The findings confirm that quiet quitting adversely impacts output, consumption, investment, and capital while reducing the volatility of these variables.

Countries must adapt to this structural shift in the labour supply, as labour remains a crucial component of output and economic growth. One strategy for firms is to substitute labour with capital. However, the feasibility of this substitution depends on the degree to which capital can replace labour, which can significantly vary across firms. Another approach involves enhancing labour productivity to counteract the decline in working hours. If labour productivity increases sufficiently, it can offset or surpass the effects of reduced working hours, potentially stabilizing or increasing output.

Further research should emphasize changes along the intensive margin, particularly during and after the pandemic. Solely relying on extensive margin indicators will misrepresent the recovery of the labour supply. As Lee, Park, and Shin (2023) demonstrated, a significant portion of the decline in hours worked—more than half—stems from the intensive margin. Consequently, neglecting this aspect would lead to underestimating the actual decline in hours worked.

The results presented in this paper are limited by excluding changes in labour productivity. Future research should evaluate labour productivity dynamics between 2019 and 2022 to fully assess the impact of quiet quitting. If labour productivity has changed during this period it should be incorporated as a separate parameter from capital productivity. Unlike the model used in this paper which lacks a direct parameter for labour productivity, limiting the ability to observe such effects. Addressing these aspects in future research could provide insights into whether increased productivity mitigates the impact of declining annual hours, contributing further to the literature on quiet quitting.

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APPENDICES

Tables and Figures

Table 1: Targeted Hours Worked

year	*annual hours*	*daily hours*
2019 (pre-covid)	1229	5.134
2022	1193	4.968

Note: The table shows the average annual hours worked and the corresponding daily hours for 2019 (pre-covid) and 2022. The annual hours are based on estimates by Lee, Park, and Shin (2023). The daily hours are calculated assuming an average individual works 48 weeks per year and 5 days per week.

Table 2: High Disutility of Labour and Low Work Unit

Key parameters	benchmark case	high labour disutility	high work unit	dual adjustment
A	2.82	2.92	2.82	3.210
h_0	0.530	0.530	0.570	0.430
implied value of B	-4.024	-4.159	-4.175	-4.196
daily hours	5.136	4.968	4.944	4.920

Note: This table displays the disutility of labour parameter A, the work unit h_0, the implied value of B and the associated daily hours for each case. B is a composite parameter influenced by A and h_0. Associated annual work hours are detailed in Table 1.

Table 3: Steady State Values

variable	benchmark case	high labour disutility
consumption, c	0.5900	0.5725
wage, w	2.3706	2.3706
interest rate, r	0.0351	0.0351
output, y	0.7936	0.7699
hours, h	0.2142	0.2078
capital stock, k	8.1390	7.8961
investment, i	0.2035	0.1974
productivity, y/h	3.7041	3.7041

Note: This table displays the steady state results of the benchmark case and the high disutility case. Omitted from this table is λ, which has a constant value of 1.

Table 4: Steady State Variables and Change Across Disutility Level

	benchmark case	high labour disutility	percentage change w.r.t. benchmark case
variable	x	x'	$100\% \times (x' - x)/x$
consumption, c	0.5900	0.5725	-2.97%
wage rate, w	2.3706	2.3706	0%
interest rate, r	0.0351	0.0351	0%
output, y	0.7936	0.7699	-2.99%
hours, h	0.2142	0.2078	-2.98%
capital stock, k	8.1390	7.8961	-2.99%
investment, i	0.2035	0.1974	-2.99%
productivity, y/h	3.7041	3.7041	0%

Note: This table shows the steady state values from the benchmark case and high disutility case. It also includes the differences as a percent of the values in the benchmark case. Omitted from this table is the value of λ, which has a constant value of 1.

Table 5: Impact of Labour Disutility on Cyclical Fluctuations

	benchmark case		high disutility	
	mean(x_t)	std(x_t)	mean(x_t)	std(x_t)
output, y_t	0.7810	0.0099	0.7542	0.0096
consumption, c_t	0.5902	0.0017	0.5700	0.0017
investment, i_t	0.1907	0.0083	0.1842	0.0080
capital stock, k_t	8.1887	0.0160	7.9083	0.0154
hours, h_t	0.2108	0.0021	0.2036	0.0020
productivity, y_t/h_t	3.7049	0.0108	3.7049	0.0108

Note: This table displays the first and second moments of the simulated variables. The second and third columns list the mean and standard deviation for the benchmark case. The fourth and fifth columns list the mean and standard deviation for the high labour disutility case.

