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Productivity and Keynes's 15-Hour Work Week Prediction for 2030: An Alternative, Macroeconomic Analysis for the United States

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Abstract: This paper analyses Keynes's 1930 prediction that technical advances would cut people's working week to 15 h by 2030 and investigates why actual working hours are significantly higher in the United States. Elaborating on Keynes's forecast to provide a general productivity formula while keeping its simplicity, we ran tests on macro-data from 1929 to 2019 and on estimates for 2030, demonstrating that productivity is surprisingly still insufficient to allow for a reduction in working hours across the US economy. This finding represents a substantial contribution to the literature, which has mostly explained long working hours by means of new consumer needs. Even by using microdata, we show that consumption does not explain the stickiness of working hours to the bottom. Hence, this paper combines a macroeconomic, logical-analytical approach based on historical time series with rigorously constructed time series at the microeconomic level. Finally, we also provide policies to narrow the productivity differential to Keynes's prediction for 2030 while fostering work-life balance and sustainable growth. To understand long working hours in the US despite technical advances—this being one of our main findings—productivity remains crucial.

Keywords: John Maynard Keynes; productivity; working hours

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1. Introduction and Literature Review

In the 1930s, John Maynard Keynes estimated for the United Kingdom that, in 2030, with fixed capital growing "by 2 per cent per annum", "a fifteen-hour week may […] satisfy […] most of us" (Keynes 1930). This prediction has been largely discussed (Freeman 2008; Crafts 2022), focusing mainly on its flaws, since working hours would be expected to drop to 780 (yearly) by 2030 (excluding holidays for simplicity). If we consider the US economy, working hours shrank from 2316 in 1929 (the basis year for Keynes) to 1765 in 2019 (−23.8 percent), which is a very far result from Keynes's estimate for the United Kingdom. As we show in this paper, the economics literature agrees that the "standard of life [has become] between four and eight times as high" since Keynes's prediction.

After almost one hundred years, Keynes's prediction remains, on the one hand, an object of timely discussion because of the enduring gap with respect to working hours. On the other hand, it becomes even more relevant in light of the so-called Great Resignation "describ[ing] the record number of people leaving their jobs since the beginning of the pandemic. After an extended period of working from home with no commute, many people have decided their work-life balance has become more important to them" (Ellerbeck 2022).

Providing an innovative finding in the economics literature, this paper explains the unfulfilled 15-hour work week with inadequate productivity *despite* technical advancement. Moreover, modelling Keynes's prediction based on the rewritten productivity formula suits the simplicity and boldness of his (just three-page long) analysis. Our main hypothesis shall be corroborated by evidence from the United States for the period 1929–2030, where working hours have by far exceeded the average in countries belonging to the Organisation for Economic Co-operation and Development (see Organisation for Economic Co-Operation and Development 2023) and which, unlike Keynes's home country, have so far attracted less interest in the economics literature[1].

With specific regards to the literature on "[l]abour productivity [which] is closely linked to economic growth, competitiveness, and living standards within an economy" (International Labour Organization 2023), Biddle (2014) claims that this variable exhibits pro-cyclical behaviour without a clear trend. Furthermore, even if Bjuggren (2018) documents an increase in productivity after corresponding institutional reforms in Sweden, this has not been linked so far to a change in working hours. Finally, Walheer (2021) decomposes labour productivity into three main components (namely, efficiency, technological, and the capital-labour ratio), but again, nothing is said about the link with working hours. Certainly, it has already been widely explored that Keynes's prediction has not become true (Elliott 2008; Conerly 2020) and how working hours and productivity interact with each other (Pencavel 2015; Collewet and Sauermann 2017). Moreover, Crafts (2022) suggests that "[l]eisure in retirement contributes to high life satisfaction for the elderly, but building up savings to pay for it is a barrier to working only 15 h for week". This argument is certainly true given that, in the United States, pensions are rare and most individuals rely on investment accounts (like a 401(k) plan). Consequently, many people continue working to ensure they have saved a sufficient amount of income to retire and ensure that they do not have to live on social security alone. However, accepting this argument (which this paper does not rebut) implies admitting that productivity before retirement has been insufficient to sustain an adequate standard of living for retired individuals (who are forced by circumstances to continue working).

There is as yet no significant agreement in the literature on the relationship between levels of productivity and hours worked and, in particular, on the effect of working hours on labour productivity (Collewet and Sauermann 2017; Cette et al. 2023). Considering net of fixed time, start-up costs, and no production, one might postulate—theoretically—that longer working hours could lead to a better allocation of capital assets and thus to higher productivity. For instance, Feldstein (1967) studied the coefficient of variation of productivity on a Cobb-Douglas production function and—upon the change in working hours from 41 to 50 h per week (+0.275) in 24 industries in 1960 and after using a non-frontier approach as well as through regression techniques—a result of (just) +0.076 was achieved. Instead, the progression of hours worked leads to increased worker fatigue, which reduces the marginal effect on productivity for each hour after the start of the decline. Clearly, this result is variable for each individual worker, and its standard deviation is sharpened by the type of task and the different product sectors to which employees belong (Pencavel 2015). Moreover, this point is highlighted without taking into account any external shocks that could play a role in affecting the number of hours worked, total or marginal productivity, both components, or even the correlation between the two. The recent COVID-19 pandemic, despite its extraordinary nature determining its scarcely tangential position with respect to the considerations of this article, which is instead based on long-term structural elements, produced a crisis exogenous to the economy. Certainly, that crisis was also (and perhaps above all) linked to the necessary absence of workers from their jobs (even with mechanisms of temporary lay-offs or working from home), with repercussions on the general output of the productive fabric (Asfaw 2022; Beretta et al. 2023; Bloom et al. 2023).

Empirical research on employed personnel and analysis of production functions based on sector data have also shown contrasting outcomes on the performance curve with respect to hours worked. Nevertheless, it has been found that in a moderate majority of tests, there has been a gradual decay of productivity as working hours increased. See for this Leslie and Wise (1980), Tatom (1980), and Shepard and Clifton (2000), as well as more recently Brachet et al. (2012), Dolton et al. (2016), and Lu and Lu (2017). Likewise, examples of output that was proportional to working hours (Crépon et al. 2004; Schank 2005; Kramarz et al. 2008) or that even showed increases, albeit logarithmically (Hart and McGregor 1988; Anxo and Bigsten 1989; Ilmakunnas 1994) may have been flawed in the trials by shortcomings in the capacity utilisation measurement of those employed—for example, by neglecting possible undersizing—or by aggregation bias (DeBeaumont and Singell 1999).

Again, apparently discordant findings have arisen more recently in Reif et al. (2021), who—on a sample of national data from 15 OECD countries—found productivity growth relative to working hours over the period 1963–2006, when compared to Bick et al. (2022), who, still using national datasets, found a trend in the function, with hours worked in the abscissa and GDP in the ordinate, forming a parabola with a downward concavity. Finally, Li (2023), on US data from 1948 to 2017, observed a progressively negative slope of the relationship; Bourlès and Cette (2007), Aghion et al. (2009), Cette et al. (2011), and Bourlès et al. (2012) also found diminishing returns, up to a halving of hourly productivity, over the progression of working hours. What appears from the bibliographical references presented here is that—though there is a general consensus on the non-constancy of returns in the progression of working hours—there is still no clarity on the trend (either increasing or decreasing) of these returns. In this article, we, therefore, attempt to follow the dynamics that lead to this non-unique trend and identify which policies could accommodate a maintenance of returns with a reduction in working hours.

Our contribution to the existing research work consists of testing Keynes's 15-hour workweek prediction for 2030 for the United States and explaining long working hours with *insufficient productivity* instead of—as mostly done so far—*new consumer needs*. In parallel to extending the frontiers of research on this specific topic by means of this innovative (and, apparently, counterintuitive) conclusion, in this paper we also explore which policy implications Keynes's prediction might have for better work-life balance and sustainability after the COVID-19 pandemic. Moreover, taking into account remote work and social demand for better occupations, this contribution demonstrates why a 15-h working week remains utopian.

The paper is structured as follows: in Section 2, we present macro-level data for the US economy, and in Section 3, we provide further evidence using US microdata from the Panel Study of Income Dynamics (PSID). In Sections 4 and 5, we respectively present the policy implications of our findings while providing specific country examples to draw further relevant conclusions. This paper provides numerical evidence that *insufficient productivity* is responsible for long working hours. Moreover, the results presented in Section 2 replicate—we shall say, "literally translate"—Keynes's analysis and prediction in his *Economic Possibilities for Our Grandchildren* (1930) step-by-step, transpose it to the US economy, and reconstruct what has happened in productivity terms. Table 1 represents, in addition, a particularly long data series (1929–2030) of some of the most relevant macroeconomic variables in the US economy needed to conduct our analysis.

2. Macroeconomic Model, Materials and Methods: An Alternative Explanation for Long Working Hours

Any production contributing to real GDP (Y) is a function of labour force (L) net of unemployed workers (U) and capital (K):

$$Y = f(L - U; K) \tag{1}$$

(1) is nothing else than a macroeconomically more specific formula than its "general form: $Q = f(L, K, t, \text{etc.})$ where Q is output, L is labour, K is capital, t is 'technical

progress' and where the 'etc.' indicates that other inputs may also be relevant (raw materials, for example)" (Pearce 1983, p. 355). Moving a step forward, we construct average annual working hours (H) as the ratio between real GDP per employee $\left(\frac{Y}{L-U}\right)$ and h:

$$H = \frac{\frac{Y}{L-U}}{h} \tag{2}$$

where h is productivity of an employee per working hour in US dollars. Moreover, h can be obtained after rewriting (2) as follows:

$$h = \frac{\frac{Y}{L-U}}{H} \tag{3}$$

The higher h, the lower *ceteris paribus* H needed for $\frac{Y}{L-U}$. Moreover, h reflects the notion of "productivity per hour worked", which mostly corresponds to "gross domestic product (GDP) per hour of work" (Our World in Data 2023b). (2) and (3) represent, therefore, the main relations the analysis in Section 2 is founded on in order to "translate" Keynes's prediction into numerical terms. To be sure, our modelling in Section 2 could have been more complex. For instance, by creating a Cobb–Douglas production function, which is mostly described as $Y = AK^{\alpha}N^{1-\alpha}$ where A is the total factor productivity, N the labour input, and α a value between 0 and 1 (Cottrell 2019). In such a case, however, we would neglect that Keynes (1930) simply states that "[i]f capital increases […] 2 per cent per annum, the capital equipment of the world will have increased by a half in twenty years, and seven and a half times in a hundred years". The fact that from 1996 to 2019, gross capital formation at the world level has increased on average by 3.4 percent per year (The World Bank 2023b) and gross fixed capital formation compared to GDP has globally stood at 24.7 percent between 1972 and 2019 (The World Bank 2023c) confirms that K has even exceeded Keynes's prediction. Moreover, K plays a generic role in Keynes's prediction since his focus is instead on the input H and the output $\frac{Y}{N}$ or $\frac{Y}{L-U}$. Hence, our analysis does not neglect K, although it does not explicitly appear in (2) and (3). In fact, h already contains any other production inputs besides $L-U$, since it is based on real GDP per employee. In other words, H already reflects accumulated fixed capital and—conversely—so does h too. Furthermore, (3) mirrors in its simplicity two commonly accepted macroeconomic relations (Blanchard et al. 2016) like:

$$\text{productivity} = \frac{output}{input} \tag{4}$$

and

$$Y = AL \tag{5}$$

where A measures increases in productivity and represents another way of expressing h. If we accept that A is the ratio between output as measured by GDP (Y) or its derivations like real GDP per capita $\left(\frac{Y}{N}\right)$ or real GDP per employee $\left(\frac{Y}{L-U}\right)$ and the production input L, we are bound to accept that rewriting (5) into:

$$A = \frac{Y}{L} \tag{6}$$

is in some way the *alter ego* of h as formulated in (3). Despite Keynes's (1930) prediction "that a hundred years hence we are all of us, on the average, eight times better off in the economic sense" and that by "standard of life" he was clearly referring to $\frac{Y}{N}$ (which is still a commonly used measure of economic wealth as reminded for instance by the Federal Reserve Bank of Boston (2003), we centre (3) around $\frac{Y}{L-U}$. In fact, $\frac{Y}{N}$ but even real GDP per unit of labour force $\left(\frac{Y}{L}\right)$ would be less precise, since only actually employed labour force $(L-U)$ being a subset of N and L contributes to real GDP. Our object of investigation is simple: since $\frac{Y}{N}$ in 1929 has increased by 538.0 percent by 2019 and real GDP per capita expected for 2030 $\left(\frac{Y^E_{2030}}{N^E_{2030}}\right)$ is predicted to stand at \$66,096 and be more than six times its 1929 size (Table 2), what is a macroeconomic and productivity-related explanation for the limited drop in working hours by just 22.1 percent?

To measure what productivity Keynes estimated for 2030 (h^{KE}_{2030})—regardless of the fact that he "assum[ed] no important wars and […] increase in population"—we have to adapt (3), turning it into:

$$h_{2030} = \frac{\frac{\delta Y_{1929}}{L_{1929} - U_{1929}}}{H^{KE}_{2030}} \tag{7}$$

where:

- H^{KE}_{2030} corresponds to 780 (that is, the number of working hours predicted by Keynes for 2030);
- $\frac{Y_{1929}}{L_{1929} - U_{1929}}$ corresponds to \$23,209 (Table 2);
- $2 \leq \delta \leq 8$ is the number of times Y_{1929} will be higher in 2030 given that Keynes (1930) assumed a "standard of life […] between four and eight times as high".

Table 1 sums up h^{KE}_{2030} for these seven different scenarios, while $\frac{h^E_{2030}}{h^{KE}_{2030}} \times 100$ represents the productivity differential between actual forecasts for 2030 and Keynes's estimate for the same year. Moreover, we test h^{KE}_{2030} and $\frac{h^E_{2030}}{h^{KE}_{2030}} \times 100$ for seven different levels of GDP increase with respect to 1929 because of the following reasons:

- $2Y_{1929}$, $3Y_{1929}$, and $4Y_{1929}$: as already mentioned, the standard of living in the United Kingdom stood at half of that of the United States in 1929. Therefore, it seems appropriate to verify the macroeconomic effect if Keynes's prediction of GDP increase would be halved for the US economy (from "between four and eight times" to "between two and four times");
- $5Y_{1929}$, $6Y_{1929}$, $7Y_{1929}$, and $8Y_{1929}$: we have to analyse Keynes's prediction as literally formulated by him (see "standard of life […] between four and eight times as high"), no matter if it was intended for the UK or the US economy.

As reported in column 1 of Table 1, expected productivity in 2030 will exceed Keynes's prediction only in one case, namely if real GDP increases by two times within a century. In the remaining cases reported in columns 2–7 of Table 1, we find a productivity gap ranging from 11.6 to 66.8 percent. We conclude that—the more Y_{1929} has increased within a century—the more the ratio $\frac{h^E_{2030}}{h^{KE}_{2030}} \times 100$ reflects the inability of h^E_{2030} to come up to the productivity level expected by Keynes (h^{KE}_{2030}).

Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.

Interventionary studies involving animals or humans and other studies that require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

Table 1. Keynes's productivity expectations for 2030.

	(1) **$2Y_{1929}$**	**(2)** **$3Y_{1929}$**	**(3)** **$4Y_{1929}$**	**(4)** **$5Y_{1929}$**	**(5)** **$6Y_{1929}$**	**(6)** **$7Y_{1929}$**	**(7)** **$8Y_{1929}$**	
h^{KE}_{2030}	59.5	89.3	119.0	148.8	178.5	208.3	238.0	**\$/employee/hour**
$\frac{h^E_{2030}}{h^{KE}_{2030}} \times 100$	132.6	88.4	66.3	53.0	44.2	37.9	33.2	**%**

Source: own calculations.

Additionally, we focus our analysis on what actually happened in terms of the standard of living in the United States. As shown in Table 2, real GDP per capita for 2030 $\left(\frac{Y^E_{2030}}{N^E_{2030}}\right)$ is expected to be 7.3 times its value of 1929 $\left(\frac{Y_{1929}}{N_{1929}}\right)$. Based on Table 2, we find with specific regards to real GDP per employed person expected for 2030 $\left(\frac{Y^E_{2030}}{L^E_{2030}-U^E_{2030}}\right)$ that it corresponds to 6.1 times its magnitude in 1929 $\left(\frac{Y_{1929}}{L_{1929}-U_{1929}}\right)$. The data in Table 1, which seem to be of greater interest because of verifying actual estimates for 2030, are those referring to $6Y_{1929}$ and $7Y_{1929}$ (reported in the grid-lined columns 5 and 6). It results in:

- h^E_{2030} covers only 44.2 percent of h^{KE}_{2030} with $6Y_{1929}$;
- h^E_{2030} covers only 37.9 percent of h^{KE}_{2030} with $7Y_{1929}$.

Our preliminary conclusion is that both H_{2019} and H^E_{2030} have not decreased to H^{KE}_{2030} because h_{2019} and h^E_{2030} remain too distant from h^{KE}_{2030}. These results, based on the numerical translation of Keynes's prediction, integrate the dominant interpretation so far that working hours have not shrunk on account of new consumer needs (Bourne 2019). Despite surely contributing to long working hours, they seem in fact not sufficient to explain why working hours are still so high. In parallel, we have to investigate which level of h for 2030 would make Keynes's estimate possible. Based on (3) and forecasts of real GDP per employee in 2030 $\left(\frac{Y^E_{2030}}{L^E_{2030}-U^E_{2030}}\right)$, we calculate which level of h_{2030} would compress H_{2030} to 780, namely to Keynes's prediction of working hours $\left(H^{KE}_{2030}\right)$:

$$h_{2030} = \frac{\frac{Y^E_{2030}}{L^E_{2030}-U^E_{2030}}}{H^{KE}_{2030}} \tag{8}$$

After due calculations, it results in that h_{2030} should correspond to 182.6\$/employee/hour (to wit, be 165.8 percent higher than h_{2019}). Let us verify it if our results change, if GDP per capita $\left(\frac{Y}{N}\right)$ instead of GDP per employee $\left(\frac{Y}{L-U}\right)$ is chosen. This can be done by rewriting (8) into:

$$h_{2030} = \frac{\frac{Y^E_{2030}}{N^E_{2030}}}{H^{KE}_{2030}} \tag{9}$$

which after due calculations corresponds to 84.7\$/employee/hour and is less than half h_{2030} when $\frac{Y}{L-U}$ is taken. In other words, if we would choose $\frac{Y}{N}$, h_{2030} would be even more distant from h^{KE}_{2030} with Y_{2030} equal to $6Y_{1929}$ or $7Y_{1929}$ (see Table 1). Once again, productivity seems too far from making Keynes's prediction possible.

Based on this additional evidence, it is not a matter of *wanting* (Walterskirchen 2016) but of *having* to work long. This is a crucial observation for the frontier reached so far by the economics literature, which has mostly explained long working hours with the *willingness* to behave so. While this might be true for "meaningful work", which "[s]ome employees even value [it] above other work characteristics like income, job security, promotions, or working hours" (Van Wingerden and van der Stoep 2018, p. 1), our analysis as well as Keynes's prediction centre around *average* employment characteristics. This is not astonishing, since forecasts mostly look at the *big picture*. Moreover, in light of strong inequalities among worker categories, we necessarily have to embrace a more *general* perspective.

Even if $\frac{Y^E_{2030}}{N^E_{2030}}$ and $\frac{Y^E_{2030}}{L^E_{2030}-U^E_{2030}}$—respectively, \$66,096 and \$142,412 (Table 2)—look close to Keynes's more optimistic "eight times" prediction (Keynes 1930) with $\frac{8Y_{1929}}{N_{1929}}$ equal to \$72,864 and $\frac{8Y_{1929}}{L_{1929}-U_{1929}}$ equal to \$185,672, appearances are once again deceiving. In fact, Figure 1 shows the huge differential in terms of h (\$/employee/hour) tested so far:

- the first bar (h_{2019}) shows the productivity level for 2019;

- the second bar (h^{E}_{2030}) shows the *actually* expected productivity level for 2030;
- the third and fourth bar—respectively, "h^{KE}_{2030}, if $6Y_{1929}$" and "h^{KE}_{2030}, if $7Y_{1929}$"—show the productivity level for 2030, which Keynes would have expected if $\frac{Y}{L-U}$ as of 1929 would have grown by respectively six or seven times;
- the fifth bar ("h_{2030}, if H_{2030} = 780") shows the productivity level needed in 2030, if yearly working hours should be cut to 780.

The dotted line also highlights the gap between the productivity level predicted for 2030 $\left(h^{E}_{2030}\right)$ and Keynes's scenarios $\left(h^{KE}_{2030}\right)$. Only with $h^{E}_{2030} > h^{KE}_{2030}$ and $H > 780$ (that is, with expected productivity for 2030 exceeding Keynes's prediction and working hours remaining nevertheless higher than what expected by the Cambridge economist) we could claim that individuals are *willing* (not *forced*) to work long hours. As demonstrated, this is however not the current case[2]. All underlying data are taken from Table 2.

There is no doubt that consumer needs have increased too, contributing to working long hours, although "[t]oday it's possible to work only 15 h a week and make a good living" (Poutintsev 2021). This reasoning apparently echoes Keynes (1930), who stated that there are needs being "absolute […] whatever the situation […] may be, and those being relative […] only if their satisfaction lifts us above […] our fellows". If by "relative needs" we mean anything buyable with income above the poverty threshold ($13,011 in 2019) (US Census Bureau 2019) and only "absolute needs" are relevant, real GDP is bound to shrink. Whether downgrading individuals' standard of living to make individuals work less is what Keynes meant should be strongly questioned. In fact, the Cambridge economist meant that "all of us, on the average" would be "better off in the economic sense" (Keynes 1930, p. 365), which is clearly not achievable if the standard of living should shrink. According to his most genuine interpretation (which is also the most logical), it is not a matter of deciding between working and earning more or working and earning less, but of working less and earning more. Interpreting his prediction as an "either-or" (instead of an "and-and") scenario would miss the point. In this specific regard, Section 3 provides further empirical evidence of the microeconomic reasons for working long hours. New consumer needs, which are one of the main reasons identified so far as a potential explanation, are not among them.

