IMPACT OF INTEREST RATES AND PRIVATE WEALTH ON LABOR SUPPLY: A STUDY ON G7 COUNTRIES

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Dedication

I dedicate my thesis to my esteemed supervisor and mentor, **Dr. Alexander Bilson Darku**, whose support and guidance have been instrumental throughout my graduate studies. His mentorship has not only shaped my academic journey but also blessed me with invaluable advice and personal direction.

Abstract

This study examines the impact of interest rates and private wealth on labor supply across the G7 countries using data from 1971 to 2020. It uses a panel data analysis to explore how the changes of these variables influence labor supply, with a particular focus on substitution effect — where labor supply increases as the interest rates rise — and income effects — where wealth accumulation reduces the labor supply. The study uses a Representative Agent New Keynesian (RANK) model to frame the theoretical discourse on the labor supply decisions. In the empirical analysis we considered the possibility of structural break and implemented diagnostic checks for it. The findings postulate insightful results, such as the dominance of the substitution effect in the case of interest rates, and the dominance of income effect when the interest rate was persistently high. Although, there is a statistically significant impact of these variables on the labor supply, the magnitude of these impacts remains modest

Acknowledgement

I begin by expressing my gratitude to Almighty Allah for His boundless blessings, guidance and mercy. I am deeply grateful for the strength and patience granted to me throughout this academic journey.

I would like to extend my heartful gratitude to my supervisor, Dr. Alexander Bilson Darku, for his invaluable support and expertise. I am truly grateful for the time and effort he dedicated to my work, and I consider myself extremely fortunate to have had the opportunity to work under his supervision.

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List of Abbreviations

ADF	Augmented Dickey Fuller (for unit root testing)
ARDL	Autoregressive Distributed Lag
CPS	Current Population Survey
EMS	European Monetary System
GDP	Gross Domestic Product
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
G7	Group of Seven
GMM	Generalized Method of Moments
HANK	Heterogeneous Agent New Keynesian
IV	Instrumental Variable
LLC	Levin-Lee-Chin (for unit root testing)
LCH	Life Cycle Hypothesis
OLS	Ordinary Least Squares
PIH	Permanent Income Hypothesis
PSID	Panel Study of Income Dynamics
PPP	Purchasing Power Parity
RANK	Representative Agent New Keynesian
TANK	Two Agent New Keynesian
USD-	United States Dollar
VECM	Vector Error Correction Model
VAR	Vector Autoregressive

Chapter One: Introduction

1.1 Background

The labor market plays a crucial role in the economy. Labor supply is an essential input for production and influences macroeconomic outcomes, such as unemployment and inequality. So, it becomes a priority to comprehend the determinants that influence the supply of this factor of production, as they can cause significant impacts on the aggregate production. Particularly, it is critically essential to focus on the supply of the factor labor because it is the number of human working hours and drives the utilization of other factors into production.

Macroeconomists and labor economists have exhibited inquisitiveness to explore the responsiveness of labor supply in their works. Labor supply can be estimated at an intensive margin, such as the number of hours worked and at an extensive margin, such as the labor force participation rate. One of the ways that the responsiveness of labor supply is measured is through the Frisch elasticity, named after the Norwegian economist Ragnar Frisch (Westergaard, 1932). It measures how changes in after tax compensation affect the intertemporal labor supply decisions.

The changes in labor supply can be separated into income and substitution effect. When an effect, such as an increase in wages, causes the opportunity cost of leisure (not working) to rise, it makes leisure more costly than before, encouraging to supply more working hours. This change can be termed as the substitution effect. On the other hand, an increase in wages also causes the income level to rise, eventually an increase in purchasing power. Wealthier individuals may decrease their labor supply once their desired level of income is attained, and their utility is maximized.

Therefore, in the case of intertemporal substitution of labor (leisure), the income and substitution effect stand contradictory.

Interest rate and wealth play an important role when it comes to deciding the intertemporal labor supply. Interest rate is deemed as the cost of borrowing or the return on savings. This phenomenon makes interest rates an imperative component for labor supply decision making process of households. A change of interest rate can be channeled into the intertemporal labor supply decision, through the avenues of income and substitution effects. Higher interest rate encourages savings, which may consequently lead the individual to supply more working hours. So, the individual may decide to substitute consumption with savings by working more hours. On the other hand, higher interest rates cause the purchasing power of the individual to increase. The income effect would dictate that a higher interest rate will lower the supply of working hours. Therefore, the substitution and income effects are contradictory when it comes to the change in interest rates. In the case of effects of wealth on labor supply, higher wealth leads to lower labor supply. This can be better understood as the application of Carnegie Conjecture, which states that wealth reduces the probability of an individual supplying more labor in his lifetime. For a person with higher lifetime wealth, the lifetime consumption of leisure is increased since it is considered as a normal good.

Furthermore, interest rate and wealth are attributed to monetary and fiscal aspects of the economy respectively. Interest rate is a monetary policy instrument, which is used to control the price level of the economy. Wealth, on the other hand, plays an important role in terms of constructing fiscal policies. Higher wealth causes more consumer spending, which may lead to tightening fiscal policies in terms of higher taxation and vice versa. Thus, the effects of interest rate and wealth on labor supply can have macroeconomic implications for the labor market.

The labor supply decisions can be traced to the Life Cycle Hypothesis (LCH) and Permanent Income Hypothesis (PIH). LCH states that individuals save by working more when they are in their working age, to accumulate funds for retirement period. PIH dictates that individual consumptions are driven by permanent income, which is the average of their lifetime income, rather than current income. An individual will base their decision of supplying labor hours depending on the changes in permanent income, such as rise in wealth. This change will cause the individual to supply lesser working hours to meet their needs, as the long-term average income increased. Juan and Seater (2006) have stated that industrial and advanced economies support these theories, while developing countries do not. They attribute this discrepancy in accordance with the data quality of these two distinct groups of countries. Consequently, this study uses data from advanced economies.

G7 is a group of 7 advanced economies, consisting of Canada, France, Germany, Italy, Japan, the United Kingdom (UK), and the United States of America (USA). This group contributes to approximately 40 percent of the global GDP (World Bank, 2024) and includes a working age population of more than 490 million as of 2020 (OECD, 2024). The study examines the labor supply responsiveness to changes in interest rates and wealth using the data of G7 countries because of its significant contribution to global GDP, a large working age population, and similar economic structure as recommended by Juan and Seater (2006).

1.2 Statement of Problem

Labor supply is a key input for the aggregate production function. It ensures that the aggregate supply side matches the aggregate demand of the economy and keeps inflation within the target.

Therefore, to fortify the flow of supply in the economy, it is essential that policies should be made in a way that reflects the importance of labor supply. Contemporary studies on labor supply predominantly concentrate on factors such as wage, unionization and taxation. However, it is crucial to investigate other factors that can possibly influence labor supply.

Interest rate can impact the labor supply decisions of households as it offers a reward for savings while deterring borrowing. The interest rate is also a monetary policy apparatus. Conversely, wealth navigates fiscal policy makers, aiding them in adjusting fiscal policy measures such as taxation. In other words, interest rate and wealth consist of macroeconomic implications for labor supply. A well-informed policy formulation process will ensure the capability to pave the way for a better and more efficient outcome.

Labor supply is directly related to labor income, generated in the form of salary and wages. Consumption, as discussed earlier, is dependent upon expected lifetime income rather than transitory income. So, it is crucial to focus on how labor supply shapes the pathway of consumption because it accounts for approximately 60 percent of GDP in advanced and developing economies (OECD, 2024 and World Bank, 2024). If interest rate and wealth affect labor supply, then it holds the potential to impact consumption level of the economy, in other words, 60 percent of the GDP.

Contemporary literature offers frameworks to support the theory and provide empirical estimates in a manner that holds interest rate constant in analysis (Keane and Rogerson, 2011 and Card, 1990). Although some recent papers presented some work on the impacts of interest rates on labor supply, much of the attention is devoted to understanding the heterogeneous effects of interest rate shocks and using microeconomic data (Cantore et al., 2022 and Graves et al., 2023). On the other

hand, studies on the responsiveness of labor supply to wealth effects have rigorously focused on microeconomic analysis, such as the effects of inheritances or lottery winnings on labor supply.

Therefore, there is a lack of study that addresses the labor supply responsiveness to interest rates and wealth changes using aggregate data. It is required to conduct research using aggregate data for a few reasons. Firstly, aggregate data can offer a comprehensive overview of the impact of interest rates and wealth on labor supply at the macroeconomic level. It is helpful because it can emphasize long-term trends and cyclical behavior in labor supply related to other macroeconomic variables. Secondly, it allows for analysis across different populations, such as countries, underscoring structural differences, and cyclical behavior. These are important aspects that need to be explored, which cannot be done using microdata.

Given this situation, the study identifies the problem arising from a lack of research using macroeconomic data and examines interest rate and wealth change effects on labor supply and to fulfill this gap.

1.3 Research Objective

The objective of this study is to investigate the impact of different types of interest rate and private wealth on labor supply. To accomplish this objective, the study uses macroeconomic data from G7 countries since they represent a substantial part of the global economy. The study also uses a Representative Agent New Keynesian (RANK) model to examine the possible mechanism behind the labor supply responses to interest rate and wealth changes. It is possible that these changes may demonstrate their effects on labor supply either immediately or in subsequent periods, which indicates short-term and long-term effects. Furthermore, the study focuses on using private financial assets as a percentage of net wealth per adult to represent the changes in private wealth.

This measure captures the most liquid form of wealth that is accesible to the individuals. Lastly, related to the argument of the contrasting income and substitution effects of interest rate changes and labor supply, it is necessary to identify the dominant effect.

Thus, the research objective can be outlined by the following:

1) To examine the impact of different types of interest rates on labor supply.
2) To identify the impact of changes in the concentration of liquid assets on the labor supply.
3) To derive the dominance of income and subtitution effect of changes of interest rate over labor supply over time.

1.4 Research Question

In order to fulfill the research objectives, the study will attempt to answer the following research questions:

1) Can changes in different types of interest rates (long-term and short-term) have effects on labor supply?
2) How do changes in concentration liquid assets influence labor supply decisions?
3) Does the substitution effect of change in interest rate on labor supply dominate the income effect over time?

1.5 Structure of the Study

The remaining of the study consists of five chapters. Chapter two discusses the historical overview of these economies within the timeframe of 1971 to 2020. Chapter three presents a review of the existing literature on the impact of the interest rate and private wealth on labor supply and includes a gap in the review. Chapter four introduces a theoretical framework, research methodology and

data used to generate econometric estimates. Chapter five provides and analyses the main findings of the study. Lastly, chapter six offers a summary of the research, conclusion of the study, and presents some policy implications.

Chapter Two: Overview of the Labor Supply, Interest Rates and Private Wealth of the G7 Countries from 1971 to 2020.

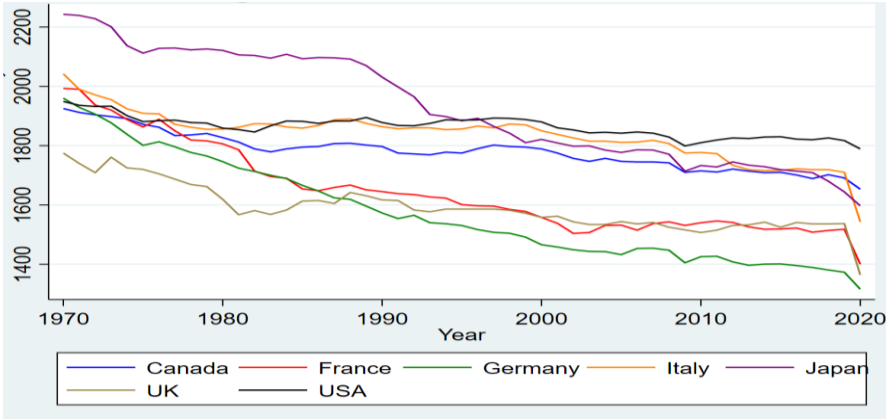
2.0 Introduction

In the past five decades, significant changes in the trend of the labor supply can be noticed, along with changes in interest rates and private wealth of the G7 countries [1]. This chapter focuses on providing an overview of these changes and intends to study the possible reasons behind these fluctuations. This chapter is important because it will lay the groundwork for the analysis and provide substantial guidance for econometric modeling. Therefore, it will provide an overview of the dynamics of the number of hours worked, different types of interest rates, and private wealth and its components, discussing possible global and domestic economic shocks the G7 countries faced between 1971 and 2020.

[1] G7 countries include Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States of America.

2.1 Number of Hours Worked

Figure 2.1: Average Number of Hours Worked Annually



Data Source: OECD (2024)

Table 2.1: Average of Annual Number of Hours Worked by Decade

Country	1971-1980	1980-1990	1990-2000	2000-2010	2010-2020
Canada	1,872.91	1,797.50	1,784.20	1,751.40	1,701.45
France	1,888.27	1,681.00	1,603.80	1,529.60	1,513.82
Germany	1,837.09	1,655.10	1,521.30	1,445.10	1,392.08
Italy	1,922.09	1,871.50	1,860.60	1,816.70	1,713.55
Japan	2,162.45	2,089.20	1,888.00	1,784.50	1,702.91
UK	1,706.55	1,602.20	1,583.10	1,539.30	1,515.18
USA	1,901.36	1,874.60	1,882.30	1,843.90	1,819.27
G7	1,898.68	1,795.87	1,731.90	1,672.93	1,622.61

Data source: OECD (2024)

Figure 2.1 and table 2.1 illustrate the average number of hours worked annually by workers of the G7 countries within a timeframe spanning from 1971 to 2020. From a general overview of this figure, it is easy to notice that all the countries have witnessed a decline in the number of hours

worked. Several factors contributed to this decline. From table 2.1, it is visible that the number of hours worked declined over the years for G7 countries from 1898.68 hours a year in the 1971-1980 decade to 1622.61 hours a year in the 2010-2020 decade.