Table 6: Steady State Values

variable	benchmark case	high work unit
consumption, c	0.5892	0.5677
wage rate, w	2.3706	2.3706
interest rate, r	0.0351	0.0351
output, y	0.7923	0.7635
hours, h	0.2139	0.2061
capital stock, k	8.1262	7.8307
investment, i	0.2032	0.1958
productivity, y/h	3.7041	3.7041

Note: This table displays the steady state results for the benchmark case and the high work unit case. Not included in this table is the value of λ, which has a constant value of 1.

Table 7: Steady State Variables and Change across Quantity of Work Unit

	benchmark case	high work unit	change w.r.t. benchmark case
variable	x	x'	$100\% \times (x' - x)/x$
consumption, c	0.5892	0.5677	-3.65%
wage rate, w	2.3706	2.3706	0%
interest rate, r	0.0351	0.0351	0%
output, y	0.7923	0.7635	-3.63%
hours, h	0.2139	0.2061	-3.64%
capital stock, k	8.1262	7.8307	-3.63%
investment, i	0.2032	0.1958	-3.64%
productivity, y/h	3.7041	3.7041	0%

Note: This table shows the steady state values for the second experiment. It includes the percentage changes from the benchmark to the high work unit case for each variable. Omitted from this table is the value of λ, which has a constant value of 1.

Table 8: Impact of High Work Unit on Cyclical Fluctuations

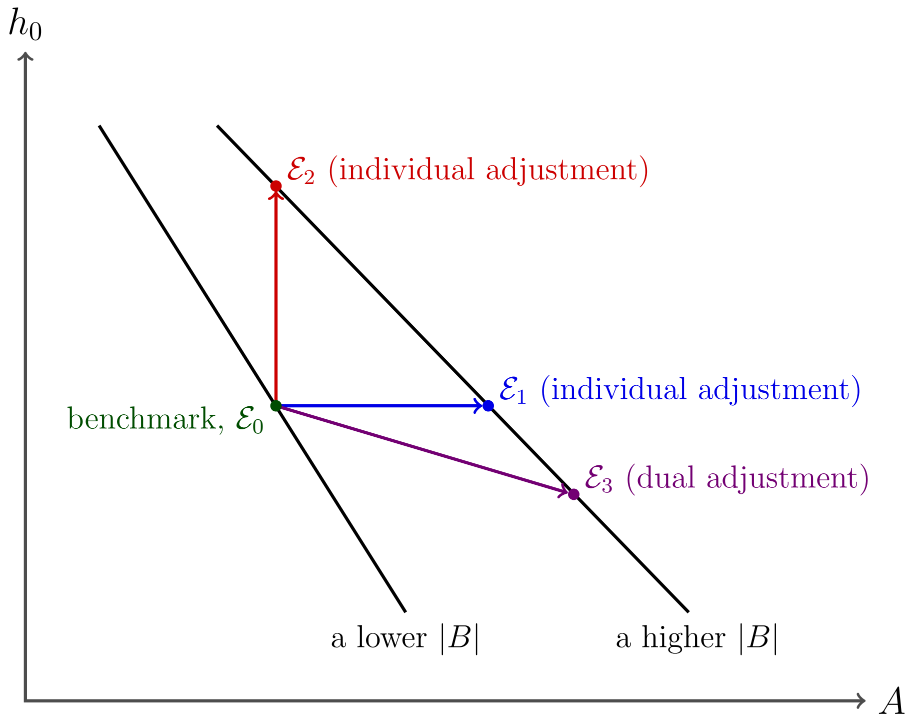
	benchmark case		high work unit	
	mean(x_t)	std(x_t)	mean(x_t)	std(x_t)
output, y_t	0.7810	0.0099	0.7514	0.0095
consumption, c_t	0.5902	0.0017	0.5679	0.0017
investment, i_t	0.1907	0.0083	0.1835	0.0080
capital stock, k_t	8.1887	0.0160	7.8786	0.0154
hours, h_t	0.2108	0.0021	0.2028	0.0020
productivity, y_t/h_t	3.7049	0.0108	3.7049	0.0108

Note: This table displays the first and second moments of the simulated variables. The second and third columns list the mean and standard deviations for the benchmark case. The fourth and fifth columns list the mean and standard deviations for the high work unit case.