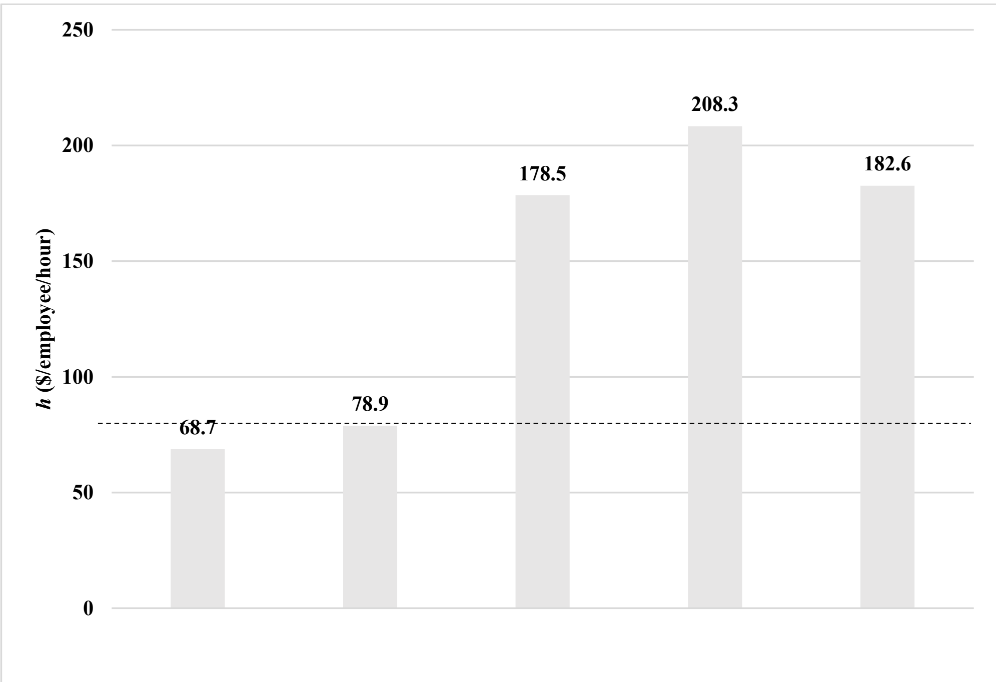

Figure 1. Differential between actual and expected productivity. Source: own calculations.

Table 2. Labour in the US (1929–2030).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Labour Force	**Unemployed Workers**	**Employed Workers**	**Population**	**Real GDP**	**GDP per Capita**	**GDP per Employee**	**Yearly Working Hours**	**Weekly Working Hours**	**Productivity**
	L	U	$L-U$	N	Y	$\frac{Y}{N}$	$\frac{Y}{L-U}$	H	$\frac{H}{52}$	h
	mill.				**bn. $**	**$**		**hours/year**	**hours/week**	**$/employee/hour**
1929	49.4	1.6	47.8	121.8	1109.4	9108.3	23,209	2316	44.5	10.0
1938	55.0	10.4	44.6	129.8	1131.6	8718.0	25,372	1756	33.8	14.4
1950	62.2	3.2	59.0	152.3	2289.5	15,092.8	38,805	1990	38.3	19.5
1960	69.6	3.8	65.8	180.8	3260.0	18,035.8	49,544	1935	37.2	25.6
1970	82.8	4.1	78.7	205.1	4951.3	24,142.5	62,914	1893	36.4	33.2
1980	106.9	7.7	99.2	227.7	6759.2	29,681.8	68,137	1802	34.6	37.8
1990	125.8	7.0	118.8	250.2	9365.5	37,435.5	78,834	1796	34.5	43.9
2000	142.6	5.7	136.9	282.4	13,131.0	46,497.3	95,917	1845	35.5	52.0
2010	153.9	14.8	139.1	309.8	15,598.8	50,354.5	112,141	1735	33.4	64.6
2019	163.5	6.0	157.5	328.5	19,091.7	58,112.5	121,217	1765	33.9	68.7
2030 ^{E}	169.0	7.3	161.7	348.4	23,028.1	66,096.7	142,412	1805	34.7	78.9
Δ%(1929–2019)	**+231.0**	**+275.0**	**+229.5**	**+169.7**	**+1620.9**	**+538.0**	**+422.3**	**−23.8**	**−23.8**	**+587.0**
Δ%(1929–2030 ^{E})	**+242.1**	**+356.3**	**+238.3**	**+186.0**	**+1975.7**	**+625.7**	**+513.6**	**−22.1**	**−22.0**	**+689.0**

Source: own calculations based on Federal Reserve Economic Data (2023a, 2023c, 2023d, 2023e, 2023j), Lebergott (1948), Our World in Data (2023a, 2023c), and U.S. Bureau of Labor Statistics (2023). Values indicated with a superscript E (for instance, 2030 ^{E}) are based on estimations.

3. Microeconomic Materials and Methods: A Counter-Analysis of "Traditional" Explanations for Long Working Hours

In order to collect further evidence on what microdata also suggest, we consider the Panel Survey of Income Dynamics (PSID) of the Institute for Social Research at the University of Michigan (2023), representing the longest data collection for the US economy and one of the broadest panel data surveys in the world. Different from many rotating panels, such as the German Socio-Economic Panel (SOEP) or the Labor Force Survey (LFS), respondents in the PSID continue, in principle, to be interviewed throughout their lives. This means that, for some individuals, we have more than 50 years of observations. Clearly enough, due to panel attrition, average individual persistence in the dataset is around 20 years.

This is useful to empirically confirm that the number of working hours did not significantly decline over time. Furthermore, our analysis allows us to show the evolution of average income and consumption in a descriptive way. Based on the PSID, the level of H annually declared by the head of each household declined from the median value of 1893 h in 1981 to 1850 h in 2011. While these numbers slightly differ from those reported in Table 2, this is due to the fact that the latter has been constructed on aggregate macroeconomic data for the US economy in its entirety. Moreover, the PSID only includes around 100,000 US families per year. The main message remains, however, unchanged: the decline in working hours over the past decades has been only modest, which is in stark contrast to Keynes's prediction. Additionally, we have to look at consumption expenditures due to increasing consumer needs, because they have been frequently judged to nourish long working hours. The PSID reports since 1999 annual expenditures of respondents on several categories of goods such as entertainment, food, health, housing, transport, and utilities. Food expenses include food consumed at home, out of home, and delivered. Moreover, we get information on whether food stamps were used for buying it. For housing, we know if an individual is a home-owner and the value of the property. For home-renters we know the annual rent paid, which enters into our measure of consumption. Entertainment includes expenses such as movie or sport-event tickets, while medical expenditures include the cost of reaching out to a doctor, going to a hospital, and the expenses for drugs prescribed. Finally, utilities expenses include those for gas, electricity, heating, and phone/Internet, while transport expenses include gas and car-maintenance costs as well as expenses for buses, taxis, and train tickets. By considering these categories, we obtain a reliable measure of total consumption, which after dividing it by the Consumer Price Index (CPI) represents a proxy of yearly real consumption. Accordingly, real consumption per adult equivalent moved from \$3853 in 1999 to \$3280 in 2011. This measure of real consumption is at the household level (that is, adding up all expenditures of people living together in a household), since the household is the main unit of analysis in the PSID. Because this measure is significantly influenced by the composition of the household, we prefer a more "standardised" measure of consumption. Further, we perform another step, namely we divide our measure of real household consumption (obtained as explained above) by the number of individuals belonging therein. Household members receive, respectively, a weight equal to 1 for the household head, 0.7 for other adults, and 0.5 for each child, which represents a sufficiently representative proxy for society as a whole. Since we strive to reconstruct a longer time series for consumption, we apply the procedure developed by Blundell et al. (2008) and take advantage from the fact that the PSID records expenses for food since 1968 and expenses for a variety of other goods since 1999. Based on the available information from 1999 to 2017, we estimate the demand functions for each category of goods while imputing consumption for them to the time from 1968 to 1997. By doing so, we are able to calculate a consistent measure of total consumption spanning over almost four decades (1968–2017). In other words, we perform a regression imputation. This procedure is made of two steps: in the first step, we regress consumption on a series of socio-demographic variables and year-fixed effects for the years for which consumption data are available (i.e., we estimate the demand functions). In the second step, we use the estimated coefficients derived from the first step in order to predict consumption for the years for which consumption data are not available.

Moreover, by dividing this measure of total consumption by the CPI and by the family equivalence scale, we obtain information on a standardised measure of real consumption, which is expressed by the following relation:

$$TC_{it} = \frac{ImputedHouseholdCons\_it}{CPI \times AdultEquivScale} \quad (10)$$

As Figure 2 makes it possible to deduce, real annual consumption as defined in the equation above has been declining from $5858 in 1981 to $2646 in 2011. In the following, whenever real annual consumption is mentioned, the reference is to Equation (10).

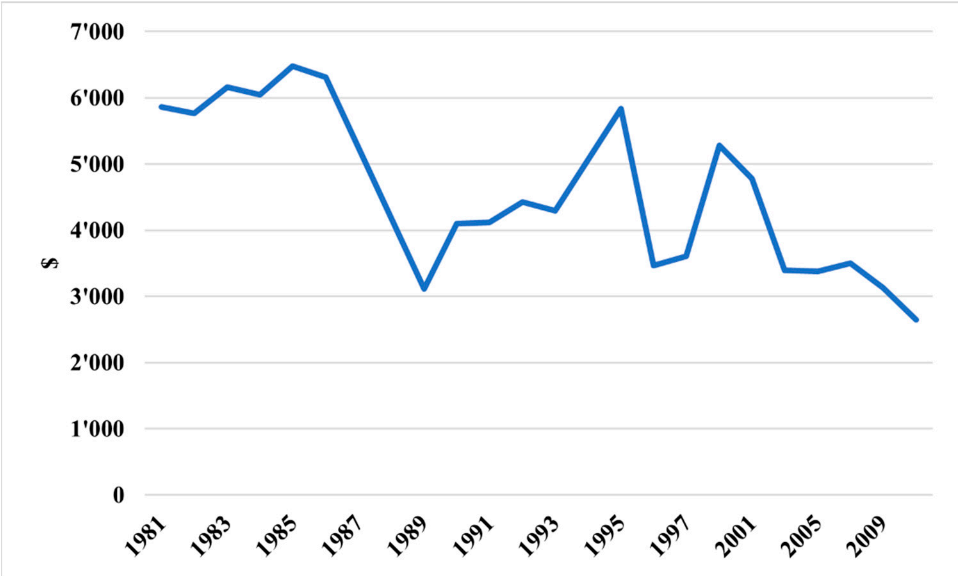

Figure 2. Average annual real imputed consumption in the US (1981–2011). Source: own calculations based on Blundell (2008) and Institute for Social Research at the University of Michigan (2023).