One of the primary factors contributing to the change in labor supply is the labor laws and regulations reforms that took place within these countries during this period. These reforms emerged as the trade unions started to muster up their capacity to bargain collectively. For instance, in 1970s and 1980s, the decline of working hours in France can be attributed to the labor law and policies crafted in this period. In 1968, following a protest by workers, the Granelle Agreement of 1968 introduced significant labor law changes, which included better pay and shorter working hours (Recluse, 2013). In 1973, the legal workweek was reduced to 40 hours a week from 44 hours a week, which further bolstered the secular decline. Though the 40-hour workweek law was passed in 1936 as "The 1936 Act of 40 Hour Working Week", it was not fully implemented until the late 1970s (Eymard-Duvernay, 1977). Also, the number of vacation week also increased from 4 weeks to 5 weeks a year in 1982. Furthermore, in the late 1990s, the implementation of Aubrey Law a reduction of work hours decreased to 35 hours a week (Michon, 2009). This law targeted to decrease unemployment by spreading available work among more workers. Eventually, this can potentially reduce the number of hours worked by French labors. Also, in Germany, 'The Hartz Reforms of 2003-2005' promoted more part-time, temporary and marginal employment which eventually reduced full-time working hours (Rinne and Schneider, 2019). Similarly, Colombo and Ida (2016) identified the decline in hours worked in Italy due to reformed labor laws in Italy. Also, the decline of labor hours in Japan was further pushed down by the government policies focusing on cutting down the number of hours worked, economic and demographic shifts such as ageing population, increased female labor force participation, and educational attainment, cultural shifts

towards work life balance (Kuroda, 2010). In the case of the USA, the Fair Labor Standards Act (FLSA) strengthened worker protections, limiting excessive work hours. This act ended up strengthening the trade unions that championed the labor rights protections (Ausube and Grübler, 1995).

Another reason that may contribute to this decline of labor supply is the change of demographic structure. Field et al. (2017) studied the effects of aging population on Canada's labor force and stated that ageing population can be a key reason behind declined number of hours worked. Japan also faces this problem, as mentioned by Kuroda (2010).

Other reasons include increased labor productivity per worker led by improved technology, increased part time jobs, shifts to the manufacturing and service sector, and improved work life balance. Dumke (1990) argued that the decline in labor hours in Germany occurred due to increased productivity over time. It took less time to produce the same amount, however, the growth of decline could be slowed down due to transfer of unskilled labor from traditional sector to manufacturing sector. Rubery (1998) indicated technological advancement in the UK which increased the labor productivity. This increase in productivity also contributed to decrease in labor hours. In the 1990s, the rise in part-time employment contributed to, the overall decline in annual hours worked. In this period, more women entered the workforce, but took shorter-hour jobs, reducing the national average work hours per worker. Also, weekend and evening based jobs increased, which lowered the overall average number of hours worked (Rubery, 1998). Furthermore, the USA transitioned from a manufacturing-based economy to a service-driven one in this decade. Manufacturing jobs that had long working hours declined as well. Therefore, service-sector jobs generally had shorter workweeks and less mandatory overtime, reducing the overall average of the working hours (Ausube and Grübler, 1995).

Lastly, the economic crisis and shocks also caused a decline in the labor hours in these countries, such as the Internet bubble crash, 2008 financial crisis, and Covid 19 pandemic. Rinne and Schneider (2019) posited during the 2008 financial crisis; German employers focused on shorter-working time (Kuzarbeit) rather than opting for mass layoffs. In the events of 2008 financial crisis, and the Covid 19 pandemic, there was a visible dip in the labor hours in Japan. It makes sense because during such economic crisis, the employers often reduce working hours to avoid employment cuts while still addressing labor cost constraints. The numbers of hours returned to almost their pre-2008 levels in 2011, indicating a quick recovery. In the case of the US, the firms responded to this economic downturn by cutting off hours instead of mass layoffs to reduce their labor cost during the dotcom crash (Hamermesh, 2019). This reduction is clearly visible in the figure 2.1. Similar but more harsh situations were present in the US during the time of the 2008 financial crisis as well. High unemployment rate caused the labor supply to decline during this shock. Lastly, during the Covid-19 pandemic, the hours of work declined significantly as well, attributing to adherence to austere lockdown regulations. Apart from these economic shocks, the rise of artificial intelligence and gig economy also contributed to the diminishing labor hours in the USA.

2.2 Interest Rates

In this study, the long-term interest rate and short-term interest rates are used in the empirical analysis. The interest rate data and definition that is used for analysis is from Jorda et al. (2016).

Figure 2.2: Long Term Interest Rate

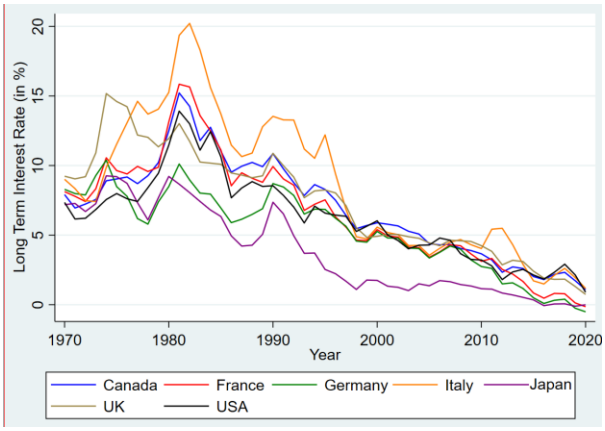
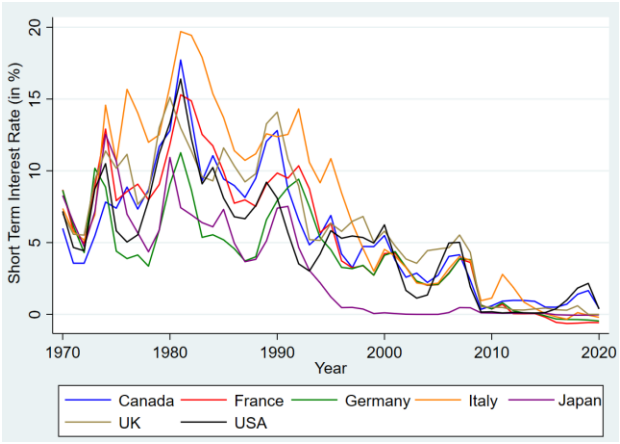


Figure 2.3: Short Term Interest Rate



Data Source: Jorda et al. (2016)

The above figures illustrate the long-term and short-term interest rates respectively. From the figures, it is evident that the G7 economies experienced a barrage of fluctuations in the interest rates from 1971 to 2020. However, much of the fluctuations can be attributed to the economic conditions during the given period. Since the G7 is a group of 7 advanced economies, much of the direction of these oscillations remains, somewhat, identitical.

The central banks of the country decides the interest rate of the country, based on the economic conditions and inflation targets. In the 1970s and 1980s, the G7 countries experienced serveral economic shocks, including the oil crisis, the collapse of the Bretton Wood system, and recessions.

In case of the French economy, the rates remained relatively moderate, with the short-term interest rate hovering around 4 to 8 percent and the long-term interest rate steadied between 4 to 5 percent. However, following the first oil crisis in 1973, the French central bank proceeded to increase the

interest rate as a response to contain the surge in inflation. In the late 1970s, the second oil shock caused the central bank to raise the interest rate even more aggressively. Between 1975 and 1980, the short-term interest rate averaged at 9 percent and the average of the long-term interest rate stood at 10.25 percent. The interest rate began to stabilize by the mid-1980s as it started to decline following the reduction of the inflation rate. The average of the short-term and long-term interest rate stood at 8.5 percent and 9.5 percent respectively. Though the rates were cut, the magnitude of these remained quite insignificant. This was primarily because the alignment of French policies with the broader European goal of achieving monetary convergence ahead of the European Monetary Union and the creation of the Euro. So, although the cuts were made, the policymaker kept targeting a lower inflation rate to meet the convergence criteria for controlling inflation and reducing budget deficits to participate in the forthcoming single currency (Goodhart, 1992). The Canadian economy also faced similar challenges, arising from the oil crisis and stagflation. This can be seen in the figures as well, where the interest rates in Canada reached its peak in the 1980s, with the long-term interest rate at around 14 percent and the short-term interest rate at around 17 percent.

The German economy also faced the challenges like those of France and Canada. In the decades of 1970s and 1980s, the annual inflation rates elevated to 4.9 percent and 2.9 percent respectively (Kofner, 2023). To combat these inflationary pressure, the Deutsche Bundesbank opted to keep the interest rates high with the short term interest rate and long-term interest rate averaging at 5.98 percent and 7.95 percent in 1970s and in 1980s, the rates were 6.39 percent and 7.58 percent respectively.

In all of the G7 economies, the Italian economy registered the highest interest rates in the 1970s and 1980s. During this period, the interest rate kept on climbing as a response to the inflation

caused by the oil price shock. The interest rate reached its zenith in the early 1980s, with the long-term interest rate reaching almost 20 percent. The central bank was forced to keep the rates this high since, the Italian economy was suffering from double digit inflation from 1973 (Jordà et al., 2016). The interest rates started dropping from mid 1980s onwards, with spikes in the interest rate in the early 1990s. Italy attempted to maintain some balance within the European Monetary System (EMS) (Corsetti and Pesenti, 1999).

Japan, like other G7 nations, opted for high interest rate to control the inflation. The rates, however, began to decline fast from mid-1970s onwards. In the 1980s, the Bank of Japan decided to increase the interest rate following the steps by US Federal Reserve to counter the impact of 1979 oil crisis (Itoh et al., 2015). The interest rate were also affected by the Plaza Accord Agreement of 1985. Due to this agreement, Japanese Yen appreciated against US Dollar, causing the Japanese export to lose its competitiveness. As a respond to this, Bank of Japan aggresively decreased the interest rates to stimulate the economy (Ito, 2015). In the 1970s, the rates seemed to be extremely high and volatile.

In 1970s, UK faced the challenges arising from the oil price shocks (Lu et al., 2024). These shocks caused the oil price to quadruple and led to high inflation. The Bank of England, like other G7 economies, decided to raise the interest rate to contain the inflation. As a result, the long term interest rate rose to about 15 percent, and the short-term interest rate increased to around 12 percent. Lu et al. (2024) stated that during the 1979 Iranian revolution, the UK was a net oil importer of the Iranian oil. This disruption in the supply chain of oil imports caused the inflation rate to go up, along with wage price spiral effects. This combination of shock from oil supply disruption and wage price spiral caused inflation to go up, which pushed the need to increase the interest rate once again in the late 1970s. In the 1980s, Margaret Thatcher government advocated

the need to keep the interest rates high to counter the inflationionary pressure. As a result the rates increased significantly in the early 1980s. The rates were cut once the inflation stablised. The rates were cut further for a short period of time, as a response to the 1987 stock market crash and were increased again. As seen in the figure 2.2 and figure 2.3, the rates were increased again in the late 1980s and early 1990s, as a measure to prevent overheating the economy (Lu et al, 2024).

In the 1970s, the US faced external economic shocks, such as oil price shocks of 1973 and 1979, much akin to the other G7 countries. In this case, the inflation rate of the US increased, which resulted in increasing the interest rates by the Fed. The spikes in the interest rate correspond to the mentioned period. Persistent increase in the oil price caused the US to suffer from cost push inflation in the 1980s. During this decade, the US economy faced the Volcker shock, named after the Fed Chairman Paul Volcker (Goodfriend and King, 2005). Volcker aggressively increased the interest rates to combat the rising inflationary pressure. During this period, the short-term interest rate exceeded 15 percent, while the long-term interest rate stood around 14 percent. The results were seen through the lens of declining inflation rate in the following years. Consequently, the interest rates also declined. However, in the end of the 1980s, there was another spike in the interest rates. The Dow Jones dropped by 22% in a single day, the largest one-day percentage drop in history in 1987. Initially, the Fed decided to cut the rates to stabilize financial markets, preventing a deep recession. However, by mid-1988, economic growth remained strong, forcing the Fed to reverse course and raise rates to prevent asset bubbles and inflation (Goodfriend and King, 2005).