Table 9: The Direction of Changes in Hours Relative to Benchmark Economy

economies	aggregate hours (i.e., $\alpha_t h_0$)	hours per employed household (i.e., h_0)
$\mathcal{E}_1$ (high labour disutility)	$\searrow$	constant
$\mathcal{E}_2$ (high work unit)	$\searrow$	$\nearrow$
$\mathcal{E}_3$ (dual adjustment)	$\searrow$	$\searrow$

Figure 1: Diagram Representation of the Three Experiments



Note: This figure provides a diagrammatic representation of the three experiments conducted in this paper. Included in the figure is the benchmark case ($\mathcal{E}_0$), the high disutility case ($\mathcal{E}_1$), the high work unit case ($\mathcal{E}_2$) and the dual adjustment case ($\mathcal{E}_3$). In $\mathcal{E}_1$, the disutility of labour (A) is increased while keeping the work unit (h_0) and all other parameters constant. In $\mathcal{E}_2$, the work unit is increased while holding the disutility of labour and all other parameters constant. In $\mathcal{E}_3$, the disutility of labour is increased, and the work unit is decreased, with all other parameters remaining unchanged. The two dark curves represent different values of $|B|$, with $|B|$ remaining constant along each curve. It is important to note that the figure is intended to illustrate the direction of changes in A and h, even though the actual values of $|B|$ differ slightly across the three experiments, ranging from 4.159 to 4.196. In the benchmark economy, $|B|$ is 4.024.

Table 10: Steady State Values

variable	benchmark case x	dual adjustment x'	change w.r.t. benchmark case $100\% \times (x' - x)/x$
consumption, c	0.5900	0.5649	-4.25%
wage rate, w	2.3706	2.3706	0%
interest rate, r	0.0351	0.0351	0%
output, y	0.7936	0.7597	-4.27%
hours, h	0.2142	0.2051	-4.24%
capital stock, k	8.1390	7.7918	-4.26%
investment, i	0.2035	0.1948	-4.27%
productivity, y/h	3.7041	3.7041	0%

Note: This table displays the differences in steady state values between the low disutility and the dual adjustment cases, calculated as a percentage of the low disutility case values.

Table 11: Impact of High Labour Disutility and Low Work Unit on Cyclical Fluctuations

	benchmark case		dual adjustment	
	mean(x_t)	std(x_t)	mean(x_t)	std(x_t)
output, y_t	0.7810	0.0099	0.7477	0.0095
consumption, c_t	0.5902	0.0017	0.5651	0.0017
investment, i_t	0.1907	0.0083	0.1826	0.0080
capital stock, k_t	8.1887	0.0160	7.8394	0.0153
hours, h_t	0.2108	0.0021	0.2018	0.0020
productivity, y_t/h_t	3.7049	0.0108	3.7049	0.0108

Note: This table displays the mean and standard deviations of each variable x_t in the benchmark and dual adjustment cases.

Table 12: Changes in volatility with respect to the benchmark case

	benchmark case	high disutility	high work unit	dual adjustment
	$100\times\text{std}(x_t)$	$100\times\Delta\text{std}(x_t)$	$100\times\Delta\text{std}(x_t)$	$100\times\Delta\text{std}(x_t)$
output, y_t	0.99	-0.03	-0.04	-0.04
consumption, c_t	0.17	-0.00	-0.00	-0.00
investment, i_t	0.83	-0.03	-0.03	-0.04
capital stock, k_t	1.60	-0.05	-0.06	-0.07
hours, h_t	0.21	-0.00	-0.00	-0.00
productivity, y_t/h_t	1.08	0.00	0.00	0.00

Note: This table displays the standard deviation of each variable x_t in the benchmark case and the difference between the benchmark case and each respective case. The first column lists six variables observed in the model. The second column presents the difference in standard deviation between the benchmark and high disutility case. The third column presents the difference between the benchmark and high work unit case. The fourth column presents the difference between the benchmark and dual adjustment case. All values in this table have been multiplied by 100.