Not surprisingly, the decline in real consumption witnessed in available data has not been homogeneous across the consumption distribution. For instance, Figure 3 shows how real annual consumption has evolved in the bottom consumption quintile (between $0 and $2800) and, more precisely, that it has declined from $2637 to $1117 (1981–2011). Interestingly, even in the top consumption quintile (between approximately $7000 and $12,000), real annual consumption has declined from $10,065 to $4769.

We thus once more conclude that the main reason for the limited drop in working hours is most likely the insufficient gain in productivity and not—or not primarily—the expansion of consumer needs. The counter-analysis by means of microdata from the PSID proves itself to be relevant to perform the analysis across quintiles of the distribution, which concludes once again that productivity increases are still insufficient to sustain such a significant drop in working hours as imagined by Keynes (1930).

If we should have taken Federal Reserve Economic Data (2023i) into account despite not being suitable for the analysis across quintiles of the distribution carried out in Figure 3, real personal consumption expenditures per capita might look as having significantly increased from 1947 (the first available year) to 2019, namely respectively from $8989 to $39,955 (Federal Reserve Economic Data 2023h). Nevertheless, this would be a deceiving conclusion. In fact, Figure 4, looking at personal consumption expenditures to GDP, corroborates our previous claim according to which the increase in the share of consumption on GDP has been modest and has moved from 64.8 percent in 1947 to 67.5 percent in 2019. Strikingly enough, this share even decreased from 74.0 percent in 1929 (the basis year for Keynes) to 67.5 percent in 2019. Note that we do not expect the analysis carried out with the PSID to provide us with identical results as those obtained with FRED data. Indeed, the first data source is household-level data, and consumption is estimated via an imputation procedure for each household. In contrast, FRED data are aggregated at the level of the whole country.

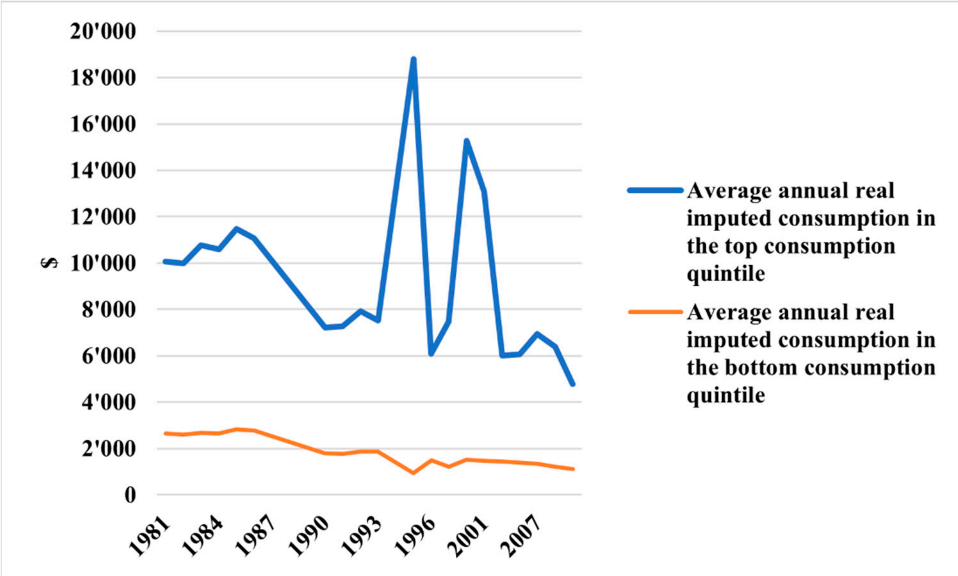

Figure 3. Average annual real imputed consumption in the bottom *versus* top consumption quintile in the US (1981–2011). Source: own calculations based on Blundell (2008) and Institute for Social Research at the University of Michigan (2023).

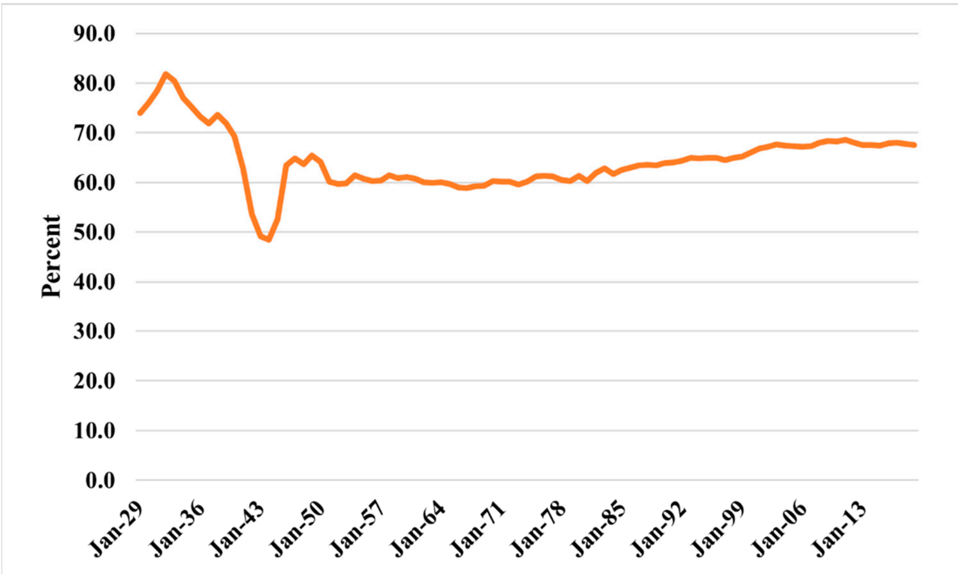

Figure 4. Personal consumption expenditures to GDP in the US (1929–2019). Source: Federal Reserve Economic Data (2023i).

Clearly, it could be argued that there are many expenses (like bequests, savings for education, within-family insurance by means of transfers, and so on) that do not go under the "label" of consumption. Nevertheless, our measure of consumption is as comprehensive as possible, because it includes housing (rents, mortgage interests, house-maintenance expenditures, and so forth). Notably, the PSID also includes a measure of wealth, which can be used as a proxy for motives like precautionary savings and bequests. Without replicating the entire analysis of this additional variable for space reasons, it suffices to say here that—in the PSID for the period under scrutiny—average real "standardised" wealth (that is, wealth divided by the CPI and by the adult-equivalence scale in the same way as we standardised consumption above) has increased from approximately $37,000 to about $40,000. Clearly, this is not enough to explain the missing drop in working hours.

Reducing consumer needs to work less inverts the causality implied by Keynes, namely that societies should *work less* and *earn more* instead of *earning less* to *work less*. Keynes's beneficial effect can succeed, however, only if h is sufficiently high. Although income is not explicitly mentioned in Keynes's original analysis (which our article sticks on purpose to), our results can be read as being also in line with Friedman (2015, p. 221), according to whom "[w]ith widening inequality, median income […] has risen […] more slowly than [Keynes] anticipated". In our framework, "inequality" implies that h of some few individuals would be already sufficient to cut H—the economics literature has already explored the social reasons why wealthier people tend to work more despite not needing to (Smeets et al. 2020)—but the majority's is by far not. By linking this conclusion to Wodehouse (2013, p. 3) who "observed [that] the American captain of industry doesn't do anything out of business hours. When he has put the cat out and locked up the office for the night, he just relapses into a state of coma from which he emerges only to start being a captain of industry again", some individuals *decide* to centre their lives around working. However, on average and by following Keynes's reasoning, individuals are in general *forced* by circumstances to work more than they would.

Clearly, inequality is a relevant issue in the United States. According to The World Bank (2023a), the Gini index commonly regarded as a reasonable proxy for income inequality has risen from 0.38 in 1991 to 0.42 in 2019 (with 0 standing for perfect equality and 1 for maximum inequality). Moreover, based on Federal Reserve Economic Data (2023f, 2023g), the real median household income has risen less (by 30.4 percent) than the real mean household income (by 56.0 percent) from 1984 to 2019 (Figure 5).

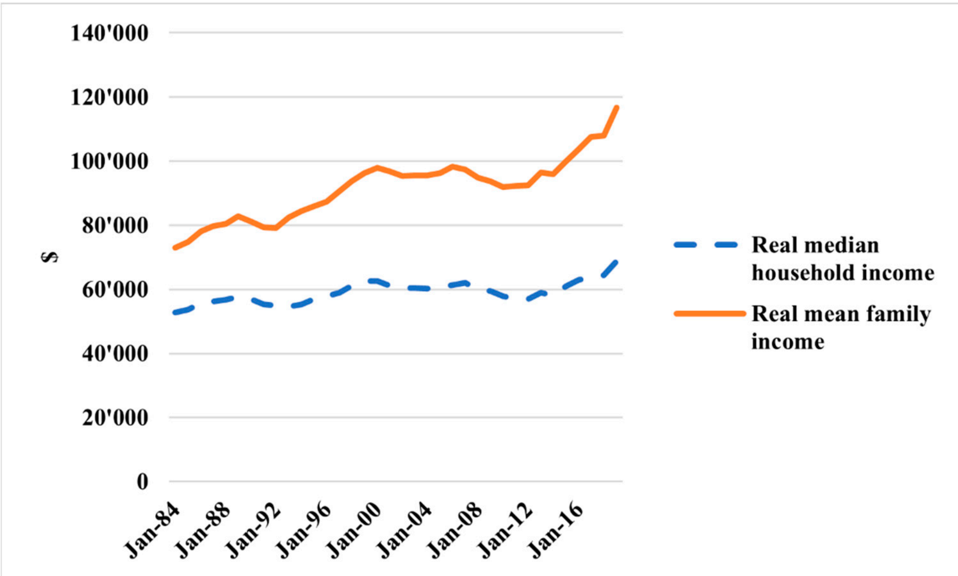

Figure 5. Real mean family income *versus* real median household income in the US (1984–2019). Source: Federal Reserve Economic Data (2023f, 2023g).

A deeper analysis of the links between productivity and inequality lies beyond the scope of the present paper, although we are aware of the literature on increasing skill polarisation (Autor and Dorn 2013) and, consequently, growing income inequality in the US economy in the latest decades. For the sake of the present analysis, it has to be noted that Keynes's original prediction about the 15-hour workweek was intended "for most of us" (to wit, the average individual). As our analysis has demonstrated from different angles of view and by means of macro- as well as micro-data, the story behind long working hours is by far more complex than assumed so far.