The interest rates began to decline steadily in the mid-1990s in Canada. This showcases a shift in Canadian economic policy toward lower interest rates to promote economic growth. While the short-term rates continued to fall in the late 1990s, the rate of change in the long-term interest rates seems relatively slower. In the 2000s, both short-term and long-term interest rates slowed down

compared to the preceding decade. In this decade, the global financial crisis of 2007-2008 and following recessions pressed the central bank to formulate lower interest rates to promote borrowing, spending and investments. During this decade, the rates remained relatively lower with little to no significant increments. Lastly, following the 2008 financial crisis, the central banks opted to keep the interest rates lower, with the short-term interest rate hovering between 0.5 percent to 1.5 percent and the long-term interest rate stayed between 1 to 4 percent between 2010 and 2019. This trend continued until the Covid 19 pandemic, where the rates dropped in 2020. France adopted the Euro officially in 1999. This marked a shift in monetary policy under the European Central Bank (ECB). Due to the adoption of the Euro, the interest rate declined further since the ECB sets the interest rate the entire Eurozone (Eichengreen, 2009). In the early 2000s, the dot-com crash and global recession led to further rate cuts. Between 1995 and 2000, the average short-term and long-term interest rates stood at 3.95 percent and 5.67 percent respectively, while it dropped to 3.02 percent and 4.47 percent respectively between 2000 and 2005. The rates kept on diminishing following the 2008 financial crisis, where the central banks worldwide opted for low interest rates. Lastly, the Covid 19 pandemic caused the interest rates to drop further as the central bank prepared for emergency rate cuts with ECB maintaining near-zero interest rates. In the early 1990s, the reunification of Germany took place and faced economic challenges, which inflationary pressure and high government spending. The Deutsche Bundesbank continued to keep the rates high in most of the first half of the decade, with the short term and long-term interest rate averaging at 5.61 percent and 6.62 percent respectively. Germany adopted the Euro in 1999. Jean et al. (2008) found that long-term interest rates became less sensitive to short-term monetary shocks after the introduction of Euro. This lowered the rates till 2007, which was followed by massive rate cuts to stimulate the downturns of the economy caused by the 2008 financial crisis. Since the 2010s, the

rates kept on dropping and dropped to lowest in 2020 with negative short term and long-term interest rates to counter the economic crisis caused by the Covid 19 pandemic. In case of Italy, the economy witnessed some spike in the early 1990s. The short-term and long-term interest rates declined steadily in the decades of 2000s and 2010s. In the event of 2008 global financial crisis, the rates were cut, with the short-term interest rate declining from 3.76 percent in 2008 to 0.95 percent in 2009 and the long-term interest rate decreased from 4.68 percent in 2008 to 4.31 percent in 2009. Similar cuts were also seen during the Covid 19 pandemic. The short-term interest rate was set at negative 0.204 percent, and the long-term interest rate was set at 1.17 percent in 2020. Bank of Japan swiftly increased its interest rate in the early 1990s to combat the inflation (Ito, 2015). However, following this hike, the interest rate kept on falling steadily in the remaining decade of 1990s, 2000s and 2010s. This steady decline can be attributed to ageing population problem of Japan (Fujita and Fujiwara, 2023). They explained that Japan's aging workforce and declining labor force entry rates could play a critical role in lowering real interest rates. Interestingly, The 1990s decade can be characterized as a decade of transition for the UK monetary policy. In the beginning of this decade, the rates continued to remain high. But the rates dropped down quite drastically following the economic growth stabilization. In 1997, chancellor Gordon Brown granted the Bank of England full independence to set interest rates. This caused the rates to stabilize and hover around 5 to 7 percent.

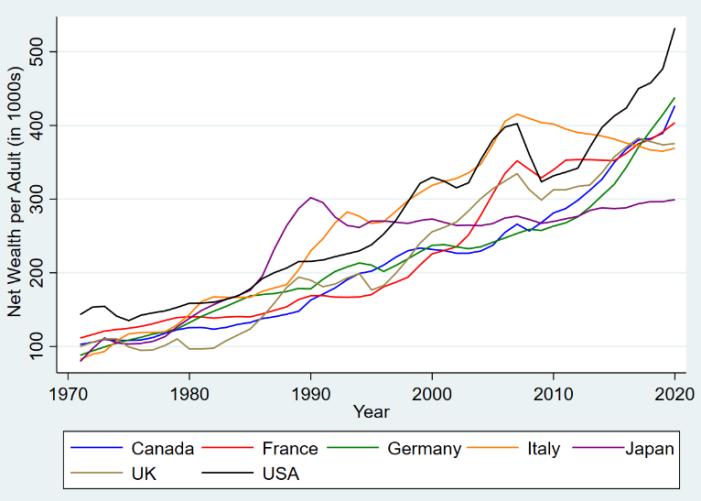
In the 2000s, the rates looks relatively stable and in a downward trend. Following the collapse of Lehman Brothers in 2008, the global financial crisis was caused.The UK was heavily affected due to its large financial. The Bank of England responded to this crisis by cut the rates radically to almost zero percent. In the 2010s, the rates were severely low following the economic crisis of 2008. In 2016, the UK exited the European Union and Brexit happened. To cushion the impact of

this exit, the Bank of England kept the interest rate low to about 0.25 percent (Lu et al., 2024). Similarly, in the event of Covid 19 pandemic, the rates were kept low to stimulate the economy and as an attempt to prevent economic downturn. For USA, the rates were mostly stable at around 5 percent for the short-term interest rate and around 7 percent for the long-term interest rate throughout 1990s. In the decades of 2000s and 2010s, the interest rate dropped significantly, with occasional spikes. Capraro et al. (2021) accredits this decline to the Fed's shift toward financial stability, cheap credit policies, and responses to crises. In this decade, the only spike appears to take place was during the mid-2000s due to the expected inflation arising from keeping the rates low for too long and preventing asset bubble formation (Capraro et al., 2021). At the time of the 2008 financial crisis, the rates were cut to below 1 percent. Similarly, during the time of Covid 19 pandemic, the rates lowered to stimulate the economy.

2.3 Private Wealth per Adult

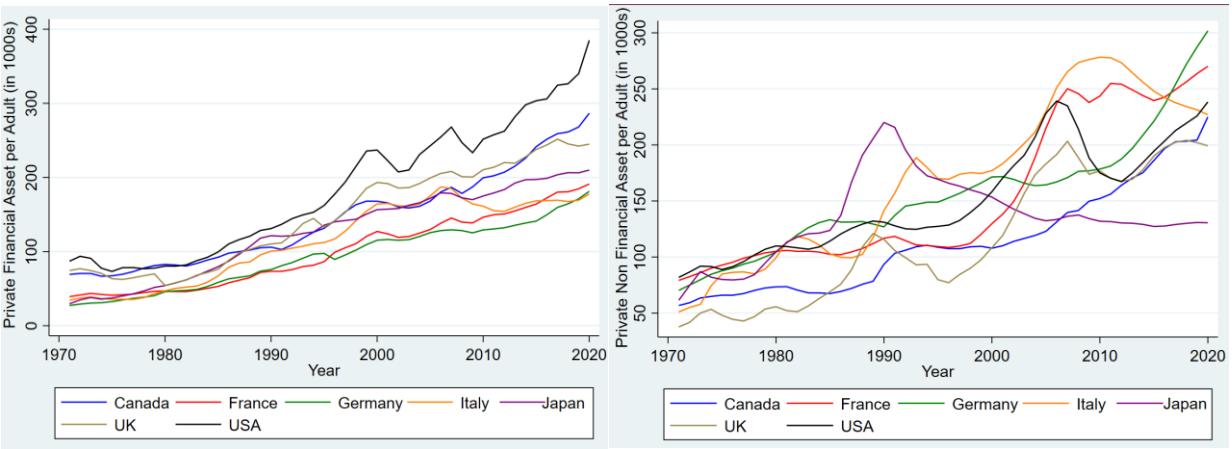
This section introduces the private net wealth per adult, private financial asset per adult, and private non-financial asset per adult of the G7 countries from 1971 to 2020. All the figures shown are in 2023 US Dollars, and at Purchasing Power Parity (PPP) exchange rate. From an overview of the diagram, these countries experienced an increase in private wealth over the period.

Figure 2.4: Net Wealth per Adult



Data Source: WID (2024)

Figure 2.5: Private Financial and Non-Financial Asset per Adult



Data Source: WID (2024)

The 1970s and 1980s marked an era with economic uncertainty due to the oil price shock. Interestingly, Canada seems to remain immune from this crisis, perhaps due to its oil reserves. The

Canadian economy remained mostly stable in these two decades, and the private wealth were least affected by this crisis.

In 1970s and 1980s, the increase of private wealth per adult in France can be attributed to various government policies, In the post-World War II economy, the government of France promoted industrialization which increased employment opportunities. This led to an increase of wages and overall increase in private wealth (Kresl and Gallais, 2002). Also, the French government aligned their policies to promote more homeownership (Gobillon et al., 2019). The government provided subsidized loans and tax incentives to promote access to homeownership. This can cause an increase in non-financial wealth and eventually lead to an increase in private wealth.

For Germany, the increase in private wealth can be attributed to the outcomes of Wirtschaftswunder or the 'Economic Wonder' in the post war era. In the 1980s, it is also visible that financial wealth increased at a faster rate than overall wealth and non-financial wealth per adult. This sharp increase of financial wealth can be caused by the financial deregulations, including deregulation of nationalized financial institutions, and the openness of stock market, which in turn made the financial wealth accumulation more feasible for individuals.

The Italian economy in the 1970s experienced decent growth, with some challenges arising from inflationary pressure, oil shocks and continuous lira devaluations (Lubitz, 1978). Historically, the Italian households prefer real estate investment, which is visible in the figure 2.3.2 as well (Acciari et al., 2024). This trend of growth in private wealth kept its momentum in the 1980s as well.

Like other G7 country, the private wealth of Japan increased during the 1970s and 1980s. Fukao and Makino (2021) postulated that private wealth adult increased steadily in the 1970s due to factors such as rising incomes, high savings rates and growing real estate values. High interest rates acted as an incentive for the Japanese to invest in financial assets to take the leverage of higher return on savings. This trend also followed in the 1980s, with steady increase in the private wealth till the late 1980s and early 1990s.

For the UK, the trendline appears to be relatively flat, indicating that the private wealth per adult really did not increase much in the 1970s. Blake and Orszag (1999) suggested that this was caused by a series of factors. Firstly, the UK witnessed high taxation and expansion of welfare state in the 1970s, which led to lower wealth accumulation since the high income individuals faced high taxation. This was further fuelled by high inflation rates, which reduced the real interest rate to the negatives (Blake and Orszag, 1999). Additionallly, the oil crises of 1973 and 1979 led to economic instability, reducing wealth accumulation. All of these factors complemented one another, leading to private wealth left to be unchanged. In the 1980s, the trend looks to improve, with the private wealth per adult increasing to almost twice the amount of the 1970s. In most part of the decade, the financial wealth seems to be more dominating the non financial wealth. Blake (2004) stated that this dominance was caused by the stock market expansion (Big Bang 1986) where the financial accesibility was increased. Also, the privatisation of public asset such as the British Gas, contributed significantly to this change in the private wealth portfolio management. Blake (2004) emphasized that financial wealth grew at a faster rate than the non-financial wealth (housing) in the 1980s, though both increased, and underscored that financial wealth became the dominant form of wealth for upper-income group.

In the 1970s, private wealth per adult remained mostly stagnated in the USA. This stagnation can be explained by the presence of high inflation in the economy (Hurd and Shoven, 1985). However, the non-financial wealth seems to grow a little as wealthier households hedged inflation with real estate and stocks. In the 1980s, private wealth grew at a faster rate compared to the preceding decade. Woff and Zacharias (2007) accredited this change to the financial deregulation policies of the early 1980s. The Depository Institutions Deregulation and Monetary Control Act (1980) removed interest rate caps, making financial markets more attractive for investment, and Garn-St Germain Depository Institutions Act (1982) deregulated savings and loans institutions, allowing them to invest in riskier assets (Wolff and Zacharias, 2009). As a result, the financial wealth (stocks, bonds) increased sharply, benefiting higher-income individuals, stock ownership became more widespread, though concentrated among the wealthiest, and the net private wealth per adult grew steadily throughout the decade, especially in financial assets.

In the mid-1990s and early 2000s, the growth of private wealth kept increasing in Canada, which can be associated with the dot-com boom and the performance of stock market during these years (Bonis et al., 2013). The private wealth per adult of Canada faced some downturns because of some economic shocks such as the 2001 Internet Bubble crash, 2003 Economic Recession and 2007 Global Financial Crisis. Between 2010 and 2020, the private wealth per adult shows a sharp increase, followed by a decrease in 2019 and 2020 due to Covid 19 pandemic.

Throughout 1980s and 1990s, the French government undertook expansionary fiscal policies. This ensured tax reforms through tax cuts, including top income tax cuts, inheritance tax cuts, and corporate tax cuts. So, lower capital gains tax, coupled with tax incentives for business, promoted an atmosphere for more private wealth accumulation (Banting, 1991). Additionally, real estate prices in major urban areas like Paris witnessed significant growth, primarily due to an increase in

domestic and international demand. Since the wealthiest household invested in real estate, the rise in property value caused the private wealth to increase significantly (Renaud, 1997). The boom of private wealth in the 2000s and 2010s can be described as a combination of several factors. Firstly, since the interest rates were cut, there were more opportunities to invest in the economy. Real estate proved to be major choice of investment in France, as it provided with higher returns, and caused the private wealth to increase. Also, the French people were offered with private banking services and wealth management services during the 2000s and 2010s. It provided a much more well-organized investment strategy for individuals (High net-worth individuals mostly), allowing them to grow and preserve their wealth (Beaverstock et al., 2013).

In the 1990s, the effects of the unification of Germany are visible in the private wealth data. Albers et al. (2022) argued that East Germany suffered from the reunification, while the West Germany benefited from the reunification. East Germans possessed little capital and due to the exchange rate of Deutsche Marks, their savings were further devalued. On the other hand, the private business wealth concentrated in the West, and much of East German state firms were privatized through the Treuhandanstalt, which eventually benefitted the West German investors. So, even though the private wealth increased in this era with slight decrease due to economic slowdown in 1995, structural changes resulted in more inequality.