A Further Details for Hours Worked

For the quantitative analysis in this paper, it is assumed that individuals work 48 weeks each year, regardless of the number of weeks they are paid to work. The actual hours used in the analysis are annual estimates calculated by Lee, Park, and Shin (2023) using CPS data. Daily work hours can be calculated by dividing the yearly estimates by 240, reflecting a 48-week work year and a five-day workweek. Specifically, 1,229 annual hours per worker in 2019, distributed over 48 work weeks with a five-day workweek, translates to approximately 5.12 hours worked daily. Similarly, in 2022, 1,193 annual hours per worker equates to about 4.97 hours worked daily. The calibration of the real business cycle targets these daily hours worked per worker.

The analysis in this thesis is motivated by the findings of Lee, Park, and Shin (2023) on shifts in work hours between 2019 and 2022. Their study analyzes changes along the extensive and intensive margins using data from the Current Population Survey (CPS) from January 2007 to December 2022. The key variables in their analysis are employment status and actual hours worked, derived from the CPS variables EMPSTAT and AHRSWORK1, respectively. Additionally, average hours worked per worker are calculated from yearly averages of the monthly CPS data and are seasonally adjusted.

B Replication of Hansen (1985)

The original results from Hansen's (1985) model with indivisible labour are reproduced and presented below in Table B.1. In this theoretical economy, a contract between households and firms to supply labour establishes that households will exchange 0.53 units of 24 hours with probability α_t. The remaining fraction of households $1-\alpha_t$ are unemployed. The steady state level of hours worked in this economy is calculated to be 0.30 units per capita, which translates to approximately 7.2 hours a day, which is consistent with the results of Hansen (1985).

Table B.1: Steady State Values and Business Cycle Predictions

	steady state values	business cycle prediction	
variable	Hansen (1985)	std(x_t)	corr(y_t, x_t)
output, y_t	1.1189	1.77 (0.23)	1.00 (0.00)
consumption, c_t	0.8320	0.51 (0.09)	0.88 (0.02)
investment, i_t	0.2869	5.65 (0.73)	0.99 (0.00)
capital Stock, k_t	11.4760	0.48 (0.11)	0.36 (0.03)
hours, h_t	0.3021	1.34 (0.17)	0.98 (0.00)
productivity, y_t/h_t	3.7041	0.51 (0.09)	0.88 (0.02)

Note: The table is divided into two sections. The first section presents the steady state values from Hansen (1985), while the second section shows the business cycle predictions, including the mean percent standard deviations (std (x_t)) and correlations with output (y_t) after a technology shock. Sample standard deviations are shown in parentheses for the business cycle predictions. The steady state results are for the replication of Hansen (1985). Omitted from this table is λ, which has a constant value of 1.

Table B.2: Steady State Variables and Change across Quantity of Work Unit

variable	benchmark case x	high work unit x'	change w.r.t. benchmark case $100\% \times (x' - x)/x$
consumption, c	0.5892	0.5677	-3.65%
wage rate, w	2.3706	2.3706	0%
interest rate, r	0.0351	0.0351	0%
output, y	0.7923	0.7635	-3.63%
hours, h	0.2139	0.2061	-3.64%
capital stock, k	8.1262	7.8307	-3.63%
investment, i	0.2032	0.1958	-3.64%
productivity, y/h	3.7041	3.7041	0%