4. Further Reflections by Means of a Micro-Founded Macroeconomic Approach

In this section, we aim at examining the conceptual nature of productivity and its determinants more in detail in an attempt to find a synthesis between the macroeconomic and microeconomic reasonings presented, respectively, in Sections 2 and 3. This approach aims to consider the findings of the microeconomic analysis of the whole economic system, which began in 1927 with the Ramsey model (Guerrini 2010) predicting that consumers would make advantageous and dynamic consumption as well as investment choices by optimising their utility function while governments would make fiscal and monetary policy decisions. The relations defining the general economic equilibrium would then be aggregated and combined with the balancing conditions needed to obtain the dynamic evolution of the main macroeconomic variables. Moreover, the partially micro-founded macroeconomic relations were also presented in Solow's growth model of 1956 (see Dykas et al. 2023).

As is well known, classical models such as the IS–LM model were in fact challenged in the 1980s both by models of economic disequilibrium in the neo-Keynesian tradition and by Lucas's neoclassical critique. The micro-foundation of macroeconomics became later the foundation of the research on real business cycles. Macroeconomic models became models of general economic equilibrium where the choice of agents (consumers, firms, and governments) are determined by dynamic optimization processes. A growing need to combine the rigour of general dynamic economic equilibrium models with the policy analyses typical of Keynesian models was further noticed in the following decade.

Out of this fusion it emerged a new neoclassical synthesis, which proposed micro-foundations according to which businesses (whose decision-making is approximated by means of a monopolistic attitude) would be subject to various constraints in determining prices, making price dynamics viscous. Divergence phenomena in both demand and supply are then introduced, which make monetary policy in turn non-neutral due to a lack of any swift price adjustment mechanisms following aggregate shocks. More recently, these models have been further improved by implementing features on market choices for labour, finance, and products, while references to the micro-foundation of governments' objective functions have also been included. These comprise the Barro and Gordon model (see Rathi and Srinivasan 2020) and the Kydland and Prescott model (see Cherrier et al. 2023), which introduced policies for the monetary authority to decide inflation levels aiming at minimising an assumed loss function, represented by the deviation of inflation rates and production levels from their targets. In this specific regard, Woodford's (2000) theory of monetary economics goes a step further through the idea of the micro-foundation of the target function of governments and monetary authorities and it assumes that policy-makers would maximise the same utility function as other economic agents (consuming households and producing enterprises) through procedures optimising the trajectories of the same loss function.

We are hereby trying to complete the theoretical support of our analysis by including empirical backing through the Neo-Keynesian Dynamic (DNK) model, which (although it does represent a crucial tool for the analysis of monetary policy decisions) also helps to better articulate the range of determinants setting the economic system's outputs (including (weekly) working hours in relation to other variables). The DNK model proposed below is based on fundamental assumptions of the Keynesian school, namely aggregate supply and demand in imperfect competition and nominal rigidities.

Although businesses would hence not operate under pure competition as "price-takers", there could still be an assortment of differentiated goods and each enterprise producing a specific type of good could exercise some degree of market power by deciding autonomously the selling price and by maximising the discounted flow of present and future profits. Subjection to nominal rigidities would constrain the frequency of price adjustments and the costs associated with those adjustments, so that flexibility in reacting to structural shocks would also be checked. For this reason, changes in the nominal interest rate would lead to corresponding changes in the inflation rate and give rise to fluctuations in the real interest rate, which would consequently lead to the aforementioned non-neutrality of monetary policy. These inefficiencies would therefore reinforce the role of economic and monetary policies in stabilising the business cycle. Moving from the IS–LM–AS model, the DNK model offers a dynamic, micro-founded structure in which aggregate supply and demand are derived directly from the microeconomic behaviour of households and firms.

Starting from a certain inter-temporal interval, within which the stock of physical capital can be considered constant and the intervention of fiscal policy can be left out (being at most assumable *ex-post* for its redistributive value, to mitigate inequalities), we describe the demand of households, C_t, which consume a composite basket of all differentiated goods produced and retrievable on the relative market in that period:

$$C_t \equiv \left(\int_0^1 C_t(i)^{1-\frac{1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{11}$$

with C_t representing actual consumption at time t, and $\varepsilon > 1$ being the elasticity of substitution among the goods offered, which are identified in turn by $i \in [0,1]$. The maximisation of choice is given by:

$$max_{[C_t(i),\ N_t,\ \beta_t]} E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, N_t) \tag{12}$$

where E_0 indicates the rational expectation process in relation to the information during the period $t = 0$. β indicates the (deterministic) discount factor and N_t is the number of labour hours offered. For $t = 1, 2, \ldots m$:

$$\int_0^1 P_t(i) C_t(i) di + B_t \leq W_t N_t + (1 + r_{t-1}) B_{t-1} + D_t \tag{13}$$

In accordance with Equation (11) and guaranteeing asymptotic solvency, $P_t(i)$ is the price of the i-th good while—more generally—P_t represents the aggregate price level. B_t is a savings bond, risk-free at its maturity between $(t-1)$ and t, with nominal yield r_{t-1}. Again, W_t is the nominal hourly wage and D_t is the nominal profit of enterprises.

By disregarding here the issue of optimising the basket of goods i, we will focus on the optimal choice problem for households between contingent consumption and savings. In other words, we analyse how much should be used to self-finance consumption and how much for the enjoyment of leisure. From this perspective, there are two conditions for equilibrium: the first leads to the dynamic evolution of aggregate consumption while the second is the number of working hours. The reasoning rests on the equality between the marginal utility sacrifice (cost) by foregoing the consumption of an additional unit in t_0 and the marginal utility advantage (expected discounted benefit) of having a share of savings increased by the periodic return in t_m (evidently, with $m > 0$):

$$U_{C_t} = \beta(1 + r_t) E_t \left\{ U_{C_{t+1}} \frac{P_t}{P_{t+1}} \right\} \tag{14}$$

U_{C_t} shows the marginal utility of consumption at time t. By equating the marginal rate of substitution of consumption and leisure and their relative price, we obtain:

$$-\frac{U_{N_t}}{U_{C_t}} = \frac{W_t}{P_t} \tag{15}$$

We can then determine the labour supply curve by deriving the number of working hours based on the real hourly wage and the level of consumption sought:

$$U(C_t, N_t) = \frac{C_t^{1-\varsigma}}{1-\varsigma} - \frac{N_t^{1+\nu}}{1+\nu} \tag{16}$$

In (16), ς indicates the inverse of the elasticity of the intertemporal substitution of consumption. The inverse of the Frisch elasticity (see Whalen and Reichling 2012) of the labour supply ν is included in the convolution, since the household utility function is assumed to be isoelastic. The respective log-linear versions—lower case letters are used to express the logarithms of the variables adopted above—as determined by the optimality conditions just expressed are:

$$w_t - p_t = \varsigma\, c_t + \nu\, n_t \tag{17}$$

$$c_t = E_t\{c_{t+1}\} - \frac{1}{\varsigma}\,(\iota_t - E_t\{\pi_{t+1}\} - \rho) \tag{18}$$

where π indicates the rate of inflation (in this case, expected in $t+1$), $\iota_t \equiv r_t$ represents the nominal short-term rate of interest and $\rho \equiv \beta$ is the discount rate.

By taking Equations (5) and (6)—and by rewriting them according to the notations in the current section—since we are assuming that constant returns to scale (CRS) technologies are available, we obtain:

$$Y_t(i) = A_t N_t(i)^{(1-\alpha)} \tag{19}$$

for the business *continuum* indicated by all the $i \in [0,1]$ in each t and with $(1-\alpha)$ measuring the dispersion of prices and production among the same businesses. Further, in the following equation:

$$A_t = A_t^{P_\varsigma} e^{U_{\varsigma,\nu}} \tag{20}$$

A_t represents the aggregate productivity index of available technology and Equation (20) describes its evolution according to a stochastic log-stationary process, while P is the price level. According to the model, the amount of the labour factor employed will be such that the real marginal costs equal the real wage per unit of efficiency. Each business will also reset the price of its output in each period—regardless of the number of periods since the last adjustment—according to a probability $(1-\theta)$. It follows that a portion of enterprises equal to θ will leave their prices unchanged in the same period of time. The average duration of a price will therefore be $(1-\theta)^{-1}$ and θ will represent the natural index of price rigidity (Galí 2015). By indicating the price set by the businesses $(1-\theta)$ in the period with P_t^* and being $\Pi_t = \frac{P_t}{P_{t-1}}$ the gross inflation rate, the aggregate price dynamic is determined by the following equation:

$$\Pi_t^{1-\varepsilon} = \theta + (1-\theta)\left(\frac{P_t^*}{P_{t-1}}\right)^{1-\varepsilon} \tag{21}$$

from which we see the existence of a steady state with zero inflation: $\Pi_t = 1$ and $P_t^* = P_{t-1} = P_t$. Hence, the corresponding log-linear approximation will be:

$$\pi_t = (1-\theta)(p_t^* - p_{t-1}) \tag{22}$$

which leads to the deduction of the determination of the inflation rate due to the deviation of prices $(1-\theta)_t$ compared to the average price of the previous period $(1-\theta)^{-1}{}_{t-1}$.

For the purposes of our reasoning and with the aim to try to understand the systemic effects of a reduction in working hours N_t, we should first analyse the underlying elements of the pricing decision mechanisms by the productive fabric, which is clearly a problem of profit maximisation of the k-th period considering the cost function $\Psi_t(\cdot)$, the output of the period $Y_{t+k|t}$ following the price adjustment in t, and the stochastic discount factor for nominal payoffs $r_{t,t+k} \equiv \left[\beta^k \left(\frac{C_{t+k}}{C_t}\right)^{-\varsigma} \left(\frac{P_t}{P_{t+k}}\right)\right]$:

$$max_{P_t^*} \sum_{k=0}^{\infty} \theta^k E_t \left\{ r_{t,t+k} \left(P_t^* Y_{t+k|t} - \Psi_{t+k} \left(Y_{t+k|t} \right) \right) \right\} \tag{23}$$

with demand constraints of the type $Y_{t+k|t} = \left(\frac{P_t^*}{P_{t+k}}\right)^{-\varepsilon} C_{t+k}$. The associated first-order condition is:

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ r_{t,t+k} Y_{t+k|t} \left(P_t^* - \Xi \psi_{t+k|t} \right) \right\} = 0 \tag{24}$$

where $\Xi = \frac{\varepsilon}{\varepsilon-1}$ and $\psi_{t+k|t} = \Psi_{t+k}\left(Y_{t+k|t}\right)$ indicate the nominal marginal cost in the period $t+k$ following the price adjustment in t. If there is no rigidity in the prices, $\theta = 0$ and therefore $P_t^* = \Xi \psi_{t|t}$ where Ξ is the desired fully flexible markup. Dividing by P_{t-1} and imputing $\Pi_{t,t+k} = \frac{P_{t+k}}{P_t}$, we will have:

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ r_{t,t+k} Y_{t+k|t} \left(\frac{P_t^*}{P_{t-1}} - \Xi MC_{t+k|t} \Pi_{t-1,t+k} \right) \right\} = 0 \tag{25}$$

with $MC_{t+k|t} \equiv \frac{\psi_{t+k|t}}{P_{t+k}}$ representing the real marginal cost of the period $t+k$ after which in t the businesses will have adjusted their output prices. In the stationary point at zero inflation, where therefore $\Pi_{t-1,t+k} = 1$, we observe the maintained constancy of the price level $P_t^* = P_{t-1}$ and therefore $\frac{P_t^*}{P_{t-1}} = 1$ but also $P_t^* = P_{t+k}$, with a stable level of production $Y_{t+k|t} = Y$ and real marginal costs $MC_{t+k|t} = MC$. Once again, $r_{t,t+k} = \beta^k$. Applying the Taylor rule to that point we have the log-linearised form:

$$p_t^* - p_{t-1} = (1-\beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t \left\{ \hat{mc}_{t+k|t} + (p_{t+k} - p_{t-1}) \right\} \tag{26}$$

which becomes:

$$p_t^* = \xi + (1-\beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t \left\{ mc_{t+k|t} + p_{t+k} \right\} \tag{27}$$

while considering the logarithmic deviation of the marginal cost $\hat{mc}_{t+k|t} \equiv mc_{t+k|t} - mc$ from the value of equilibrium $mc = -loglog\, \Xi = -\xi$. Hence, the businesses implementing the price adjustment $(1-\theta)$ will choose a position corresponding to the desired markup Ξ based on the average of the current and expected nominal marginal costs and weighted with the probability that the price will remain efficient in each θ^k (Galí 2015). Moreover, the equilibrium in the goods market requires:

$$Y_t(i) = C_t(i) \tag{28}$$

Since the aggregate output is such for $Y_t = \left(\int_0^1 Y_t(i)^{1-\frac{1}{\varepsilon}} di\right)^{\frac{\varepsilon}{\varepsilon-1}}$, then $Y_t = C_t$. By combining this condition (28) with the Euler equation for consumption, we obtain the following condition of equilibrium:

$$y_t = E_t\{y_{t+1}\} - \frac{1}{\varsigma}(\iota_t - E_t\{\pi_{t+1}\} - \rho) \tag{29}$$

Returning to the focus of this paper, the labour market requires:

$$N_t = \int_0^1 N_t(i) di \tag{30}$$

and from Equation (19):

$$N_t = \int_0^1 \left(\frac{Y_t(i)}{A_t}\right)^{\frac{1}{1-\alpha}} di = \left(\frac{Y_t}{A_t}\right)^{\frac{1}{1-\alpha}} \int_0^1 \left(\frac{P_t(i)}{P_t}\right)^{-\frac{\varepsilon}{1-\alpha}} \tag{31}$$

In terms of logarithms and by indicating the price index with di and $d_t \equiv (1-\alpha)log \int_0^1 \left(\frac{P_t(i)}{P_t}\right)^{-\frac{\varepsilon}{1-\alpha}}$:

$$(1-\alpha)\ n_t = y_t - a_t + d_t \tag{32}$$

By modelling on the assumption of zero inflation, in the relative stationary range $d_t = 0$ within the first-order approximation so that the equation relating to aggregate output to employment and technology, it will be:

$$y_t = a_t + (1-\alpha)n_t \tag{33}$$

with respect to the average real marginal cost while indicating with mpn_t the average marginal product of labour:

$$\begin{aligned} mc_t &= (w_t - p_t) - mpn_t \\ &= (w_t - p_t) - (a_t - \alpha n_t) - log(1-\alpha) \\ &= (w_t - p_t) - \tfrac{1}{1-\alpha}(a_t - \alpha y_t) - log(1-\alpha) \end{aligned} \tag{34}$$

Since:

$$\begin{aligned} mc_{t+k|t} &= (w_{t+k} - p_{t+k}) - mpn_{t+k|t} \\ &= (w_{t+k} - p_{t+k}) - \tfrac{1}{1-\alpha}\left(a_{t+k} - \alpha y_{t+k|t}\right) - log(1-\alpha) \end{aligned} \tag{35}$$

we rewrite it on the basis of $c_t = y_t$:

$$\begin{aligned} mc_{t+k|t} &= mc_{t+k} + \tfrac{\alpha}{1-\alpha}\left(y_{t+k|t} - y_{t+k}\right) \\ &= mc_{t+k} - \tfrac{\alpha\varepsilon}{1-\alpha}(p_t^* - p_{t+k}) \end{aligned} \tag{36}$$

substitute the latter with (27) and impute $\Theta = \frac{1-\alpha}{1-\alpha+\alpha\varepsilon} \leq 1$:

$$\begin{aligned} p_t^* - p_{t-1} &= (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\Theta \hat{mc}_{t+k} + (p_{t+k} - p_{t-1})\} \\ &= (1-\beta\theta)\Theta\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\hat{mc}_{t+k}\} + \sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\pi_{t+k}\} \end{aligned} \tag{37}$$

which can be reformulated as:

$$p_t^* - p_{t-1} = \beta\theta\ E_t\left\{p_{t+1}^* - p_t\right\} + (1-\beta\theta)\ \Theta\hat{mc}_t + \pi_t \tag{38}$$

and can be recomposed with Equation (22). Since $\lambda \equiv \frac{(1-\theta)(1-\beta\theta)}{\theta}\Theta$ is also strictly decreasing both in terms of the rigidity of the prices θ and of the (decreasing) returns α as well as in the elasticity of demand ε, we arrive at representing the inflation equation as follows:

$$\pi_t = \lambda\sum_{k=0}^{\infty}\beta^k E_t\{\hat{mc}_{t+k}\} \tag{39}$$

The relation between real marginal cost and aggregate output can be therefore referred to as:

$$\begin{aligned} mc_t &= (w_t - p_t) - mpn_t \\ &= (\varsigma y_t + \nu n_t) - (y_t - n_t) - log(1-\alpha) \\ &= \left(\varsigma + \tfrac{\nu+\alpha}{1-\alpha}\right)y_t - \tfrac{1+\nu}{1-\alpha}a_t - log(1-\alpha) \end{aligned} \tag{40}$$

Let $y_t^n = \phi_{ya}^n a_t + \vartheta_y^n$—with $\phi_{ya}^n = \frac{1+\nu}{\varsigma(1-\alpha)+\nu+\alpha}$ and $\vartheta_y^n = -\frac{(1-\alpha)[\xi - log\ (1-\alpha)\ ]}{\varsigma(1-\alpha)+\nu+\alpha}$—be the equilibrium output level under flexible price conditions:

$$mc = \left(\varsigma + \frac{\nu+\alpha}{1-\alpha}\right) y_t^n - \frac{1+\nu}{1-\alpha} a_t - log(1-\alpha) \tag{41}$$

From the difference between Equations (40) and (41), we obtain the proportional relationship between the logarithmic deviation of the real marginal cost (in steady state) and the logarithmic deviation of production with respect to the corresponding output under flexible prices, which we call the output gap and we indicate with $\tilde{y}_t = y_t - y_t^n$:

$$\hat{mc}_t = \tilde{y}_t \left(\varsigma + \frac{\nu+\alpha}{1-\alpha}\right) \tag{42}$$

which combined with the inflation Equation (39) and $\kappa \equiv \lambda\left(\varsigma + \frac{\nu+\alpha}{1-\alpha}\right)$ leads us to the Neo-Keynesian Phillips curve (NKPC):

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t \tag{43}$$

As a next step, we will also write the dynamic Investment-Saving (DIS) curve (also called the log-linearized Euler equation) indicating with $\varrho_t^n = \rho + \varsigma E_t\{\Delta y_{t+1}^n\}$ the natural interest rate:

$$\tilde{y}_t = -\frac{1}{\varsigma}(\iota_t - E_t\{\pi_{t+1}\} - \varrho_t^n) + E_t\{\tilde{y}_{t+1}\} \tag{44}$$

Since the real interest rate is $\varrho_t = \iota_t - E_t\{\pi_{t+1}\}$ and by considering the asymptotic cancellation of nominal rigidities such that $lim_{T\to\infty} E_t\{\tilde{y}_{t+1}\} = 0$:

$$\tilde{y}_t = -\frac{1}{\varsigma}\sum_{k=0}^{\infty}\left(\varrho_{t+k} - \varrho_{t+k}^n\right) \tag{45}$$

In this specific regard, the NKPC determines the inflation rate given an output gap trajectory, while the DIS equation determines the production gap given the exogenous natural rate of interest and the real effective rate of interest. For the sake of the present paper, it is necessary to consider monetary policy operations that determine or attempt to rebalance the system over time by adopting policy measures on the nominal interest rate ι_t. After considering the rigidity of prices, the equilibrium—or, more properly, the quasi-equilibrium—of the real variables cannot be established independently of monetary policy interventions. Therefore, as stated in the introduction to this section, monetary policy is not neutral.

With respect to Keynes's argument about the reduction of working hours due to the increase in available technology and by leaving current equilibrium values unchanged, Equation (31) and the subsequent development confirm the findings of the comparative empirical investigation carried out in this paper. Furthermore, it has already been mentioned that monetary policy is not neutral. Thus, within a certain level of discretion, the effects of a reduction in the number of working hours can be adjusted for the maintenance of the current quasi-equilibrium. However, the model also refers to the deep connections between demand and productivity. Hence, in a scenario of reduced working hours, a strengthening of household incomes would support the constancy of consumption levels, and it is precisely here that an effective financial policy could partly support this mechanism. After examining the repercussions of a "negative" divergence of aggregate demand in t, a reduction in production y_{t+1} will be identified. If the shock is not temporary—for instance, because there have been interventions on the very structure of the system (for instance, by reducing N by law)—operators will revise their expectations on inflation π_{t+1} and the curve (43) will undergo a downward shift, which will correspond to a reduction of (44) with the evidence of a newly worsened equilibrium (y, π) in terms of income level and of triggering risks of pro-cyclicality of the phenomenon.

The level of equilibrium in economic activity over the period—based on the foregone reasoning—can be attributed to demand, investment, and government activity in terms of both economic and monetary policies. Neutralising this last component in order to further investigate the trajectories of the cycle in the event of depressed consumption (and, for now, in the absence of intervention by policy makers), we are proposing the Hansen–Samuelson multiplier–accelerator model (see Besomi 2003) in the following form:

$$Y_{t+1} = a(1+z)Y_t - azY_{t-1} \tag{46}$$

where $aY_{t-1} = C_t$ represents the relationship between intended household consumption at time t and the measure of output in the previous interval and $I_t = z(C_t - C_{t-1})$ shows how the propensities of investment react to the pace of change in demand. Moreover, z and a are the proportion coefficients. If we indicate $x = az$, we can rewrite Equation (46) as follows (where $\rightsquigarrow$ means mathematically speaking "leads to"):

$$\begin{pmatrix} Y_t \\ Y_{t-1} \end{pmatrix} \rightsquigarrow \begin{pmatrix} a+x & -x \\ 1 & 0 \end{pmatrix} \begin{pmatrix} Y_t \\ Y_{t-1} \end{pmatrix} \tag{47}$$

When there is a situation of a progressive contraction of demand and there is $(a+x)^2 < 4x$, complex conjugate eigenvalues λ and $\underline{\lambda}$ emerge verifying the conditions of the Neimark–Sacker theorem (see Röst 2005):

- $|\lambda| = \sqrt{x}$
- $Arg(\lambda) = arccos\left(\frac{a+x}{2\sqrt{x}}\right)$.