The adaptation of Euro caused a slight decline in private wealth due to short-term financial volatility, but it stabilized in the following years. Albers et al. (2022) stated that financial wealth stagnated due to the Euro transition and lower interest rates. They also postulated that in the event of 2008 financial crisis, the German economy was affected less significantly than other advanced economies due to its strong banking system, government stimulus and lower household debt. It is also reflected as the decline in private wealth seems almost negligible. The economy's strong

endurance to shocks also reflects in the Covid 19 pandemic, where the private wealth did not decrease in Germany, and in fact, increased for the individuals' holding assets and real estate due to asset price inflation (Schmidt, 2021).

The private wealth of Italy kept on increasing in the 1980s as well. However, extremely high interest rates during the early 1980s affected the private non-financial wealth in the late 1980s, demonstrating a lag effect. This pattern can also be noticed through a rise in non-financial wealth in the early 1990s, as the rate dropped in the late 1980s. The private wealth of Italy kept on increasing in the 2000s. But, from the figure, it can be stated that the Italian private wealth suffered during 2008 financial crisis and the Covid 19 pandemic shocks. Private non-financial wealth and overall wealth per adult started to decline during these shocks. Much of the decline was caused by the housing market downturn (Acciari et al., 2024).

During the 1990s, the Japanese economy was challenged with the asset bubble burst crisis. As it is visible in the figure as well, the economy witnessed a sharp decline in the private wealth, as a result of the fall in the non private wealth per adult (Fukao and Makino, 2021). This collapse stagnated the trend of non-financial wealth in the 2000s and 2010. On the other hand, financial wealth kept on increasing steadily throughout the period. Fukao and Makino (2021) commented on this phenomenon as Japanese prefering government bonds for savings, demonstrating a risk averse behavior. Interestingly, the Japanese private wealth were not affected by the 2008 financial crisis and Covid 19 pandemic. This resilience from the unprecedented shocks could be a result of scrupulous private wealth planning.

In the 1990s, the financial wealth continued to be the dominant form of wealth in the UK. This growth of financial wealth was driven by the shift of private pensions to be the main financial

asset, surpassing cash savings and stocks. Also, the stabilisation of inflation led to lower interest rates, which eventually made borrowing more lucrative. So, most of the real estate turned to be more debt driven and dependent (Blake, 2004). The financial wealth dominance continued in the following two decades as well. In the early 2000s, the non financial wealth per adult grew quite fast. However, this growth was adversely affected by the events of the 2008 financial crisis, which reduced the non-financial wealth. Afterwards, the slight recovery was followed, and stagnated after the Brexit of 2016.

The growth rate of private wealth per adult in the USA kept on accelerating in the 1990s as well. Particularly, figure 2.2.1 shows a sharp increase in the private wealth during the late 1990s, which could potentially be driven by the dot-com boom and expansion of the financial market. In the early 2000s, the burst of the dot-com bubble is visible, as the private wealth declined. However, it soon recovered, only to face the massive 2008 financial crisis shock. Due to this shock, the non-financial wealth per adult saw a sharp decline, which consequently affected the overall private wealth per adult. Lastly, the Covid 19 pandemic caused the US economy to enter recession, however, the effects of these shocks on private wealth are not immediate but left impacts on private wealth in the years to come (Alexander, 2022).

Chapter Three: Literature Review

3.0 Introduction

This chapter reviews the existing literature on the impact of interest rate and wealth on labor supply. In the first section, the review commences by introducing the distinct labor supply theories, particularly focusing on the theory of intertemporal substitution models and other New Keynesian Agent frameworks. It is followed by an extensive review of econometric methodology, datasets, and findings. In the second section, this chapter provides an in-depth review of the impact of private wealth shocks, stemming from different sources, on the labor supply decision. Lastly, the concluding section is dedicated to identifying and analyzing potential gaps in existing literature.

3.1 Literature Review on the Impact of Interest Rates on Labor Supply

There is a considerable stock of literature on the relationship between interest rates and labor supply. Heckman (1993) states that labor supply can be classified in two ways, which can be termed as at an extensive margin and at an intensive margin. where the extensive margin is the labor force participation rate and employment choices, while the intensive margin is the number of hours worked or weeks of work for workers. However, a lot of the empirical studies chose to use the intensive margin definition as the definition of labor supply (Altonji, 1986; Angrist, 1991; McCurdy, 1981; Hams and Reilly, 2002; Domeiji and Flodén, 2006; Peterman, 2016; Siggurdson, 2020; Martinez et al., 2021).

Much of the literature on the theoretical modelling of labor supply is premised upon the intertemporal substitution of labor framework. Lucas and Rapping (1969) pioneered the intertemporal substitution of labor theory which paved the way to conduct many studies on labor supply. In their work, they introduced a concept that demonstrated that labor supply decision is

subjected to the relative value of curent versus future wages, anticipating changes in prices and wages. They also showed that the transition of short term labor supply elasticity to long term elasticity as the change of expectated prices and wages stabilize. McCurdy (1981) focused on building a life cycle model to estimate the intertemporal substitution of labor supply. He acknowledged that the labor supply decision is dependent upon current wages and anticipated future wages, much akin to the findings of Lucas and Rapping (1969) and McCurdy (1981) who examined the labor supply by characterizing it as divisible. However, in some papers, the labor supply is also characterised as indivisible, such as Diamond and Mirrlees (1978), Hansen (1985), Rogerson (1988), and Christiano and Eichenbaum (1992).

A good proportion of literature on the labor supply responses to the interest rate changes, challened through monetary policy shocks, employs different New Keynesian frameworks as the theoretical basis for anlysis. These frameworks assist the studies to construct their theory which eventually provides the groundwork to produce econometric estimates. Cantore et al. (2022) used Two Agent New Keynesian (TANK) theory to study the effects of interest rate on labor supply of USA and UK households. Basu et al. (2001) also used a New Keynesian theory with representative agent and two period framework to explore the responsiveness of labor supply to interest rate risks. White (2018) applied New Keynesian Search and Matching model to study the effects of monetary policy shocks on the labor market dynamics. The model was solved using second order approximation to capture both the welfare effects and nonlinearity associated with these shocks in labor market. Other studies such as Amberg et al. (2022), Acharya et al. (2023), Gerke et al. (2024), Junicke et al. (2024) and Ma (2020) used Heterogeneous Agent New Keynesian (HANK) models to simulate the interest rate shocks on labor markets. On the other hand, labor supply responsiveness is measured by methods other than the New Keynesian frameworks. Graves et al.

(2023) disintegrated the labor market flows and stock into three distinctive categories, employment, unemployment and non participation. In order to conduct this study, they first described the labor market flow data and its relationship with aggregate variables like unemployment and employment. The paper subsequently focused on labor supply driven labor market flows and its components.

Most of these studies performed their analysis using granular administrative microdata (Altonji ,1986; Cantore et al. ,2022; Graves et al.,2023; Junicke et al.,2024; White, 2018). On the other hand, a few studies such as, Basu et al. (2001), Dutkowsky and Dunsky (1996) and Lucas and Rapping (1969) used aggregate data. The extensive usage of Panel Study of Income Dynamics (PSID) and Current Population Survey (CPS) datasets of the USA can be observed in the studies that used microdata in their research. The rise of usage of time series analysis and granular level microdata can be traced to the increasing focus on using HANK frameworks in their theories. These studies are interested in examining the heterogeneous impacts of monetary policies on the labor market dynamics. Microdata usage enables these studies to assess this intended effect since these datasets offer a high level of granular information. Therefore, it paves the way to establish a study where heterogeneity of population can be addressed. Furthermore, these studies employed a variety of econometric methods to answer their research questions. The literature on labor supply decisions also demonstrated concerns over potential endogeneity problem and opted for different approaches to address this problem. Lucas and Rapping (1969) used Two-Stage Least Squares (2SLS) in his work to estimate the responsiveness of labor supply. The paper instrumented variables of population demography and labor quality to help identify the labor supply. Their findings indicate that interest rate and labor supply are positively associated. McCurdy (1981) constructed a two stage empirical approach, where the first stage estimated the labor supply

function with marginal utility of wealth constant demand function for consumption and leisure, and the second stage computed the individual specific component of labor supply as a function of initial assets, lifetime wages, and other demographic factors. Altonji (1986), like Lucas and Rapping (1969), employed instrumental variable approach to estimate the intertemporal substitution of labor supply to address the potential endogeneity, where he used instrumental variables including lagged values of wages and other demographic variables, such as age, education and household characteristics. Interestingly, Dutkowsky and Dunsky (1996), who contributed to this field of effects of the interest rate on intertemporal labor supply decisions by adapting asset's rate of return as a proxy for interest rate, addressed the potential endogeneity problem by applying a three-equation Euler system to estimate the structural parameters using Generalised Method of Moments (GMM). As a set of instrumental variables, the study used lagged values of consumption, leisure, and money holdings as well as real assets and money returns. They found that rate of return on asset is a statistically significant variable for labor supply in the short run, with an increase of 1.02 percent in labor supply if the asset's rate of return goes up by 1 percentage point. However, some literature reported contradictory findings as well. Apart from the endogeneity problem, the works by Basu et al. (2001) emphasising on interest rate risk effects on labor supply decision, employed a Generalised Autoregressive Conditional Heteroscedasticity (GARCH) to estimate the time-varying interest rate risk and its impacts on labor supply, and concluded that the direction of the movement of labor supply in response to changes in the interest rate risk relies on the intertemporal substitution elasticity value. If the elasticity is greater than 1, an increase in rate of return risk will lead to increase in labor supply.

The recent papers, spanning 2018 to 2024, focused on employing time series methods in their studies, deviating from the previous studies. For instance, Cantore et al. (2022) used Factor

Augmented VAR (FAVAR) for both US and UK to estimate interest rate effects on labor supply, and found households with income on the bottom 20 percentile increased their labor supply during the high interest rate period. This can be understood by the income limitations: according to the theory, poorer households are required to work more hours to maintain their consumption bundle after the interest rate hike. Graves et al. (2023) estimated the response of labor market flows to exogenous variation in monetary policy by using a structural monetary policy VAR with high frequency identification, and found evidence that in times where the interest rates are high, households significantly increase their labor supply. Interestingly, they interpreted this behaviour as an income effect on the labor supply, such as households facing deteriorating economic conditions may increase their level of labor supply to keep up with their consumption. Junicke et al. (2024) applied mixed frequency VAR model, using Czech labor market data. They analysed using this method because their dataset consisted of variables of different frequencies (months, quarters and years). White (2018) used Autoregressive Distributed Lag (ARDL) model to capture the effects of monetary policy on the labor market dynamics, and computed the Impulse Response Functions (IRF) to assess the cumulative shock of monetary policy. Other methodologies include quasi-experimental approach Coglianese et al. (2021), where they estimated the effects of monetary policy shocks on labor markets. Faia et al. (2022) postulated that a decline in the interest rate induces the working population to participate more in the labor market. The reasoning behind this statement is that declined interest rates may encourage more investment, and more labor demand, which eventually causes the wages to rise.

3.2 Literature Review on The Impact of Wealth on Labor Supply

Unlike the studies of labor supply responses to interest rate changes, the literature on the responsiveness of labor supply to wealth changes consist of methodologies that characterize

different forms of wealth. An increase in wealth is proxied by lottery winnings in a number of studies. Imbens et al. (2001) have estimated the effects of wealth effect, through lottery winnings, on labor supply decisions. They used data from a survey of individuals playing and winning lottery from Massachusetts in the mid-1980s. Their findings indicated that positive wealth changes affect the labor supply, where lottery winners reduce the number of hours they work. Their study stated that for every $10,000 dollars in lottery winnings, the number of hours worked in a week decreases by 1. Though the magnitude is modest, the finding remains statistically significant. Picchilo et al. (2018) studied the effects of winning a lottery on the intensive and extensive margins of labor supply of the Dutch population using nationally representative sample data. Their study found that the lottery winning have a significant impact on the intensive margin of labor supply. They also noted that the labor supply decision is subjective to the amount of prize, where bigger winnings leave a more prominent and long term effects. Cesarini et al. (2017) studied the effects of wealth on Swedish household labor supply decision. They used high quality administrative data, consisting of about 2.5 million lottery players and their households. They found that winning lotteries negatively affects labor earnings, as the households reduce their labor supply. The study reported a larger than proportionate decline in the household's labor supply, because the spouses of the lottery winners, irrespective of the gender, also supplies lesser hours. The primary finding is that about 1 percent of the wealth shock, channeled through lottery winnings is spent on lesser hours worked in each of the years in the decade following the win.

In other studies, the wealth variable is represented by the inheritance level of individuals. Eder (2016) studied the effects of inheritance on the retirement decision using data from 10 European countries. The research used longitudinal data ranging from 2004 to 2011 from the datasets of the Survey of Health, Ageing and Retiring in Europe. The study found a relationship between

inheritance and retirement decision, where the amount of the inheritance also influences the retirement decision. It indicated that those who inherited more than €50000 are 6.3 percent more likely to retire early, while those with inheritance less than €50000 are likely 5.9 percent more likely to retire early. Kindermann et al. (2019) studied the mechanism behind inheritance tax and labor supply of the heirs. They prepared a three-period life cycle model which assumes that individuals gain utility from consumption and leisure, and reports disutility from working. The distinctive feature of this study is that it delves into the depth of analysis by employing a dynamic structural life cycle model, which is a simulation-based approach rather than directly using econometric methods. It also characterized wealth by expected(inheritance) and unexpected wealth(lottery). In conclusion, they reported that groups with large inheritance witnesses a more than proportionate decline in labor supply, while the groups with smaller inheritance barely alter their labor supply decision.

