1 Introduction

It has been well known for at least the past two decades that the standard neo-classical growth model, notwithstanding its surprising success in explaining many aggregate phenomena, performs poorly when it comes to explaining business cycle fluctuations in the labor market.

The work of Gomme, Rogerson, Rupert, and Wright (henceforth GRRW) builds on the premise that the understanding of labor market fluctuations over the business cycle is enhanced by moving beyond standard representative-agent models. In particular, they propose to analyze models with heterogeneous agents and to study their implications, not only for the aggregate time series, but also for cyclical variation across heterogeneous groups of agents.

\footnote{Department of Economics, 2001 Sheridan Road, Evanston, IL 60208-2600, USA. E-mail: nagypal@northwestern.edu}
There are at least two reasons why this is a promising approach to take. First, the empirical evidence shows that different demographic groups exhibit substantially different labor market fluctuations over the business cycle. Second, the heterogeneous impact of business cycle shocks is an important testing ground for theories of fluctuations which aim to improve the ability of business-cycle models to explain labor market phenomena. Many such models have been proposed in the literature, so offering additional ways to test the empirical validity of these alternatives is much needed.

For these reasons I applaud the premise of the paper — the emphasis on heterogeneity in understanding labor market fluctuations — since it sets the stage for further exploration of some crucial questions in the study of labor markets over the business cycle. It also provides a good overview of the relevant empirical and theoretical results. In particular, the empirical results of the paper show that the findings of Clark and Summers (1981) regarding the demographic differences in cyclical volatility extend to the recessions of the last two decades, while the theoretical part of the paper shows that extending the model studied by Rios-Rull (1996) to include home production and incomplete markets does not significantly alter its implications for the life-cycle pattern of cyclical volatility.

The aim of my discussion is, first, to highlight the most important empirical phenomenon regarding the life cycle pattern of business cycle volatility that a theoretical model should aim to explain; then, to clarify why the theoretical approach taken by GRRW fails to explain this phenomenon; and, finally, to push the premise of the paper further and offer an alternative explanation to this phenomenon. Correspondingly, my discussion is organized to deliver three main points.

First, I argue that the difference in the cyclical volatility of hours between prime-age
and old workers are second-order in comparison to the substantial difference in the cyclical volatility of hours between young and prime-age workers. Hence, the very high cyclical variation in the hours of young workers is by far the most important empirical phenomenon that a model which sets out to explain the life-cycle variation in business cycle volatility should aim to tackle. This means that the authors’ focus on the “U” shape of cyclical volatility over the life cycle is somewhat misplaced, since what is quantitatively relevant is the high cyclical volatility at a young, and not an old, age. Second, I argue that the model studied by GRRW explains only a small fraction of the high business-cycle volatility of hours of the young compared to that of the prime-aged. I explore which of the mechanisms in the GRRW model work in the right direction to explain the higher business-cycle volatility of hours of the young and which do not. I argue that several of the mechanisms built into the model have no potential to explain the high relative volatility at a young age, and highlight the one mechanism that does. Finally, I suggest that an additional promising mechanism to explain the high cyclical volatility of young workers is increases in the amount of specific human capital or experience with age. I propose an alternative model with such a mechanism and show that it helps to explain qualitatively why the hours of young workers respond more to business cycle shocks.
2 Empirical evidence on labor market fluctuations over the life cycle

To empirically motivate their study, the authors present measures of cyclical volatility for different demographic groups. Since heterogeneity by age is the driving force in the theoretical model studied by GRRW, I restrict my discussion to the results regarding age. It is worth noting, however, that there is also substantial variation in cyclical volatility of hours by education group, a fact that has frequently been noted empirically but that has not received much attention in theoretical work (for an exception, see Nagypál (2001)).

The authors use the March CPS to construct average hours worked by demographic group for each year between 1962 and 2000. Then, as a measure of cyclical volatility in hours worked by group, they use the standard deviation of the projection of the group-specific HP-filtered log weekly hours series onto the aggregate HP-filtered log weekly hours series.\(^2\) The measure thus constructed does not have well-established statistical properties and possibly expects more from the available annual data than they might be able to deliver. This is because, in the annual hours data between 1962 and 2000, there are only four distinguishable downturns, \(i.e.,\) four episodes during which aggregate hours declined, each episode roughly corresponding to a period of recession. This is due to the fact that, even though there were five recessions between 1962 and 2000, the twin recessions of the early 1980s are not distinguishable using annual data. Hence, as a robustness check, I construct a less demanding measure of cyclical volatility. I use the same dataset, but extend it to 2003 so as to have information on the

\(^2\)See Appendix 3 of their paper for a more detailed explanation of the measure used and a motivation for its use.
most recent downturn, which started in 2001. For each downturn\(^3\), I calculate the share of
total hours worked by each age group in the peak year preceding it:

\[
s_{i,r} = \frac{H_{i,r}^p}{H_r^p},
\]

(1)

where \(H_r^p\) is the number of aggregate hours worked in the peak year in recession \(r\) and \(H_{i,r}^p\) is the total number of hours worked in the same year by group \(i\). I compare this to the share
of each age group in the drop in total hours between the peak and the trough year:

\[
d_{i,r} = \frac{H_{i,r}^t - H_{i,r}^p}{H_r^t - H_r^p},
\]