From these values, stability breaks down and a subcritical Hopf bifurcation is observed (see Guckenheimer and Willms 2000). The trajectory can be then described by an invariant curve in an unattractive and unstable cycle, which is deteriorating towards moments of (pseudo)equilibrium as precarious as they are temporary, featuring variables increasingly contained in their (decreasing) values. The system is permeated by chaos—at least within a so-called "long economic wave" (see Forrester 1997; Lane 2007). A response "decided" by the central bank will certainly contain these results.

For the sake of further completeness, the log-linear money equation μ is of the following type:

$$\mu_t - p_t = Y_t - \eta\ \iota_t \tag{48}$$

where η represents the (semi-) elasticity of the interest rate of money demand. These dynamics illustrate that any transitions to a reduction in working hours would have to be "gradual" in order to allow the magnitude of negative demand shocks to be limited and to offer progressive corrections to monetary policy makers. Furthermore, as already mentioned above, household demand would also intervene (together with businesses) even in the production factors' market. Hence, a depression of technology expenditure would therefore (also) lead to a technology shock τ_t, which will follow an AR process of the type $\tau_t = g_\tau \tau_{t-1} + o_t^\tau$ with $0 \leq g_\tau \leq 1$, and—since σ is the degree of risk aversion, $o_t^\tau \sim d\left(0, \sigma_\tau^2\right)$—to an additional IID shock. Clearly enough, these factors would also negatively impact on the dynamic IS equation.

In light of this, the real interest rate equation can be reformulated as follows:

$$\varrho_t = \left(1 - b_\varrho\right)\left(b_\pi \pi_t + b_{\tilde{y}} \tilde{y}_t\right) + b_\varrho \varrho_{t-1} + s_t^\varrho \tag{49}$$

in which the Taylor rule is referred to and where:

- b_ϱ indicates the inertia on the real interest rate;
- b_π represents the sensitivity of monetary policy to inflation;
- $b_{\tilde{y}}$ represents the responsiveness of monetary policy to the output gap;

- s_t^{ϱ} indicates the monetary policy shock leading to the stochastic evolution of the policy rate.

This also follows an AR process: $s_t^{\varrho} = g_R s_{t-1}^{\varrho} + o_t^{\varrho}$ with $0 \leq g_{\varrho} \leq 1$ and, again, an IID shock $o_t^{\varrho} \sim d\left(0, \sigma_{\varrho}^2\right)$.

Finally, wage stickiness and the different technological requirements among the various productions contribute to the emergence of socio-economic and labour market inequalities, which make a reduction in working hours *erga omnes* not easily manageable due to the fact that there may be population "pockets" with reduced consumption and agents with stable or even incremental demand. All this complicates the effects of monetary policies, which are evidently systemic and which act on aggregate variables. However, internal differentiations could bring further turbulence to the rebalancing tensions.

In order to empirically understand the "leverage points" towards a reduction in working hours compatible with maintaining system equilibrium and with safeguarding the achieved standard of living, we would also like to propose an extension of the application of Okun's law not on the unemployment rate (Prachowny 1993), but on working hours (Fontanari et al. 2022).

Based on the data collected, the official unemployment rate has been registered at a minimum level of about 3.7 percent in the United States (Table 2). Let us now formally introduce the original equation:

$$\Delta u_t = -b\left(g\widetilde{y}_t\right) \tag{50}$$

with Δu_t representing the change in the unemployment rate, $g\widetilde{y}_t$ representing the growth rate of the output gap and $-b$ being Okun's coefficient.

According to the theory underlying Equation (50), there exists a relatively stable relationship between the GDP growth rate and the reduction of the unemployment rate (especially, at certain levels where the economy proves to be sufficiently vital to grow): changes in production have a less than proportional impact on unemployment levels ($b < 1$). However, changes in production affect unemployment levels in a manner that is less than proportional. This is due to the fact that, confronted with a growing demand, businesses prefer to increase the hourly commitment of their current employees rather than hire new labour, namely a concept known as "labour hoarding" (see Burnside et al. 1993). Therefore, labour underutilization in terms of employed units seems to have not been proven to be the most reliable indicator and this phenomenon plays a significant role in this analysis.

It is therefore interesting to perform calculations on Okun's coefficient and to apply the relevant formula—first in its standard form and subsequently by using the growth rate of working hours Δhu_t—instead of the conventional unemployment rate measured in terms of individuals. By doing so and by considering the time series of Δu_i and Δhu_i based on the data collected in the United States and referenced in previous sections (Table 2), we verify whether the results from applying the two methods are similar or how much they differ and in what proportion. In particular and by using working hours as an independent indicator, a dynamic version of Okun's law can be estimated by regressing the growth rate of working hours on the growth rate of output. Moreover, stationarity tests of the variables are confirmed, and the residuals are found to be homoskedastic and not serially correlated. From the application of an estimation with an ARMAX model, it is also evident that based on Δu a cumulative coefficient of $-b = -0.629$ will be obtained. By adopting the same methodological requirements and by using Δhu on similar output variations, we obtain an Okun's coefficient of -0.808. Assuming the bijectivity of the phenomenon, this means that by reducing working hours by 1% and by keeping the number of employed workers constant, 1.238 of GDP would be "sacrificed" in current times. Reducing the units of employed workers by the same percentage would result in a -1.590% decrease in production.

This result—if the economy would not be "overheated" (Bell and Blanchflower 2018)—could lay the groundwork for structuring the transition to reduced working hours thanks to the effects of gradual compensation achievable through the aforementioned monetary policies (which, numerically speaking, should not be too expansive). With the simultaneous vitality of technological development and a rebalancing of the workforce in more productive sectors, a temporary macroeconomic equilibrium (y^*, π^*) with demand not undergoing particular negative shocks could be sustained. Upon achieving the target production (and inflation), a similar approach could be adopted in a subsequent interval until the point of re-optimisation is reached. In the post-Keynesian tradition, productivity and its primarily determinants, income and employment, are—for the sake of example—a result of the constantly shifting level of effective demand that is influenced by financial conditions, income distribution, capacity utilisation, and other macroeconomic variables (see Kregel 1976, 1985).

Overall economic policy should, therefore, simultaneously promote occupational osmosis in higher-productivity jobs. Moreover, it should be noted that in the United States (at least since the end of the twentieth century) employment trends tend to be higher in low-productivity and low-wage sectors (see Porter) with the effect of depressing the aggregate average labour productivity and lower autogenous expansiveness of the economy. However, it has also been noted that high-productivity sectors are also those with a higher rate of technological innovation, but technologies have often not supported workers in productive activities but have instead replaced them (see Acemoglu and Restrepo 2019). This also explains why—despite technological progress in the twentieth century—the working hours of employed individuals (especially in low-productivity jobs) have not spontaneously decreased significantly.

5. Policy Implications, Future Research, and Research Limitations

While there are macro- and microeconomic considerations—respectively, pertaining to the economy as a whole and to individuals—, Keynes's prediction and working hours also have several business implications.

For instance, the COVID-19 pandemic has changed the work of individuals, with 72.2 million US employees teleworking in week 32 of 2021 (US Census Bureau 2023) depending also on contagion numbers. While remote working can under specific circumstances boost productivity (see Clancy 2020; Organisation for Economic Co-Operation and Development 2020), world recovery has been faced several times with a traditional call for getting back to offices (Gibbs et al. 2021) on the one hand and a more visionary plea for hybrid types of work on the other (Grzegorczyk et al. 2021). More generally, we should investigate whether certain work paradigms are still up-to-date. In fact, further research should be devoted to exploring why, despite capital accumulation of 6.4 percent a year (1961–2019) (Federal Reserve Economic Data 2023b), productivity is still insufficient. A plausible reason may be precisely a 'work-hours' rather than 'result-oriented' philosophy (Elsbach et al. 2010). In fact, Equation (2) implies that, if H has to drop, h has to grow either with constant:

$$H \downarrow = \frac{\frac{Y\uparrow}{L-U}}{h\uparrow} \tag{51}$$

or higher $\frac{Y}{L-U}$:

$$H \downarrow = \frac{\frac{Y}{(L-U)\downarrow}}{h\uparrow} \tag{52}$$

In the first case (51), Y would rise and $L - U$ remain constant while in the second (52) $L - U$ would shrink and Y would be constant. This additional interpretation of one of our main relations confirms that it is not a matter of insufficient numbers of employed persons ($L - U$), but rather of productivity (h). Only the latter is, according to our analysis, the key to close the distance to Keynes's estimate.

It also goes without saying that cutting H would contribute to environmental sustainability and work-life balance (see Pullinger 2014) and also push h, as shown by Iceland's decision to introduce a four-day week after trials "remained revenue neutral for both the city council and the government" (Haraldsson and Kellam 2021, p. 10). Other countries like Scotland and Wales (but also the United Kingdom for a limited number of companies from June 2022) or global companies have recently begun testing a four-day week (Kelly 2021; Joly et al. 2022), which is progressively becoming a global movement. Some of these approaches go under the name "100–80–100 model—100% of the pay, 80% of the time, but critically in exchange for 100% of the productivity" (4 Day Week Global 2022). Moreover, leisure creates opportunities to consume and foster Y, because personal consumer expenditure contributes to 69.0 percent of real GDP per capita (Federal Reserve Economic Data 2023i).