Some studies characterized wealth through windfall gain. Georgarakos et al. (2024) analyzed how the labor supply responds to a windfall gain using Consumer Expectations Survey by European Central Bank (ECB). In their research, they applied experimental approach, where they randomly assigned windfall gain effects ranging from €5000 to €10000 to individuals while collecting responses for the survey. This approach assisted the study to measure the impact of wealth shocks on labor supply across different demographic groups. The usage of this unique experimental approach enabled the study to make a significant contribution to the literature of windfall gain impacts on labor supply. The study concluded that windfall gains can reduce the labor supply, subjective to the size of the windfall. They reported that for gains between €25,000 and €100,000, there is a decline of 3 percentage points of likelihood of working. Additionally, households reduce their working hours by 1 hour for windfall gains over €50,000. Sila and Sousa (2014) investigated

how windfall gains affect the labor supply in European countries, akin to Eder (2016). They used European Community Household Panel Longitudinal Users' Database to perform their research. In their findings, the study postulated that an increase in the windfall gains is likely to cause individuals to decrease the number of working hours by 3.3 percent. They also reported that the magnitude of the windfall also matters, when making decisions regarding labor supply. When the windfall is less than €10,000, which is categorized as 'Small', the households are likely to decrease their labor supply by 13.2 percent, while if the windfall is greater than €50,000, they are likely to reduce their labor supply by more than 55 percent.

Additionally, other research reported wealth changes through the lens of financial wealth shocks. Botazzi et al. (2021) studied how labor supply responds to financial wealth shocks using Italian data during the 2007-2008 crisis. They used Survey of Household Income and Wealth from 2004-2010, comprising about 7000 observations. In their study, they found that a loss of €1000 in financial wealth leads to an increase of 2.4-3.1 annual working hours. This decline is relatively strong among individuals near retirement age. Daminato and Pistaferri (2020) investigated the how changes in asset prices and wages impact the consumption and labor supply of household with two earners. They incorporated housing, consumption and labor decisions in a life cycle framework. Using Panel Study of Income Distribution (PSID) from 1998-2014, they deployed GMM and estimated parameters to capture Frisch Elasticity of Consumption with respect to asset price and wage changes. Their study postulated that negative housing shock has adverse impacts on consumption but can possibly increase labor supply to act as a catalyst for losses, and risky asset shocks, for instance stock market downturns, can cause the household to increase labor supply for primary earners. Additionally, younger households are more vulnerable to housing shocks, while older households are relatively more immune from such vulnerability.

Lastly, there are papers that use cross sectional analysis to estimate the change in labor supply of households with heterogeneous wealth levels. Ferrero and Valaitis (2022) explored the impact of wealth on hours worked using cross sectional microdata from the USA. They argued that wealthier households emphasize much more on the quality of consumption rather than the quantity. Wealthier households posit a marginal utility of consumption that exhibits positive relationship with quality; therefore, they may choose to work more hours to afford an expensive, high quality consumption basket. To quantify the model, the study postulated a calibration and provided results that matched the argument. The work of Mustr-del-Rio (2015) deviates from the traditional understanding of heterogeneous models' predicted outcome that employment falls with increase in wealth. He presented an incompelete market models with indivisible labor supply where households differ in their labor disutility and market skills. The model shows that the relationship between labor supply and wealth relies on the skillset of individuals, where high skilled individuals do not decrease labor supply with increase in wealth. It also suggests that in order to capture the labor supply decisions of the poor households, it is crucial to factor in the asset based, means testing in the model.

Based on the literature reviewed, it can be stated that the existing studies postulated evidence that mostly bolsters the narrative that wealth and labor supply are negatively related. The existing studies dedicated much of their focus on representing the wealth effect through events like winning lottery, inheritance receipt and financial asset (negative) shocks, and actively used microdata of different surveys.

3.3 Literature Gap

The literature on the impact of interest rate and wealth on labor supply has produced credible evidence with robust methodological support. The research literature underscored the importance of these studies, which exhibit various macroeconomic policy implications. However, it is important to note that the present academic literature focused heavily on using granular level microdata to conduct these analyses. There seems to be no recent study that uses aggregate variables to answer these questions. The last study that used aggregate variables is Basu et al. (2001), which focuses on interest rate volatility and labor supply. Given the changes in global economic conditions since then, it is crucial that there is a need for more studies that use aggregate variables to address these questions and exhibit a better understanding of macroeconomic shifts of labor supply dynamics. Furthermore, the current literature focuses on using data from advanced economies but surprisingly does not have any cross-country analysis of this phenomenon. Different economies may exhibit distinct responses to changes in macroeconomic policies and conditions. In this regard, there is a genuine need for studies that fills this gap.

Chapter Four: Methodology and Data

4.0 Introduction

This chapter discusses the methodology, and the dataset used in this study. This study uses an intertemporal substitution of labor model as the theoretical framework. The model builds on the theory that focuses on explaining the mechanism behind the impact of interest rate and wealth on the labor supply decisions. Lastly, this chapter concludes with a discussion on the utilized model specification and methodological framework.

4.1 Theoretical Framework

The theoretical framework for the study is based on the Representative Agent New Keynesian (RANK) model and closely follows the model of Kindermann et al. (2020). The advantage of RANK model is its usage of the micro-foundation to generate macroeconomic relationships, where the model assumes that households are homogeneous. While Kindermann et al. (2020) focused on basing their theoretical framework on the impact of interest rate and wealth on labor income, this paper centers on examining the impact of the interest rates and wealth on labor supply.

The theoretical framework is based on the following assumptions.

1) The household is rational and utility maximizer.
2) The household lives for two periods.
3) The household is assumed to be risk averse.
4) The household's total allocated time is divided between work and leisure activities.
5) The household is endowed with inheritance (bequest) in the first period and lumpsum transfer of wealth acquired through means like lottery winnings or windfall gains.

The household lifetime utility function is

$$U = \frac{C_1^{1-\gamma}}{1-\gamma} - \frac{l_1^{1+\alpha}}{1+\alpha} + \beta\left(\frac{C_2^{1-\gamma}}{1-\gamma} - \frac{l_2^{1+\alpha}}{1+\alpha}\right) \quad (1)$$

Equation (1) is the household lifetime utitlity function, where C_1 is the consumption in period 1 and C_2 is the consumption in period 2. The household gains utility from consumption of goods and services, while it accumulates disutility from working. The time discount factor is denoted by β and l_1 is the time spent on working in period 1, and l_2 is the time spent on working in period 2. γ and α represents risk aversion factor and Frisch elasticity (response of labor supply with respect to wages) respectively. Since the household is risk averse, the γ is strictly positive ($\gamma > 0$) and the Frisch elasticity is positive ($\alpha > 0$) as well.

The budget constraint of the household is given as

$$C_1 + \frac{C_2}{1+r} = (1-\tau)\left(w_1 l_1 + \frac{w_2 l_2}{1+r}\right) + (1-\tau_b)b + T_1 + \frac{T_2}{1+r} \quad (2)$$

Equation (2) is the budget constraint of the household. In this equation, w_1 represents the wage rate in period 1, and w_2 represents the wage rate in period 2. Interest rate is represented by r. τ is the tax on labor income and τ_b is the tax on bequest or inheritance. T_1 and T_2 is used to denote lump sum transfers in period 1 and period 2 respectively. The equation shows that the total net present value of lifetime income is equivalent to the total net present value of lifetime consumption expenditure. The household therefore consumes its entire labor income and wealth generated throughout the lifetime.

The household will attempt to maximize its life time utlity(equation 1) subjected to its constraint (equation 2).

$$\underset{c_1,c_2,l_1,l_2}{\text{Maximize}}\ \text{U} = \frac{C_1^{1-\gamma}}{1-\gamma} - \frac{l_1^{1+\alpha}}{1+\alpha} + \beta\left(\frac{C_2^{1-\gamma}}{1-\gamma} - \frac{l_2^{1+\alpha}}{1+\alpha}\right)$$

Subject to $C_1 + \frac{C_2}{1+r} = (1-\tau)\left(w_1 l_1 + \frac{w_2 l_2}{1+r}\right) + (1-\tau_b)b + T_1 + \frac{T_2}{1+r}$

Using equation (1) and equation (2), the Lagrangian can be set as follows:

$$\mathcal{L} = \frac{C_1^{1-\gamma}}{1-\gamma} - \frac{l_1^{1+\alpha}}{1+\alpha} + \beta\left(\frac{C_2^{1-\gamma}}{1-\gamma} - \frac{l_2^{1+\alpha}}{1+\alpha}\right) + \lambda\left[(1-\tau)\left(w_1 l_1 + \frac{w_2 l_2}{1+r}\right) + (1-\tau_b)b + T_1 + \frac{T_2}{1+r} - C_1 - \frac{C_2}{1+r}\right] \quad (3)$$

Therefore, the choice variables for the household are C_1, C_2, l_1, l_2. From the first order conditions, the following equations can be derived:

$$C_2 = C_1[\beta(1+r)]^{\frac{1}{\gamma}} \quad (4)$$

$$l_2 = l_1\left(\frac{w_2}{w_1}\right)^{\frac{1}{\alpha}}[\beta(1+r)]^{-\frac{1}{\alpha}} \quad (5)$$

$$C_1 = [(1-\tau)w_1]^{\frac{1}{\gamma}} l_1^{-\frac{\alpha}{\gamma}} \quad (6)$$

Equations (4) and (5) show the intertemporal relationship between consumption in period 1 and consumption in period 2, and intertemporal relationship between labor hours in period 1 and labor hours in period 2 respectively. Equation (6) shows the intratemporal relationship between consumption and labor hours.

From equation (5),

$$\frac{l_1}{l_2} = \left(\frac{\beta w_1(1+r)}{w_2}\right)^{1/\alpha} \quad (7)$$

Equation (7) shows that a rise in interest rate will lead to a relatively higher labor supply in period 1 than labor supply in period 2. Therefore, from the theory, it can be deduced that interest rate changes cause an immediate impact on the labor supply.

Substituting the intertemporal conditions into the budget constraint leads to:

$$C_1\left[1+\beta^{\frac{1}{\gamma}}(1+r)^{\left(\frac{1}{\gamma}-1\right)}\right]=(1-\tau)w_1l_1\left[1+\left(\frac{w_2}{w_1}\right)^{1+\left(\frac{1}{\alpha}\right)}\beta^{-\frac{1}{\alpha}}(1+r)^{-1-\left(\frac{1}{\alpha}\right)}\right]+(1-\tau_b)b+T_1+\frac{T_2}{1+r} \quad (8)$$

Let wealth be denoted as $R=(1-\tau_b)b+T_1+\frac{T_2}{1+r}$.

$$C_1\left[1+\beta^{\frac{1}{\gamma}}(1+r)^{\left(\frac{1}{\gamma}-1\right)}\right]=(1-\tau)w_1l_1\left[1+\left(\frac{w_2}{w_1}\right)^{1+\left(\frac{1}{\alpha}\right)}\beta^{-\frac{1}{\alpha}}(1+r)^{-1-\left(\frac{1}{\alpha}\right)}\right]+R \quad (9)$$

Let $Y_c=1+\beta^{\frac{1}{\gamma}}(1+r)^{\left(\frac{1}{\gamma}-1\right)}$ and $Y_l=1+\left(\frac{w_2}{w_1}\right)^{1+\left(\frac{1}{\alpha}\right)}\beta^{-\frac{1}{\alpha}}(1+r)^{-1-\left(\frac{1}{\alpha}\right)}$

$$Y_l(1-\tau)w_1l_1-Y_c[(1-\tau)w_1]^{\frac{1}{\gamma}}l_1^{-\frac{\alpha}{\gamma}}+R=0 \quad (10)$$

Equation (10) shows that the simplified form of the equation (9), where the intertemporal conditions are substituted in the budget constraints.

Total differential of (10) leads to

$$\frac{\alpha}{\gamma}Y_c[(1-\tau)w_1]^{1/\gamma}l_1^{-\frac{\alpha}{\gamma}-1}dl_1+Y_l(1-\tau)w_1dl_1+dR=0 \quad (11)$$

$$\left[\frac{\alpha}{\gamma}Y_c[(1-\tau)w_1]^{\frac{1}{\gamma}}l_1^{-\frac{\alpha}{\gamma}-1}+Y_l(1-\tau)w_1\right]dl_1+dR=0$$

$$\frac{dl_1}{dR}=-\frac{1}{Y_l(1-\tau)w_1+\frac{\alpha}{\gamma}Y_c[(1-\tau)w_1]^{\frac{1}{\gamma}}l_1^{-\frac{\alpha}{\gamma}-1}}$$

$$\frac{dl_1}{dR}=-\frac{l_1}{Y_l(1-\tau)w_1l_1+\frac{\alpha}{\gamma}Y_c[(1-\tau)w_1]^{\frac{1}{\gamma}}l_1^{-\frac{\alpha}{\gamma}}}$$

$$= -\frac{1}{Y_l(1-\tau)w_1 + \frac{\alpha}{\gamma}Y_c[(1-\tau)w_1]^{\frac{1}{\gamma}}l_1^{-\frac{\alpha}{\gamma}}}$$

$$= -\frac{1}{Y_l(1-\tau)w_1 + \frac{\alpha}{\gamma}[Y_l(1-\tau)w_1 l_1 + R]}$$

$$\frac{dl_1}{dR} = -\frac{1}{Y_l(1-\tau)w_1\left(1+\frac{\alpha}{\gamma}\right) + \frac{\alpha}{\gamma}\frac{R}{l_1}} < 0 \qquad (12)$$

Equation (12) illustrates that there is an intra-temporal and negative relationship between wealth and labor supply.