(2)

where \(H_r^t\) is the number of aggregate hours worked in the trough year in recession \(r\) and \(H_{i,r}^t\) is the total number of hours worked in the same year by group \(i\). In Figure 1, I plot \(s_{i,r}\) and \(d_{i,r}\) by age group averaged over the five downturns in the data.\(^4\) If there were no difference
in the cyclical volatility of hours across age groups, we would expect hours worked by each
age group to shrink by the same extent in a downturn, and we would therefore expect the
share in total hours in the peak year, \(s_{i,r}\), to be the same as the share in the drop during
the downturn, \(d_{i,r}\). Instead, what we see is that the share of younger workers in the drop in
hours during a downturn is much larger than their share in total hours. This implies that
workers in their early thirties and younger bear a disproportionate share of the contraction
in total hours. It is this phenomenon that is by far the most important one quantitatively.

How does this measure relate to the one reported by GRRW? Note that \(d_{i,r}/s_{i,r}\) is a
measure comparable to that used by GRRW, except for a scaling factor. \(d_{i,r}/s_{i,r}\), in fact,

\(^3\)The five downturns distinguishable in the annual data are 1970 to 1971, 1974 to 1975, 1981 to 1983,
July 1990, and March 2001, respectively.

\(^4\)Plotting them separately for each downturn gives very similar patterns.
exhibits a very similar pattern to the measure used by GRRW, both of them having a “U” shape. It is clear from Figure 1, however, that the increase at older age of the relative volatility is exclusively due to workers above the age of 65, who account for a very small share of total hours in the data and who are excluded from the theoretical model of GRRW. Emphasizing the U-shape therefore detracts from the essence of the empirical finding, which is that young workers bear a disproportionate burden in downturns.

With the focus placed so heavily on young workers, it is useful to ask whether it is the extensive or the intensive margin that accounts for the bulk of the drop in their hours during a downturn. To do this, I decompose the drop $d_{r,i}$ into its extensive and intensive margin components, and find that, for all age groups, between 69% and 80% of the drop in hours during a downturn is due to the extensive margin, i.e., to the fact that fewer workers are employed, as opposed to workers working fewer hours. This number is somewhat higher than the one reported by GRRW based on a different measure, but it shares the feature that it does not show substantial variation with age.

3 The GRRW model

In the theoretical part of the paper, the authors set out to study the life-cycle version of the neo-classical growth model with technology shocks, variable labor, home production, and incomplete markets, in order to understand the extent to which the above facts can be explained by such a model.

It is instructive to consider the different channels in the model that give rise to differences between the age groups in labor-market responses to aggregate shocks. The first two
channels, the *time-horizon channel* and the *time-to-retirement channel*, are studied in detail in Sections 6.1 and 6.2 of the paper, so I will review them only briefly.

The *time-horizon channel* is present because, as agents get older, they have fewer and fewer periods of consumption (of leisure and of consumption goods) remaining. This means that a given innovation in the present discounted value of income due to an aggregate shock induces a larger and larger increase in the consumption of all goods for the remainder periods, including the consumption of leisure in the current period. In other words, the income effect on leisure of an increase in wages is higher as agents get older, which, in turn, implies a lower response in labor supply to aggregate shocks as agents age. This channel works in the right direction, at least qualitatively, to explain the larger labor-supply response of young workers, as is demonstrated in Section 6.1.

Let us next turn to the *time-to-retirement channel*. This channel introduces an increasing lifetime profile of labor-supply response to persistent business-cycle shocks. This is due to the fact that, for young workers, an innovation in the aggregate productivity process induces a large income effect on the consumption of leisure due to the persistence of the shock, *and* to the fact that young workers have many periods over which they can expect to have a higher wage. This large income effect means that the labor-supply response to higher wages is muted for young workers. For workers closer to retirement, the same innovation in

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5The cleanest way to disentangle this channel from the time-horizon channel is to consider an infinitely-lived agent who can work only for the first $T_R$ periods of her life and is then forced to retire and receive a fixed endowment in all subsequent periods. The numerical exercise in Section 6.2 of the paper maintains the assumption of finite lives, meaning that the results are influenced both by the time horizon and the time to retirement channel.
the aggregate productivity process induces a smaller income effect on the consumption of leisure, because they have fewer periods over which they can expect to have a higher wage. So, despite the fact that the shock is persistent, older workers respond to it as if it were temporary. Older workers thus respond to the same shock by increasing their hours more than young workers.