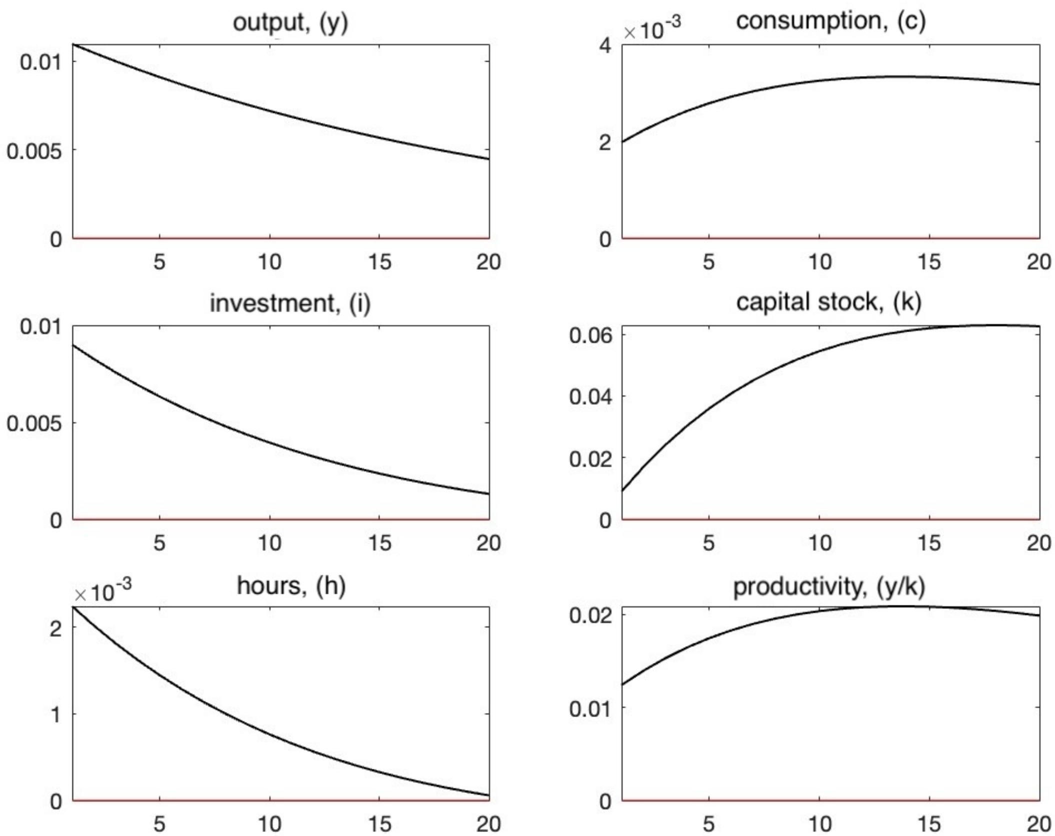
Note: This table shows the steady state values for the second experiment. It includes the percentage changes from the benchmark to the high work unit case for each variable. Omitted from this table is the value of λ, which has a constant value of 1.

C Impulse Response Functions

The results from a one-time shock to technology for each case are displayed below in Figures C.1 to C.4. The impulse responses for the benchmark and high disutility are shown in Figures C.1 and C.2. The impulse response functions for the high work unit case are displayed in Figure C.3, and the dual adjustment case is displayed in Figure C.4.