Within this landscape of opportunities and challenges, there are at least two more questions to be addressed. The first one pertains to what should be the causal direction: reducing working hours to increase productivity:

$$H \downarrow \Rightarrow \; h \uparrow \tag{53}$$

or waiting for an increase in productivity to reduce working hours?

$$h \; \uparrow \Rightarrow \; H \downarrow \tag{54}$$

Admittedly, this is not an easy question, and perhaps there is not even a "right or wrong answer". While the more recent economics literature endorses the validity of (54) by claiming that working less boosts productivity (Pencavel 2015; Park and Park 2017; Shangguan et al. 2021)—in a less recent study, Calvasina and Boxx (1975, p. 609) found however that a "change from a five- to a four-day workweek did not materially affect employees' productivity"—we cannot exclude that it might be premature to cut working hours *without* having preliminarily addressed the sources of insufficient productivity. Among the reasons for the latter there are, for instance, inadequate managerial approaches or misinterpreting new communication technologies like e-mails and worldwide connectivity in an "additive" instead of "substitutive" way (that is, allowing them to multiplicate instead of *reducing* work). For instance, already "[i]n 2004 10.2 million American workers reported that they did unpaid work at home in addition to paid work at their workplace. These workers averaged 6.8 h of additional work—essentially an extra day for which they are not reimbursed beyond their normal pay" (Freeman 2008, p. 139). Moreover, Beaujot and Anderssen (2007, p. 311) found that women are particularly affected by long working hours because of their "complementary roles" in the household and that "[s]ince time-crunch is particularly affected by hours of paid work, reducing the number of hours might benefit health and long-term productivity". Therefore, long working hours do not only amplify inequalities among workers, but they also affect health conditions and productivity itself, which are in turn correlated to decreasing output. In this specific regard, it is noteworthy to mention that "[w]hile Marx and Keynes differed radically on some fundamental matters, they agreed that society would benefit from reducing work time" (Spencer 2023, p. 25). Further research in both directions is needed, because the unexpected (and partly unprepared) switch to remote work in 2020 due to the COVID-19 pandemic resembles a "last call" for new work approaches. Moreover, we do not differentiate between the working hours of men and women and we do not take unpaid work into consideration (Ilkkaracan et al. 2021). While authors like Skott (2023) address contemporary factors potentially forcing individuals to work longer hours—for instance, consumer debt, low hourly-pay, deindustrialization, and an increase in part-time employment, as well as the inability to transform productivity gains into real wage gains—, we feel that our main finding (insufficient productivity) explains at least a significant part of the story. If h would be higher and closer to Keynes's estimate, there would be no doubt that the *general* standard of living would benefit from it. It is because h is not dynamic that involuntary part-time employment or "working poor" emerges and inequalities widen. While a shift in work paradigms is crucial from the perspective of our analysis, it should be kept in mind that technical advances have to be used *in favour* of (and not *against*) labour. For instance, the United Nations—Department of Economic and Social Affairs (2024) warns that "[n]ew technologies are contributing to increasing inequalities—both between different groups of workers and between labour and firm owners. While they do not cause widespread job losses, they do change the demand for certain skills and contribute to a shift towards more flexible but precarious "contingent work" arrangements". Such considerations are in line with our policy recommendations, which support more flexibility, if not intended "labor precarity". More specifically, technical advancement should aim at reducing workers' *effort*—not their rate of *employment*. While this is not always possible (i.e., capital-labour substitution is for some occupations less avoidable than for others), policymakers should govern such shifts proactively and make sure that the labour market will generate new occupations. In fact, as reminded by the formulas presented throughout the present article, the magnitude of GDP (Y) and of employment ($L - U$) despite being also linked to technical advancement should be necessarily preserved to keep h high and H low.

The second question to be finally addressed concerns *whether* Keynes's estimate might be wrong from scratch. In fact, our analysis in this paper investigates the productivity gap between actual estimates for 2030 and Keynes's prediction *without* questioning the rightness of his hypothesis, namely the 15-hour workweek. We simply cannot exclude this. Nevertheless, this is not the scope of the paper, which is self-limited to the analysis of the productivity differential between the *status quo* and the prediction of the Cambridge economist. This paper also aims at verifying why Keynes's forecast (which is taken as a given) has not become true. Future research is also needed to understand whether a different, less commonplace measure of productivity, such as the value added per worker per hour proposed by Webber and Huaccha (2023), would alter the results of the present analysis (which aims at staying the closest to Keynes's formulation (1930)). From a methodological perspective, we do not estimate data for working hours, but we take them in aggregate form from specific sources respectively mentioned in the text. Consequently, even our measure of productivity relies on them. Moreover, if the respective sources we have taken these data from do not provide themselves with standard errors and/or confidence intervals for their data, we cannot reconstruct them ourselves. Because of the same reasons (i.e., having taken data in aggregate form), we have also not been able to perform hypothesis tests to compare productivity between 1929 and 2019 using, for instance, a two-sample t-test and ascertain whether the productivity difference between these years is statistically significant.

Keynes himself also notes problems in labour absorption, too-quickly rising standards of living, and high interest rates as potential impediments to this realisation, while collapses in money values could independently cause declining productivity and production (Keynes 1930). However, the Cambridge economist's four main caveats to his prediction about growth in capital stock are sufficient to allow a 15-hour work week: population growth, political instability, scientific progress, and unfavourable individual allocation between accumulation and consumption. Our analysis has already shown that real consumption has been falling, despite the first two caveats being likely explanations. With specific regard to the level of political (in)stability, the United States has historically been among the most stable countries worldwide. For instance, their Fragile State Index ranks them at 141 out of 179 countries (The Fund for Peace 2023), meaning that they are part of the less fragile nations in the world. Moreover, the index called "Political stability and absence of violence/terrorism" collected by The World Bank (2023d) confirms that the country has been historically considered stable in political terms. Hence, we can rule out this additional caveat together with another one, namely that there might not have been sufficient scientific progress. It remains to address Keynes's last caveat, namely population growth (which has been particularly significant as reported in Table 2). While "[t]he relationship between population growth and economic growth is controversial" (Peterson 2017, p. 1), it is not the aim of the present paper to analyse *which factors* could have led to a level of h_{2030} not as high as h^{KE}_{2030}. What remains true based on the macroeconomic relations (which, in their mathematical simplicity, leave little to no room for interpretation) presented in Section 2 is that *productivity* will not reach Keynes's expectations, which in turn certainly contributes to the explanation of long working hours.

Our findings concerning the missing productivity *despite* increases in GDP represent therefore a significant contribution to economic research, which has so far focused on other micro- rather than macroeconomic reasons. In fact, it has to be reminded that annual working hours stood at 3096 in 1870—$\frac{H}{52}$ corresponded to 59.5 h—plummeting within 59 years by 25.2 percent and reaching 2316 yearly and 44.5 weekly hours already in 1929 (Table 2). After 101 years (1929–2030), they will shrink by just 22.1 percent, namely from 2316 to 1805 (Table 2). Even on a solely intuition-based level, the drop is too limited given that the global economy is experiencing a "Third Industrial Revolution" (Rifkin 2011) based on new communication technologies and unprecedented technical advances, which should instead nourish a much more significant reduction of working hours. So far, economics literature has already shown that technological shocks negatively affect working hours and contribute to their reduction (see Galí 1999; Whelan 2009; Ko and Kwon 2015). While this is a relevant starting point, it should be further investigated why working hours tend to be so resistant to significant decreases.

Finally, there is a last (though necessary) remark to be added, given that the COVID-19 pandemic has represented a significant and exceptional crisis episode with a potential impact on productivity. While several studies exploring a possible causal nexus are still preliminary, although they seem to support the hypothesis that new, productivity-enhancing work paradigms are on the rise (Kitagawa et al. 2021) but "firms' forecasts imply that COVID-19 will not have a large lasting impact on aggregate [total factor productivity] over the medium term" (Bloom et al. 2023, p. 32), our results are not affected by the COVID-19 pandemic. In fact, the time range is limited to the year 2019 (i.e., before the breakout of COVID-19). Moreover, the pandemic has been an extraordinary, event bringing about exogenous problems in the economic system. Some years after the substantial resolution of the COVID-19 pandemic, the economic dynamics have been substantially restored, and the focus lies on other economic and political issues. The object of our analysis is instead a long-term one.

6. Conclusions

This paper demonstrates that Keynes's prediction for 2030 holds true for the United States for statistical measures like real GDP per capita $\left(\frac{Y}{N}\right)$ and real GDP per employee $\left(\frac{Y}{L-U}\right)$, which will by then be seven times, respectively six times higher than in 1929. Instead, H and $\frac{H}{52}$ have shrunk by less than one fourth, which according to our empirical analysis is mostly due to insufficient productivity (h). Moreover, we find that:

- yearly $\left(H^E_{2030}\right)$ and weekly working hours $\left(\frac{H^E_{2030}}{52}\right)$ estimated for 2030 will respectively stand at 1805 and 34.7 (Table 2) and be higher by 231.4 percent than Keynes's estimate, who predicted them to be respectively equal to 780 $\left(H^{KE}_{2030}\right)$ and 15 $\left(\frac{H^{KE}_{2030}}{52}\right)$;
- if working hours should be set at 780, the productivity gap between h_{2030} and actual predictions for 2030 (h^E_{2030})—respectively, 182.6$/employee/hour and 78.9$/employee/hour (Table 2)—would be particularly impressive. Hence, the actually estimated productivity level for 2030 corresponds to just 43.2 percent of that needed *ceteris paribus* to work only 780 h;
- the productivity differential between h^E_{2030} and the scenarios predicted by Keynes depending on the times GDP would have risen is equally emblematic (Figure 1), because it ranges from 37.9 to 44.2 percent (Table 1).

Such results are further confirmed by the microdata from the Panel Study of Income Dynamics (PSID). Not enough, consumption expenses per household adjusted by the number of household members did not increase in the latest decades, which implies that the explanation so far according to which individuals work longer hours to afford higher consumption levels can also be excluded. Long working hours do not seem (primarily, at least) to be a consequence of new consumer needs, but rather of insufficient productivity.

Achieving Keynes's 15-hour workweek will also mean making the labour approach more efficient while ensuring a better work-life balance and enforcing sustainable growth. This will not be an easy task, because it will imply reshaping traditional work paradigms. Economic history teaches us that working hours have always (significantly) declined in parallel to economic growth, which has implied the surfacing of new, to-be-fulfilled consumer needs. If working hours have recently become "sticky to the bottom"—in fact, "[a]fter World War II, on the one hand, the number of hours per worker indeed fell further, but at a lower rate, and to a stronger degree in Europe than in the US" (Zilibotti 2007, p. 5), this should not be simply taken as a fact but should become an object of critical investigation. Perhaps, the ever-changing environment and the outbreak of the COVID-19 pandemic might contribute to the development of new work approaches. Further assessing the accuracy of Keynes's prediction before 2030 remains an interesting avenue for future research.

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Notes

1 Based on data for the United Kingdom in 1929 (such as GDP per capita ($5503), real GDP per employee ($12,958.3), yearly work hours (2257 h) and weekly work hours (43.4 h) (Bank of England 2022), it was at half the American standard of living (see columns 6–9 in Table 2 for a comparison). Therefore, Keynes's estimate of increase in the standard of living for the United States would have become "by two times" instead of "four" and "by four times" instead of "eight" (to wit, they would have to be divided by two). However, this does not affect our main hypothesis, because yearly and weekly working hours were comparable (see columns 8–9 in Table 2 for a comparison).

2 Standard time series statistical tests for the detection of structural breaks, performed on yearly data from 1950 to 2019, find evidence of a structural break in productivity in 2002 and of a structural break in working hours in 1974. Such tests reject the hypothesis of the absence of structural breaks and hint that we cannot exclude that multiple structural breaks in both the time series of productivity and in that of hours worked have taken place in the period considered. Similarly, a standard *t*-test for the difference in means rejects the null hypothesis that average productivity was the same in the period 1950–1984 and in the period 1985–2019 with a confidence level of 99%. The same result is obtained with ANOVA. With specific regard to the year 1974, our analysis is in line with Stiglitz's (2018) analysis and such structural break in working hours has been also addressed by other sources (StackExchange 2017). Concerning the year 2002, it is interesting to note that our finding is coherent with the fact that "[l]abor productivity growth in U.S. factories in 2002 was substantially above its 3.5-percent average annual growth rate since 1979" (U.S. Bureau of Labor Statistics 2004). However, the point here is not discussing whether (or not) a structural break in productivity has taken place (or not). Despite such breaks (and the reasons potentially explaining them), indeed, productivity did not increase enough to make Keynes' prediction come true.

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