The theoretical framework suggests that there is a positive relationship between interest rate and wealth, while implying a negative relationship between wealth and labor supply. These outcomes are aligned with the findings of the literature reviewed in the preceding chapter.

4.2 Model Specification

The theoretical framework discussed above indicates that labor supply is determined by interest rate and wealth. So, the dependent variable is the labor supply, and the regressors include interest rate and wealth. There can be other factors that may influence the labor supply, and needs be accounted for. For this reason, the model will also include exogeneous variables such as wage rate and inflation. So, the empirical model is

$$LS_{i,t} = \beta_0 + \beta_1 IR_{i,t} + \beta_2 W_{i,t} + \beta_3 Wage_{i,t} + \beta_4 \pi_{i,t} + \varepsilon_{i_{,t}}$$

The model above illustrates the relationship between labor supply and its regressors within a panel data framework. $LS_{i,t}$ represents labor supply of country *i* at time *t*, $IR_{i,t}$ is the interest rate of

country i at time t, $W_{i,t}$ is the wealth per adult of country i at time t, $\pi_{i,t}$ is the inflation rate of country i at time t,$Wage_{i,t}$ is the wage of country i at time t, and $\varepsilon_{i,t}$ is the error term of country i at time t.

4.3 Data Source and Description

This estimation is based on the annual macroeconomic variables for G7 countries from 1971 to 2020. These variables are labor hours worked, private wealth per adult, short term interest rate, wage rate, and inflation rate. The table below shows the description and source of these macroeconomic variables.

Table 4.1: List of Variable Names, Data Description and Data Source

Variable Name	Data Description	Data Source
Labor Supply	Proxied by average number of hours worked annually	OECD Database
Private Wealth Per Adult	Financial asset as a proportion of net wealth per adult	World Inequality Database
Interest Rate	Annual short term and long-term interest rate	Jorda et al. (2018)
Wage	Wage Index, Base 1990	Jorda et al. (2018)
Inflation Rate	Annual inflation rate; measured by Consumer Price Index	World Development Indicator

4.4 Methodological Framework

As mentioned in the previous section, the study is using a dataset within the panel data specification. The direction to the accurate method is subjected to examining the variables using certain tests. Panel unit root test is used to test the stationarity of the variables which allows the model to avoid spurious outcomes. Levin et al. (2002) proposed a panel unit root test, also known as Levin-Lee-Chin (LLC) panel unit root test. This test is based on the theoretical framework, where it allows individuals-specific intercepts and time-specific trend, along with heterogeneity in error variances and autocorrelation across the individual cross sections. This test can perform individual Augmented Dickey Fuller (ADF) test, estimate the ratio of long run to short run variances for each individual, and compute t-statistics across individuals with adjusted heterogeneity. This stationarity testing method is suitable for the study because of certain factors. Firstly, the study comprises of 50 year time period with 7 country, making it have 7 cross sections over 50 time series dimensions. Levin et al. (2002) classifies dataset of such magnitude as panels of moderate size, and the LLC test is designed for such panel structure. Traditional multivariate time series and panel data procedures may not be feasible computationally or provide reliable evidence for such dataset (Levin et al, 2002). Secondly, LLC is encouraged to use for dataset with similar cross sectional feature. In this case, the G7 countries are classified as industrial economies with similar institutional infrastructure. This makes LLC a good fit for the panel unit root test.

The results of this test will navigate the pathway to the rest of the methodology. If the variables are found to be stationary at level which is I(0), then the study will proceed towards running fixed effect or random effect model, depending on the Hausman test result.

However, if the variables are found to have unit roots (non-stationary), then the study will proceed to run the LLC unit root test on first difference of the variables. To test LLC unit root test of

interest rate, wealth and labor supply, an Augmented Dickey Fuller (ADF) type model for each of the variables for each country is considered:

$$\Delta Y_{i,t} = \alpha_i + \rho Y_{i,t-1} + \sum_{j=1}^{k} \delta_j \Delta Y_{i,t-j} + \varepsilon_{i,t} \quad (14)$$

Where, $\Delta Y_{i,t}$ is the first difference of the series, $Y_{i,t-1}$ is lagged level of the variable, α_i captures the country specific fixed effect, ρ is the common autoregressive coefficient to test for unit root, $\sum_{j=1}^{\rho} \delta_j \Delta Y_{i,t-j}$ is the lags of first difference to account for autocorrelation and $\varepsilon_{i,t}$ signifies the error term.

The modelling is based on the following hypothesis:

$$H_0: \rho = 0 \ (Non\ Stationary)$$

$$H_1: \rho < 0 \ (Stationary)$$

The result of this hypothesis determines the outcome of stationarity test. If the null hypothesis is rejected, then the variables are stationary. If the null hypothesis cannot be rejected, then the variables are expected to be non-stationary.

It is essential to run a panel cointegration test once the panel unit root test on first difference variable is conducted (Baltagi and Kao, 2001). The panel cointegration test that the study will employ is the Pedroni Cointegration test. It is suitable for this study because that method ensures that heterogeneity in both cointegration relationships and short-term dynamics across G7 countries (Pedroni (1999) and Pedroni (2004). Additionally, Pedroni Cointegration test allows the cointegration of multiple regressors which is highly pertinent to this study, since this is a study of the impact of multiple factors. Also, this test ensures individual-specific intercepts (fixed effect) and deterministic time trends, which assists to control for country specific effects and differing

growth paths or structural trend in the labor supply. Furthermore, Pedroni Cointegration test strengthens statistical power by enhancing the cross-sectional dimension of the data, successfully pooling information across multiple countries. By combining data from several countries within panel frameworks, Pedroni's method increases the sample size, and provides more accurate and reliable results, detecting long run relationships. All these reasons mark the Pedroni Cointegration test as the most suitable panel cointegration test for the study. The study proposes including dummy variable into the model to account for the exogeneous shocks, like the oil price crisis of the 1970s and global financial crisis of 2008, leading to potential structural breaks

Consider the cointegrating equation

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{K} \beta_{k,i} X_{k,i,t} + \Phi_1 D_{i,t} + \Phi_2 (D_{i,t} * B_{k,t}) + \mu_{i,t} \quad (15)$$

And the residual dynamics:

$$\mu_{it} = \gamma_i \mu_{it-1} + \varepsilon_{i,t} \quad (16)$$

The hypothesis can be constructed as follows

$$H_0: \gamma_i = 1 \text{ (cointegration does not exist)}$$

$$H_1: \gamma_i < 1 \text{ (cointegration exist)}$$

Finally, once the result of the panel cointegration test is determined, the study will determine its pathway considering both the decision of the panel unit root test and the panel cointegration test. If the variables are found to be stationary at I(1) and not cointegrated, the study will proceed towards the Panel Vector Autoregressive (Panel VAR). On the other hand, if the study finds that

the variables are stationary at I(1) and cointegrated, then it will use the Panel Vector Error Correction Model (Panel VECM).

The Panel VAR model comes with its own set of advantages that is relevant to this study. Firstly, Holtz-Eakin et al. (1988) indicates that panel VAR models are designed to capture dynamic interaction among several endogenous variables over time, within each cross-sectional unit. They also claim that this model can minimize unobserved heterogeneity, for instance, structural differences of the G7 economies through the avenue of utilizing fixed effect transformations. Additionally, this model provides the impulse response functions estimations, which are fundamental for the comprehension of mechanism behind the shocks to interest rates or wealth that can affect the labor supply over time. This is imperative to fathom the causal transmission in the macroeconomic settings.

Consider the

$$L_{i,t} = \alpha_1 + \sum_{p=1}^{P} \beta_{11,p} L_{i,t-p} + \sum_{p=1}^{P} \beta_{12,p} R_{i,t-p} + \sum_{p=1}^{P} \beta_{13,p} W_{i,t-p} + \sum_{p=1}^{P} B_{14,p} X_{i,t-p} + \varepsilon_{1,i,t} \quad (17)$$

$$R_{i,t} = \alpha_2 + \sum_{p=1}^{P} \beta_{21,p} L_{i,t-p} + \sum_{p=1}^{P} \beta_{22,p} R_{i,t-p} + \sum_{p=1}^{P} \beta_{23,p} W_{i,t-p} + \sum_{p=1}^{P} B_{24,p} X_{i,t-p} + \varepsilon_{2,i,t} \quad (18)$$

$$W_{i,t} = \alpha_3 + \sum_{p=1}^{P} \beta_{31,p} L_{i,t-p} + \sum_{p=1}^{P} \beta_{32,p} R_{i,t-p} + \sum_{p=1}^{P} \beta_{33,p} W_{i,t-p} + \sum_{p=1}^{P} B_{34,p} X_{i,t-p} + \varepsilon_{3,i,t} \quad (19)$$

$$X_{i,t} = \alpha_4 + \sum_{p=1}^{P} \beta_{41,p} L_{i,t-p} + \sum_{p=1}^{P} \beta_{42,p} R_{i,t-p} + \sum_{p=1}^{P} \beta_{43,p} W_{i,t-p} + \sum_{p=1}^{P} B_{44,p} X_{i,t-p} + \varepsilon_{4,i,t} \quad (20)$$

Here, P is the number of lags and $\varepsilon_{n,i,t}$ represents error terms, and β captures the dynamic dependencies among these variables.

On the contrary, if the results of panel unit root test find the variables stationary at I(1), and cointegrated, it is advised to proceed towards using Panel VECM in the study (Baltagi and Kao, 2001, Breitung and Pesaran, 2008). They also suggest that panel VECM helps to identify how deviations from the equlibrium actually affects the short term dynamics, and effectively captures these short term dynamics while incorporating long term equilibrium using the error correction term., Although G7 economies share some common economic features, they still exhibit differences in labor market structures, monetary policies, and wealth distribution. Panel VECM is capable of modelling country specific short run responses, while still estimating long-run relationship acroos the G7 countries. Therefore, panel VECM can be a very valid method to estimate the impact of interest rates and wealth on the labor supply of the G7 countries.

The Panel VECM can be formulated as follows:

$$\Delta L_{i,t} = \emptyset_1(\mu_{i,t-1}) + \theta_{11}\Delta R_{i,t-1} + \theta_{12}\Delta W_{i,t-1} + \vartheta_{1,p}\Delta L_{i,t-1} + \alpha_i + \epsilon_{i,t} \quad (21)$$

In this model, $\Delta L_{i,t}$ is the change in labor supply between two consecutive periods, $\emptyset_1(\mu_{i,t-1})$ is the lagged residual from cointegrating equation where $\emptyset_1$ is the adjustment coefficient for labor supply. θ_{11} and θ_{12} represents short term effects of changes in interest rate and wealth on labor supply. $\Delta L_{i,t-1}$ denotes the short term lagged variable of the labor supply and $\vartheta_{1,p}$ is the coefficient capturing the autoregressive dynamics of labor supply. α_i is the country specific fixed effect and $\epsilon_{i,t}$ is the error term.

4.5 Structural Break Test

From the findings of the historical overview of the G7 economies, the study assumes these countries have faced several economic shocks. These shocks can create structural breaks in the model, which can cause biased estimates. Therefore, it is important that the analysis be made to control these breaks, and eventually produce robust estimates. For this reason, the study uses structural break tests of Ditzen et al. (2021) to control for the structural breaks. Similar studies concerning labor market dynamics like Guliyev and Tatoğlu (2025), and Cruz (2023) applied this structural break test in their research. Furthermore, it is suitable test for this study because of its ability to produce estimates under the assumption of multiple structural breaks, which possibly exist in the model due to multiple economic shocks that took place in these countries during this period. Also, the test is also robust to cross sectional dependence (CSD) in the panel. It is crucial for this study because the G7 economies can possibly exhibit interdependence on one another due to their common economic policies.

Ditzen et al. (2021) presents a general model for panel data with structural breaks as follows:

$$y_{\{i,t\}} = x'_{\{i,t\}}\beta + w'_{\{i,t\}}\gamma_j + e_{\{i,t\}} \quad (22)$$

For $t = T_{\{j-1\}}, \ldots, T_j$ and j = 1, ..., s+1, with $T_0=0$ and $T_{s+1}=T$. So, it can be stated that there are s breaks with s+1 regimes, with regime j consists of observations from T_{j-1}, ….,T_j. Also, the equation (22) can be written regime wise as

$$\begin{aligned} y_{\{i,t\}} &= x'_{\{i,t\}}\beta + w'_{\{i,t\}}\delta_1 + e_{\{i,t\}} && for\ t = T_0, \ldots, T_1, \\ y_{\{i,t\}} &= x'_{\{i,t\}}\beta + w'_{\{i,t\}}\delta_2 + e_{\{i,t\}} && for\ t = T_1, \ldots, T_2, \\ y_{\{i,t\}} &= x'_{\{i,t\}}\beta + w'_{\{i,t\}}\delta_{s+1} + e_{\{i,t\}} && for\ t = T_s, \ldots, T_s. \end{aligned} \quad (23)$$

Here, $y_{\{i,t\}}$ is the regressor, and the regression error $e_{\{i,t\}}$ are scalars, while $x_{i,t}$ and $w_{i,t}$ are p x 1, and q x 1 vectors of the regressors respectively. It is possible the break dates are identical across all the units.

Suppose $T_s = T_1, \ldots, T_s$ be a collection of s break dates such that $T_j = |\lambda_j T|$, where $\lambda_0 = 0 < \lambda_1 < \cdots < \lambda_s < \lambda_{s+1} = 1$. Ditzen et al. (2021) successfully distinguishes the breaks from one another by specifying the breaks in this way, which is vital for computing separate regimes. Furthermore, they use three different tests to compute multiple structural breaks in the model. The first test examines whether there is at least one break in the model. If found, the second test evaluates whether there are multiple breaks in the model, also known as the sequential test. Lastly, the final approximate break date(s) is computed to create regimes accordingly. Once the regimes are identified and estimated, models are run to produce the outcomes of these events and interpreted accordingly.