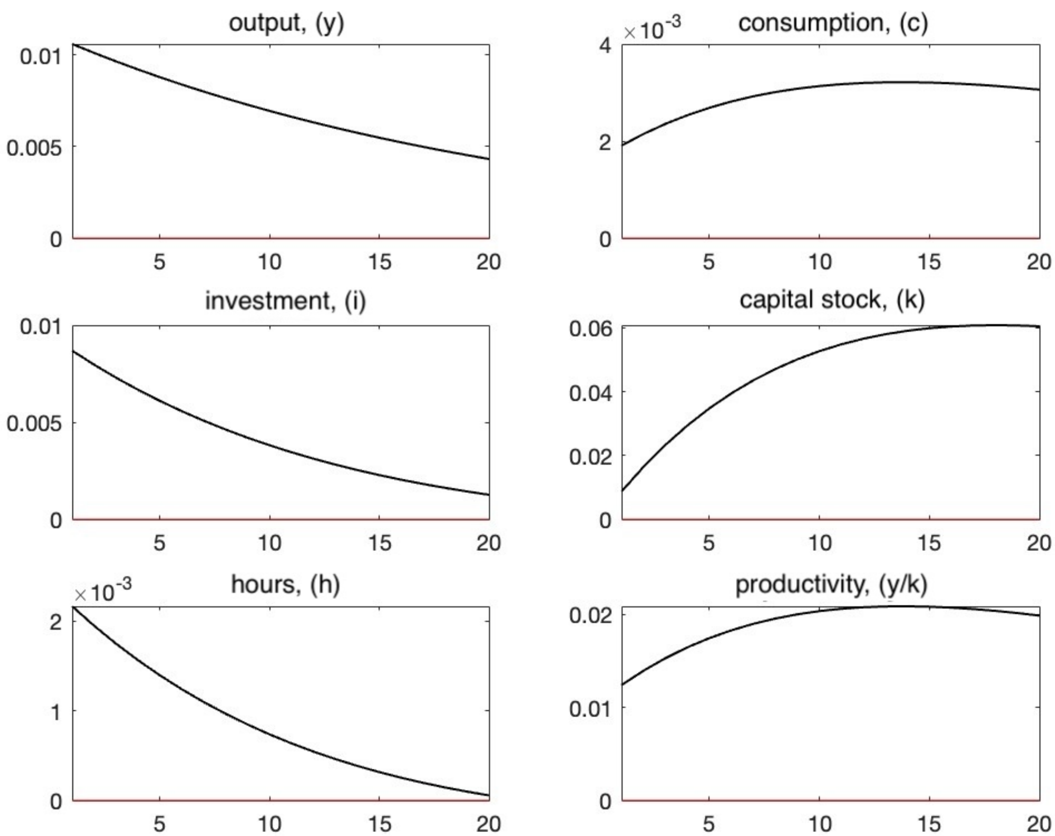
In all four cases, output, consumption, investment, capital, hours and productivity immediately and positively respond to the technology shock. The effect diminishes over 20 periods. As evidenced by the business cycle predictions, volatility decreases for output, investment, capital and hours between the benchmark case and the three main experiments. Meanwhile, consumption and productivity remain unchanged. Additionally, the results suggest that exogenous shocks to the work unit and labour disutility do not alter the direction of these responses.

Figure C.1: Impulse Response Functions: Benchmark



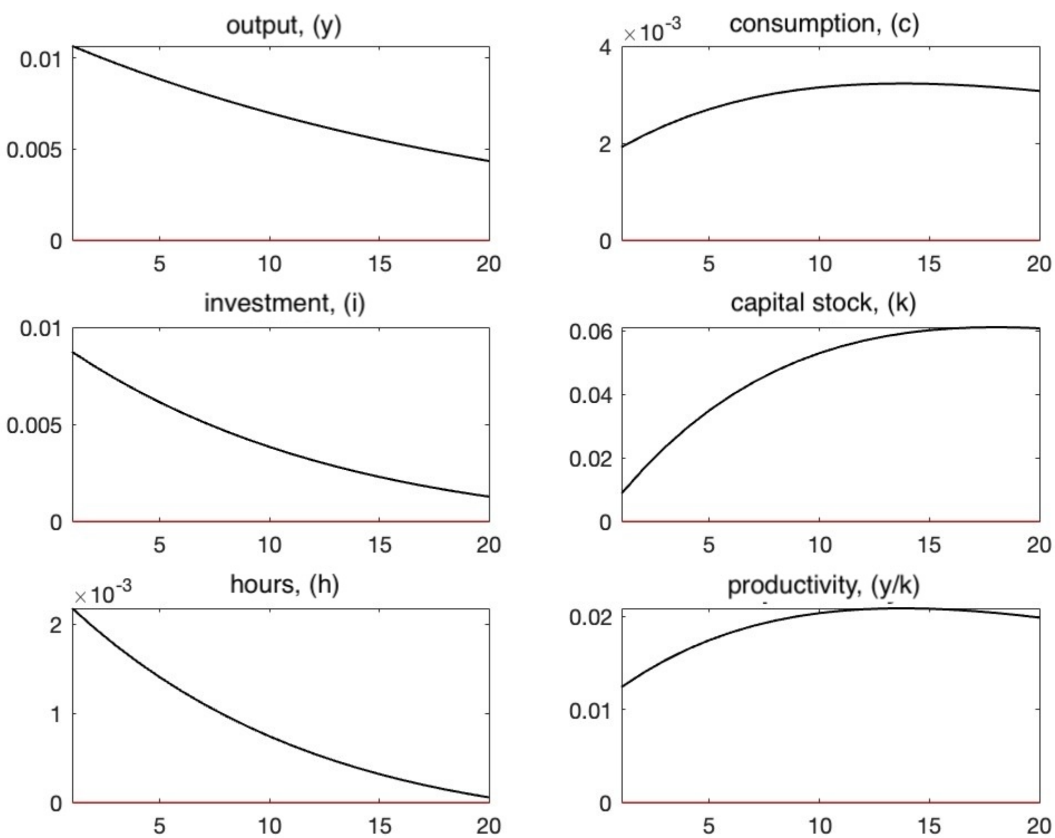
Note: This figure displays the impulse response functions to a permanent technology shock on output (y), investment (invest), hours (h), consumption (c), capital (k) and productivity. These results were derived for the case of low disutility of labour.

Figure C.2: Impulse Response Functions: High Disutility Case



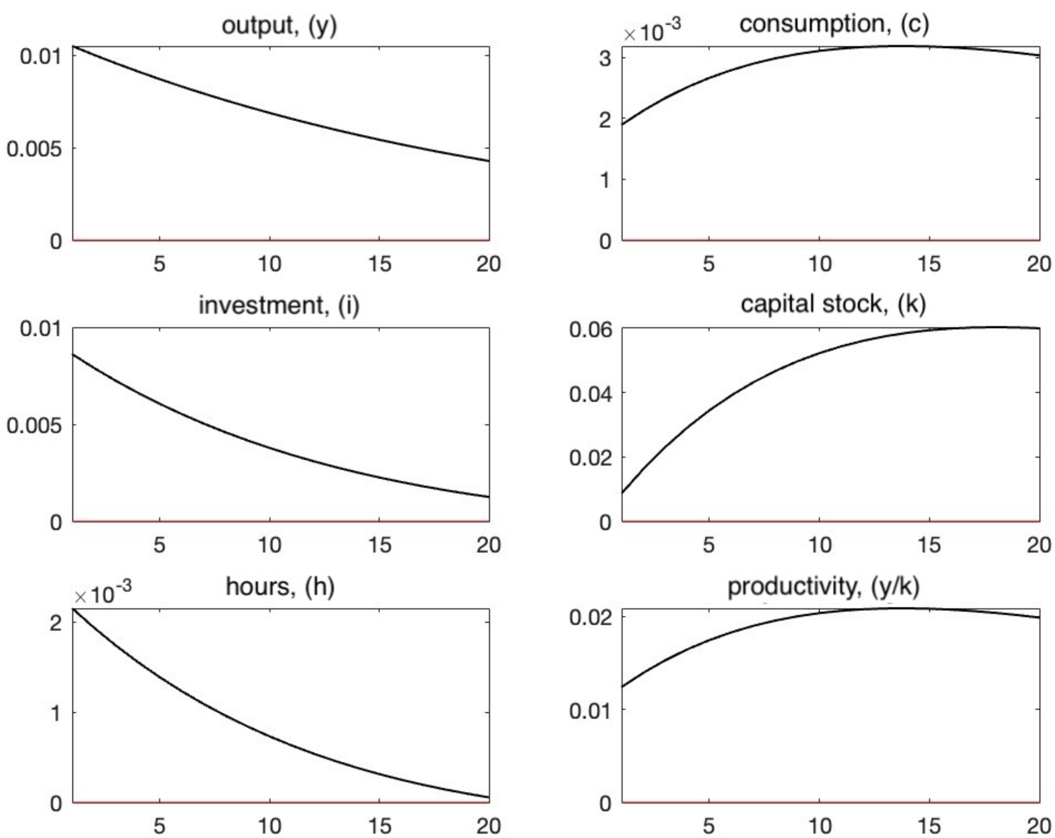
Note: This figure displays the impulse response functions to a permanent technology shock on output (y), investment (invest), hours (h), consumption (c), capital (k) and productivity. These results were derived for the case with high disutility of labour.

Figure C.3: Impulse Response Runctions: High Work Unit case



Note: This figure displays the impulse response functions to a permanent technology shock on output (y), investment (invest), hours (h), consumption (c), capital (k) and productivity. These results were derived for the high work unit case.

Figure C.4: Impulse Response Functions: Dual Adjustment Case



Note: This figure displays the impulse response functions to a permanent technology shock on output (y), investment (invest), hours (h), consumption (c), capital (k) and productivity. These results were derived for the dual adjustment case.