4.6 Diagnostic Test

The study will employ several tests to ensure the robustness of the results. It is crucial that the tests detect autocorrelation, heteroscedasticity, cross sectional dependence, and model specification, ensure stability of the models. To ensure that the assumptions of homoscedasticity, autocorrelation, and cross-sectional dependence are met, the models will be implemented using Driscoll-Kraay standard errors. It is a robust way to estimate standard errors when the data is in panel data specification. In case of model specification, Hausman test will be used to ensure that the optimal model is used.

Chapter Five: Estimation and Discussion of Results

5.0 Introduction

The chapter commences with a discussion on descriptive statistics of the variables used. These variables are the average number of hours worked annually, short-run interest rate, long-run interest rate, financial asset as a percentage of private net wealth per adult, wage index, and inflation rate. The section is followed by a section where the LLC unit root test is used to examine the stationarity of these variables. After that, the succeeding section contains the Hausman test and its results. Then, structural breaks of Ditzen at al. (2021) are conducted for detecting and controlling the structural breaks of the model. Lastly, the regression output and discussion are presented, followed by the concluding section of model diagnostic tests to ensure the stability of these results.

5.1 Descriptive Statistics

This section contains the descriptive statistics of the variables used. The average number of hours worked annually in the G7 countries between 1971 and 2020 is 1741 hours, with a standard deviation of 175.6 hours and a maximum of 2239 hours and 1315.9 hours. The maximum hour comes from the early 1970s, while the minimum hour is from the late 2010s.

For short-term and long-term interest rates, the average of these G7 countries stands at 5.29 percent and 6.39 percent, respectively. The maximum short-term interest is 19.703 percent from Italy in 1981, while the minimum short-term interest rate is -0.636 percent from France in 2017. On the other hand, the maximum long-term interest rate is 20.215 percent from Italy in 1982, and the minimum of -0.511 percent is from Germany in 2020, due to countercyclical monetary policies.

For the financial asset as a percentage of private net wealth per adult, the mean is 53.84 percent of the total net private wealth. This means that 53.84 percent of the net private wealth is comprised of highly liquid assets.

Lastly, the control variables—the wage index and inflation rate of the G7 countries from 1971 to 2020—registered an average of 53.836 and 4.07 percent, respectively. The maximum value of wage index of 268.804 was recorded in UK in 2020, and the minimum of 6.652 was recorded in Italy in 1971. On the other hand, the maximum inflation rate of 24.21 percent is from the UK in 1975, and the lowest inflation rate of -1.353 percent is from Japan in 2009.

Table 5.1: Descriptive Statistics Summary

Variable Name	Mean	Standard Deviation	Maximum	Minimum
Average Number of Hours Worked Annually	1741.083	175.572	2239	1315.9
Short-Term Interest Rate	5.288	4.492	19.703	-0.636
Long-Term Interest Rate	6.384	3.973	20.215	-0.511

Financial Asset per Adult as Percentage of Private Net Wealth per Adult	53.836	13.541	77.541	29.676
Wage Index	117.278	60.275	268.804	6.652
Inflation Rate	4.068	4.308	24.207	-1.353

Computed using STATA 17

5.2 LLC Unit Root Test

This section presents the result of the LLC unit root test. This test is crucial for this study, as it is the first stage of testing that navigates the rest of the study. The null hypothesis of this test assumes there are unit roots of the variable tested. A rejection of this null hypothesis means that the variable tested is stationary.

Table 5.2 shows the variables that are tested at I(0). The test results indicate that the average number of hours worked annually, short-run interest rate, long-run interest rate, financial assets as a percentage of private net wealth per adult, wage index, and inflation rate are all stationary at level (I(0)) at significant levels of 1 percent, 5 percent, and 10 percent.

Since all variables are stationary at I(0), the study proceeds to use OLS with fixed effects or random effects, contingent on the results of the Hausman test.

Table 5.2: LLC Unit Root Test Results

Variable Name	t Statistics	Order of Integration
Average Number of Hours Worked Annually	-1.3987*	I(0)
Short-Term Interest Rate	-4.3712***	I(0)
Long-Term Interest Rate	-2.1415**	I(0)
Financial Asset as Percentage of Private Net Wealth per Adult	-2.6353***	I(0)
Ln(Wage Index)	-4.7854 ***	I(0)
Inflation Rate	-2.8142***	I(0)

Source: Computed with Stata 17. ***, **, and * denote the rejection of the null hypothesis (of a unit root) at 1%, 5%, and 10% level of significance respectively.

5.3 Hausman Test Results: Fixed Effects vs Random Effects Models

The tables below display the coefficients, differences, and robust standard errors from Hausman tests comparing fixed effects (FE) and random effects (RE) models. The tests evaluate whether coefficient differences are systematic.

Model 1:

$$Hours\ Worked = f(Financial\ Asset\ per\ Adult\ as\ Percentage\ of\ Net\ Wealth\ per\ Adult, Short\ term\ interest\ rate, Ln(wage\ index), Inflation\ rate\ )$$

Table 5.3: Hausman Test Results for Model 1

Variable	Fixed Effects (fe)	Random Effects (re)	Difference (fe - re)	Std. Error
Financial Asset per Adult as Percentage of Private Net Wealth per Adult	-7.242	-7.178	-0.065	.0744
Short-Term Interest Rate	4.138	4.172	-0.034	0. 119
Ln(Wage Index)	-86.062	-86.132	0.705	0.642
Inflation Rate	-5.827	-5.794	-0.033	0.137

Test of H_0: Difference in coefficients not systematic

chi2(4)=0.75

Prob > chi2 = 0.9453

From the table above, the chi-square of this model is 0.75, with a p-value of 0.9443. It means that the null hypothesis cannot be rejected. Therefore, the study will proceed to employ random effects for this model.

Model 2:

$$Hours\ Worked = f(Financial\ Assets\ as\ a\ Percentage\ of\ Net\ Wealth\ per\ Adult, Long\ term\ interest\ rate, Wage, Inflation\ rate)$$

Table 5.4: Hausman Test Results for Model 2

Variable	Fixed Effects (fe)	Random Effects (re)	Difference	Std. Error
Financial Asset as Percentage of Private Net Wealth per Adult	-6.921	-6.858	-0.063	0.074
Long-Term Interest Rate	7.381	7.411	-0.039	0.140
Ln(Wage Index)	-79.787	-79.835	0.488	0.634
Inflation Rate	-6.513	-6.478	-.0.035	0.126

Test of H_0: Difference in coefficients not systematic

chi2(4)=0.74

Prob > chi2 = 0.9458

From the table above, the chi-square of this model is 0.74, with a p-value of 0.9458. It means that the null hypothesis statement (difference in the coefficient is not systematic) cannot be rejected. Therefore, the study will proceed to employ a random-effects model.

5.4 Structural Breaks Tests

This section provides a discussion on the potential structural breaks within the empirical model used. This is a crucial test because it will enhance the robustness of the study and navigate towards a better understanding of the impact. The study uses multiple breaks tests at unknown break dates by Ditzen et al. (2021), followed by their sequential test for multiple breaks at unknown breakpoints, and lastly includes estimated dates of those breaks provided by this test. The test can detect up to 5 structural breaks in the model. The first test reports whether there are any structural breaks in the model, using the null hypothesis that there are no structural breaks in the model. If at least one structural break is found, the study proceeds towards using the sequential test to verify whether multiple breaks exist and lastly reports the estimated date of those breaks. Ditzen et al. (2021) hint that in case there are multiple breaks, it is justifiable to choose the minimum number of breaks.

5.4.1 Structural Break Test of Model 1

This subsection provides the structural break test results of model 1. The initial test examines whether any structural break exists within the model. If detected, an additional test is conducted to determine the number of breaks and an estimated date of those breaks. Lastly, regimes are created based on the estimated date of the break, and random-effect models are calculated.

Table 5.5: Multiple Structural Breaks and Sequential Test for Multiple Breaks of Model 1

Test	Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Conclusion (5%)
UDmax (No breaks vs ≥1)	34.14	5.10	4.09	3.65	Reject null — breaks exist
Sequential Test F(1|0)	34.44	5.06	4.05	3.56	Reject null—≥1 break
Sequential Test F(2|1)	4.03	5.49	4.53	4.03	Fail to reject break
Sequential Test F(3|2)	7.57	5.70	4.73	4.33	Reject null—≥3 breaks
Sequential Test F(4|3)	6.89	5.76	4.91	4.50	Reject null—≥4 breaks
Sequential Test F(5|4)	6.57	5.94	5.05	4.61	Reject null—≥5 breaks

Computed using STATA 17 command *xtbreak*

Table 5.5 provides the structural break test of model 1. In the first part, it is concluded that there is at least one break in the model. So, the sequential test is conducted to determine the number of breaks. As per the results of the sequential break and the suggestion of Ditzen et al. (2021), there exists only one structural break in the model.

Table 5.6: Estimated Date of the Structural Break

Computed using STATA 17 command *xtbreak*

Break #	Index	Year	95% Confidence Interval
1	20	1990	1989–1991

The table above shows the estimated date of the structural break of model 1. According to the findings, the break of model occurred in 1990. So, random-effect estimation of model 1 will be computed with regimes before 1990 and after 1990.

Table 5.7: Random Effects Estimation Output with Regime Shifts of Model 1

	Dependent Variable: Average of Number of Hours Worked Annually		
	Full Sample	**Regime 1**	**Regime 2**
	1971-2020	**1971-1990**	**1990-2020**
Financial Asset as Percentage of Net Wealth per Adult	-7.178***	-2.283	-2.611***
	(1.056)	(1.399)	(0.860)
Short-Term Interest Rate	4.172*	-1.546	10.464***
	(2.304)	(1.283)	(2.122)
Ln(wage)	-83.131***	-83.267***	-57.733
	(8.373)	(8.020)	(36.13)
Inflation Rate	-5.794**	-0.865	-1.039
	(2.184)	(1.125)	(4.901)
Constant	2523.27***	2298.742***	2087.478***
	(24.02)	(164.301)	(275.499)
N	350	140	210
Within R square	0.1046	0.0601	0.0013

Computed using Driscoll-Krayy standard errors

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.7 shows the random effect output of model 1, computed with Driscoll-Kraay standard errors. In the first column, where the full sample is used, all the variables are statistically significant at 1 percent and 5 percent. Private wealth and short-term interest rates are statistically significant at the 1 percent and 10 percent level of significance respectively. These variables exhibit negative and positive relationships with labor supply. This matches the expected direction as per the theoretical framework. Holding other factors constant, an increase in the financial assets as a percentage of net wealth leads to a decrease in labor supply by 7.178 hours a year, and a 1 percent point increase in the short- term interest rate leads to an increase in the labor supply by 4.172 hours a year. In case of wage, the estimates show that an increase in the wage rate leads to a decrease in the labor supply indicating dominance of the income effect. Similarly, inflation and labor supply share a negative relationship as well.

Column 2 represents regime 1 of the model. Regime 1 covers the period between 1971 and 1990. Although the short-term interest rates is found to be statistically insignificant, the estimates of model 1 of regime 1 put forward the discussion on the dominating income effect of short-term interest rates. Between 1971 and 1990, this period can be marked as a high-interest period due to policies created to counter the repercussions of economic uncertainty, like the oil price shocks of 1973, the collapse of the Bretton Woods system, and stagflation. It shows a domination of the income effect over the substitution effect. In the case of private wealth, the labor supply responds negatively to an increase in the financial assets as a percentage of net private wealth per adult. Also, wages are associated with a negative relationship with labor supply.

Lastly, in the second regime, the random-effect estimations offer insights that are aligned with the theoretical framework. Both the short-term interest rate and financial assets as a proportion of net private wealth are statistically significant and share a positive and negative relationship with labor supply. On the other hand, the wage index and inflation rate are statistically insignificant.

5.4.2 Structural Break Test of Model 2

In this subsection, the structural break testing of model 2 is conducted using the Ditzen et al. (2021) methods. Initially, an analysis is conducted to examine whether any structural breaks exist. After that, if there are any structural breaks, the number of breaks is determined, and the estimated dates of those dates. Lastly, separate regimes are created based on the number of breaks, and fixed-effect estimates with Driscoll-Kraay standard errors are generated.

Table 5.8: Multiple Structural Breaks and Sequential Test for Multiple Breaks of Model 2

Test	Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Conclusion (5%)
UDmax (No breaks vs ≥1)	26.20	5.10	4.09	3.65	Reject null — breaks exist
Sequential Test F(1|0)	26.20	5.06	4.05	3.56	Reject null—≥1 break
Sequential Test F(2|1)	7.40	5.49	4.53	4.03	Reject null breaks
Sequential Test F(3|2)	12.90	5.70	4.73	4.33	Reject null—≥3 breaks
Sequential Test F(4|3)	11.08	5.76	4.91	4.50	Reject null—≥4 breaks
Sequential Test F(5|4)	10.73	5.94	5.05	4.61	Fail to reject breaks

Computed using STATA 17 code *xtbreak*

Table 5.8 shows that there are multiple structural breaks in model 2. The UDmax is based on the null hypothesis that there are no structural breaks in the data. Since the T statistic is 26.20, which is greater than the T statistic at 1 percent critical value, it means that there is sufficient evidence to reject the null hypothesis and conclude that there is at least one structural break in the model. From the sequential test, the study confirms that there are four breaks in the model, since the sequential test of F(5|4) fails to reject the null hypothesis that there are more than 4 breaks in the structure of the model.

Table 5.9: Estimated Break Dates of Model 2

Break #	Index	Year	95% Confidence Interval
1	11	1981	1980 – 1982
2	20	1990	1988 – 1990
3	28	1998	1996 – 1998
4	36	2006	2007 – 2009
5	43	2016	2012 – 2014

Computed using STATA 17 code *xtbreak*

Table 5.9 provides information on the year of the break with a 95 percent confidence interval. The results suggest that the structural breaks occurred in the years of 1981, 1990, 1998, 2006, and 2013.

To control the structural breaks, the study proceeds to use a set of regressions using the full data sets and then break the regression to employ regression based on the regimes of the estimated breaks.

Table 5.10: Random Effects Estimation Output with Regime Shifts of Model 2

	Average Number of Hours Worked Annually						
	Full Sample	**Regime 1**	**Regime 2**	**Regime 3**	**Regime 4**	**Regime 5**	**Regime 6**
	1971-2020	**1971-1981**	**1981-1990**	**1990-1998**	**1998-2006**	**2006-2013**	**2013-2020**
Financial Asset as % of Net Wealth	-6.921***	-1.855	-1.690*	-2.429***	-0.650	1.746	1.772*
	(-7.03)	(-0.69)	(-2.23)	(-6.11)	(-0.85)	(2.28)	(2.65)
Long Term Interest Rate	7.381*	1.543	19.80**	14.30	6.641	-0.300	27.46
	(2.34)	(0.58)	(3.52)	(2.34)	(1.23)	(-0.08)	(1.39)
Ln(Wage)	-79.79***	-107.5***	25.85	203.9*	-213.5*	-191.6***	-88.17
	(-7.84)	(-14.04)	(0.43)	(3.36)	(-2.91)	(-11.11)	(-0.75)
Inflation	-6.513**	-1.890	-2.068	-0.00875	-6.744	9.727**	11.32
	(-2.96)	(-1.56)	(-0.62)	(-0.00)	(-2.05)	(3.83)	(1.15)
Constant	2458.3***	2351.3***	1564.8**	800.1*	2765.6***	2516.4***	1920.2*
	(26.42)	(12.57)	(3.53)	(3.20)	(6.22)	(29.28)	(2.64)
N	350	70	210	56	56	49	56
R square	0.1100	0.0030	0.0097	0.0106	0.0010	0.0731	0.5035

Computed using Driscoll-Kraay Standard Errors

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.10 shows the results of the random effect estimation with regime shifts of Model 2 and is computed using the Driscoll-Kraay standard errors. The output provides some crucial insights about the impacts of long-term interest rates and private wealth on the labor supply of the G7 countries. The first column shows the result of the full sample, where it suggests that labor supply shares a negative relationship with private wealth at a statistically significant level of 1 percent and a positive relationship with long-term interest rate at statistically significant levels of 10 percent. For every 1 percentage point increase in long-term interest rate, holding other factors constant, the labor supply increases by 7.35 hours annually. Similarly, for every 1 percentage point increase in the financial assets as a percentage of net wealth per adult, ceteris paribus, the labor supply decreases by 6.921 hours annually. Also, it informs that wage and inflation rate are associated with a negative relationship with labor supply, at a statistically significant level of 1 percent and 5 percent respectively. For every 1 percentage increase in the wage index, ceteris paribus, the labor supply decreases by 0.79 hours a year, indicating a dominance of the income effect, and for every 1 percentage point increase in the inflation rate, the labor supply decreases by 6.5 hours annually.

The second column provides the result of the model with the first regime timeline of 1971-1981. Although private wealth and long-term interest rate are statistically insignificant in this regime, the variables are exhibiting the expected sign. Furthermore, the wage index and inflation rate are also found to have a negative relationship, with the wage index being the only statistically significant variable.

In regime 2, the model spans the period of 1981-1990. Only long-term interest rate and private wealth are found to be statistically significantly associated with labor supply and exhibit the expected signs as well. Consequently, the estimates from regime 3 indicate that private wealth and wage index are statistically significant. Interestingly, the wage index shares a positive relationship with labor supply in the third regime.

Regime 4 covers the period from 1998 to 2006. The result shows that only wage index is statistically significant in this regime. The result shows that, a 1 percent increase in wage index, ceteris paribus, the labor supply decreases by 2.13 hours annually. In regime 5, which covers the 2006 to 2013 period, wage index and inflation rate are found to be statistically significant. For every 1 percentage increase in wage index, ceteris paribus, the labor supply decreases by 1.916 hours annually, and for every 1 percent point increase in inflation rate, the labor supply increased by 9.7 hours annually.

In the last regime, which spans over 2013 to 2020 period, the estimates suggest that only financial assets as percentage of net wealth have a statistically significant with labor supply. In this period, holding other factors constant, a 1 percentage point increase in the financial assets as a percentage of net wealth per adult, the labor supply increases by 1.772 hours a year.

5.5 Discussion on the Outcome of the Models

From the output of the two models, there are various similarities noticed with the existing literature on labor supply, interest rates, and private wealth. In case of the impact of interest rates on labor supply, the result of this study complements the findings of Dutkowsky and Dunsky (1996), Basu et al. (2001), Cantore et al. (2022), and Graves et al. (2023). All of these studies reported a postive relationship between interest rates and labor supply. On the other hand, the findings of the impact

of the private wealth on labor supply is well alligned with the findings of Eder (2016), Sila and Sousa (2014), Georgarakos et al. (2024), and more specifically, Botazzi et al. (2021).

However, following the comments by White (2018), the study focuses on the magnitude of the increases of labor supply changes due to interest rates. Both the models postulates that the magnitude of the increase is minimal. An increase in the long-term interest rate will cause the individual to work around 7 hours more in a year, while an increase in the short run interest rate will make the individual work for around 4 extra hours in a year. The same comment can be made about the increase in the liquidity of the private wealth. An increase in the liquidity of the private wealth may cause the person to work one less day in a year.

It is important to explore the reason and compare the sizes of the magnitude. This exploration enable the reasoning behind the need of conducting this study. If the prime variables - private wealth and interest rates are noticed, it reveals a fascinating story. A higher concentration of accessible liquid asset can lead the individual to work lesser hours, whereas a higher cost of borrowing or return on savings can make the individual to work more by significantly greater magnitude. More importantly, these estimates represent the G7 economy and their labor market. In 2019, the household debt to income ratio of these G7 economy were extremely high. For instance, Canada had a staggering debt to income ratio of 186.37 percent. France reported 126.05 percent, Germany 92.07 percent, Italy 87.76 percent, Japan 115.49 percent, the UK 149.24 percent, and the USA 105.80 percent (OECD, 2024). Although these countries witnessed a growth of net wealth, the debt to income ratio remained high, much of which stemmed from mortgage payments and credit card payments. Since interest rates are the cost of borrowing, higher costs led the individuals to work more hours to ensure their debt payments. It is also possible that this circumstance has led individuals to take less leisure, even as the proportion of their financial assets

increased. Therefore, the difference in the size of the coefficients can be explained from this perspective.

Similar results are found in model 2, when long term interest rates and financial asset as a proportion of net wealth per adult are used. This reflect the way individuals respond to long term financial planning. Long term interest rate affect the expectation over a broader planning horizon, which allows individuals more rooms for adjustments to their labor supply. This greater degree of flexibility may enable the individuals to lead to more significant changes in annual working hours, particularly in economy where the long term planning is more feasible due to institutional or cultural factors.

Additionally, the outcome of the relationship between wage index and labor supply needs discussion. Interestingly, the estimations reported a negative relationship between wage and labor supply. This means that with an increase in wage rate, the labor supply will decrease. From a theoretical perspective, this movement indicates that the income effect is dominant than the substitution effect when it comes to G7 countries, and the surpassing of the reservation wage threshold of the labor supply curve. Intuitively, individuals from the G7 economies prefer to work lesser hours, and is alligned with the discussion presented of the overview of the labor supply changes, positing a reflection of the proclivity towards more work life balance and leisure. Furthermore, it is not uncommon to report a negative relationship between wage rate and labor supply in the existing literature. The studies of Rosenzweig (1978), Mincer (1962), and Devereux (2004) reported similar findings as well.

5.6 Diagnostic Test of the Models

This section discusses the diagnostic test of the models used in the study. Performing these tests is

essential to verify that the underlying assumptions of the model are satisfied and provide robust and reliable results. So, it is important to ensure that there is no autocorrelation, heteroscedastic standard error, cross-sectional dependence and multicollinearity in the model.

The model used in the study is computed using Driscoll-Kraay standard errors, which ensures that there is no autocorrelation, heteroscedastic standard errors, and cross-sectional dependence in the model (Driscoll and Kraay, 1998). Therefore, the only test that is required to check is for multicollinearity. To test the multicollinearity, Variance Inflation Factor (VIF) test is employed, where if the mean VIF of the model is greater than 10, then there is serious multicollinearity problem in the model.

Table 5.11: VIF Results

Model	**Mean VIF**
Model 1	6.90
Model 2	7.72

Computed using STATA17

Table 5.11 shows the results of the VIF of the two models. The result of this test shows that both the models reported a mean VIF of less than 10. Since the mean VIF of the models is less than 10, there is no serious multicollinearity in the model.

Chapter 6: Summary, Conclusion, Policy Recommendation, and Limitations of the Study

6.0 Introduction

This chapter provides a comprehensive conclusion by addressing the findings and insights from the econometric estimates. It summarizes the results of the models that examined the impact of interest rates and labor supply of the G7 countries from 1971 to 2020. Following this, the chapter offers some policy recommendations based on the findings of the study and a discourse on the limitations of the study.

6.1 Summary and Conclusion

The study examined the impact of interest rates and private wealth on labor supply of the G7 countries from 1971 to 2020. It established a theoretical framework using a two period, RANK model, where the theory dictated that interest rate shares a positive and intertemporal relationship with labor supply, while private wealth shares a negative and intra-temporal relationship with the labor supply. Afterwards, the research performed econometric analysis using a variety of tests and modelling. The methodology included a stationarity check of the variables using LLC unit root test. After finding that the variables are stationary at level (I(0)) at a statistical significance of 1 percent, 5 percent, and 10 percent, the study used the Hausman test to determine whether fixed effect model or random effect model should be used. The Hausman test concluded that random effect is the optimal choice for modelling. Afterwards, the study conducted structural break test on both models, where the test detected structural breaks in the model. So, the models were divided into regimes of structural breaks, and separate random effect estimates were computed

The econometric estimates provided statistically significant evidence to support the theory. Both the models concluded that interest rates and private wealth are associated with positive and negative relationships with labor supply respectively. However, the study found that the magnitude of the impact remains modest, though it is statistically significant. Lastly, the study discusses the possible reasons behind the modest magnitude of the impact of interest rates and private wealth on labor supply.

6.2 Policy Recommendation

The research produced some credible evidence regarding the effects of interest rates and private wealth on labor supply. This section outlines some recommendations for policy makers, based on the findings of the research. Firstly, both short-term and long-term interest rates have the potential to influence labor supply and eventually affect the individuals' decisions to supply more working hours based on borrowing cost, savings incentives and economic conditions. Therefore, policymakers should pay attention to underscore the need for a well-informed approach to monetary policy.

The second policy that is recommended is based on the findings of the impact of private wealth on labor supply, where these two variables exhibit a statistically significant and negative relationship. So, policies such as targeted tax incentives, wealth redistribution measures, or retirement reform can possibly negate the potential reduction in the labor supply. Specifically, the study revealed that the rising liquid assets cause the labor supply to decline, which makes it imperative that policies should be designed and implemented with a focus on addressing this trend. Interestingly, this finding of the study also highlights the need for more immigration. As the G7 countries have already been struggling to cope up with the labor shortages due to changing demography, a

declining labor supply due to rising wealth can create additional adversities. A powerful and robust immigration system can mitigate these problems.

The third policy recommendation is based on the different implications based on the type of interest rate. While both rates are positively associated with labor supply, the impact of long-term interest rate is nearly twice as strong. his is relevant because the interest rates are increased during periods of contractionary monetary policies. These monetary policies are typically implemented when the economy is overheating, due to factors like increased aggregate demand, causing inflation. During this period, the central banks opt for higher interest rates to keep the inflation rate within their inflation target. If they are skeptical about rising labor supply during this period, due to tightening monetary policy, they should resort to short term interest rate since the magnitude of this rate is less severe comparatively.

6.3 Limitations of the Study

This section discusses the limitations of the study. Firstly, this study only comprises of advanced G7 countries. So, the estimates produced can only be represented and used for analysis of the G7 economies. Unfortunately, due to the lack of quality macroeconomic data, the study could not span over a greater number of countries and longer time periods.

Another limitation of this study includes the assumption of economic homogeneity inherent in the RANK theory. While the utilization of two-period RANK model is theoretically acceptable, it does simplify the complex aspects of labor supply decisions, such as demography, or change. Due to the unavailability of disaggregated labor supply data by age group or gender over the study period, these heterogeneous dimensions could not be incorporated into the analysis.

Lastly, the dependent variable measures the average hours worked annually. This variable represents only the realized labor supply and crucially does not include the desired supply— which is any additional working hours the labor force was willing but unable to work. The study could not incorporate this into the empirical model because there is no aggregate data that would proxy this variable. For this reason, the study identifies this as a limitation of the study.

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