The third channel, and the one the authors emphasize the most, is the life cycle profile of productivity and preferences channel (or the life-cycle-profile channel in short). This is present in the GRRW model because the authors assume that the efficiency units of working, the disutility from labor, and the weight placed on the consumption of home goods all change deterministically over the life cycle. One can show that this channel works by influencing the life-cycle profile of three quantities: the ratio of labor income to market consumption, the ratio of home to market consumption, and the ratio of home to market hours. The ratio of labor income to market consumption matters because it determines the extent of the income effect of a change in the market wage. When labor income is large compared to market consumption (as in Section 6.3 during middle age), the income effect on the consumption of leisure of a temporary wage increase is large, and the labor supply response to this temporary wage increase is therefore small. The ratio of home to market consumption matters because it determines the strength of the income versus substitution effect of a temporary change in the market wage. A temporary change in the market wage has only an income effect on the consumption of the market good, but has an income and a substitution effect on the

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6This can be established more formally by log-linearizing the optimality conditions characterizing the decision problem of the worker around the steady state, which I omit for the sake of brevity, but which is available on request.
consumption of the home good. Finally, the ratio of home to market hours matters because it determines the extent to which market hours respond to a wage change for a given change in total and in home hours. The deterministic preference and productivity shifters play a role in determining the labor-supply response of the different age groups only to the extent that they influence these three ratios.

These three ratios, though, are observable directly. In particular, it is well known from the empirical consumption literature that household labor income and market consumption profiles are fairly similar, implying that their ratio is roughly constant over the life-cycle. The ratio of home to market consumption is more difficult, since the authors do not report this measure, but presumably it is closely related to the ratio of home to market hours. The ratio of home to market hours, in turn, can be backed out from the calibration exercise of GRRW, since they use both market and home hours to calibrate the deterministic preference and productivity shifters. Since the ratio of home to market hours is strictly increasing with age in the GRRW calibration, one can show that the life cycle profile channel introduces an increasing volatility of market hours with age in the GRRW calibration. So, just as for the retirement channel, the life-cycle-profile channel works in the wrong direction, at least given the values to which GRRW calibrate.\footnote{In light of the importance of the ratio of home to market hours, one could question the calibration exercise: it calibrates to married households only, which presumably biases the hours figures substantially for young households. Moreover, young people spend a large fraction of their time in education, something that does not appear in the model or the calibration.}

Finally, the last channel is the asset-holding channel. The GRRW model features incomplete markets, and younger workers have lower asset positions than older workers, on
average: all workers start their life with no market capital and a fixed amount of home capital and workers accumulate assets over time for the period of retirement at the end of life. The low asset position of young workers means that, holding all else equal, they work more and consume less for precautionary reasons. Hence, a positive innovation in their income will lead to a higher effect on leisure, and thus a lower labor supply response compared to agents with higher asset levels. This means that increasing asset levels over the working life implies increasing labor supply response to aggregate shocks in the model, so this channel also works in the wrong direction.

To summarize, in terms of explaining the high cyclical volatility of the hours of young workers compared to prime-age workers, the asset-market and the time-to-retirement channels always work in the wrong direction, the life-cycle-profile channel most likely works in the wrong direction given the calibration of GRRW of the home to market share of hours, and the time-horizon channel is the only one that works in the right direction. Given these observations, it is not surprising that the quantitative results of GRRW confirm that the model cannot explain the high cyclical volatility of the hours of young workers.

In terms of the quantitative results, it is worth noting that three of the above four channels are already present in the model studied by Rios-Rull (1996). Since he studies a complete-markets version of the GRRW model without home production, the asset-market channel is not present in his model, while the life-cycle-profile channel has a more limited role. Since both of these channels work in the wrong direction, it is not surprising that the results of GRRW are, if anything, less successful at explaining the high cyclical volatility of

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8 This channel is present in the variable labor version of the Krusell and Smith (1998) model presented in their Appendix.
the hours of young workers. Table 1 compares the results of GRRW and those of Rios-Rull by calculating the cyclical volatility of hours for each age group relative to the age group 35-44. We can see that the two sets of results are rather similar, implying that the additional channels are quantitatively not very important.⁹

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* *, ** not distinguished

Table 1: Cyclical volatility of hours of different age groups relative to age 35-44 in the Rios-Rull and GRRW models, and in the data.

4 Accumulation of human capital over the life cycle

In order to more successfully explain the life-cycle pattern of cyclical volatility, one needs to explore additional channels through which differences in age groups arise. This is an issue I take up in this section by exploring one additional channel, the human-capital channel, and examine whether it works in the right direction, at least qualitatively.

⁹This comparison is made somewhat more difficult by the fact that Rios-Rull treated workers between 45 and 64 as one age group, while GRRW break them into two age groups. The primary effect of this difference seems to be to make the impact of the time to retirement channel even more clear.
Differences in human capital are often emphasized in labor economics as one of the major differences between young and old workers. There are, of course, different measures of human capital, the two most prominent ones being education and experience. At first glance, it might seem that differences in education could explain some of the differences in the life-cycle profile. Younger workers (at least under a certain age) might have somewhat less education, and, as is documented in the paper, there is significant variation in the response of hours to business-cycle shocks by education. It turns out, though, that if the only variation allowed across the age groups was in education, this would not be enough to explain the differential business-cycle responses. To show this, I plot in Figure 2, for each of the different age groups plotted in Figure 1, the share in total hours in the peak year and the share in the drop in total hours during the downturn, together with the share in the drop in total hours during a downturn that would be predicted solely by different educational composition of the age groups. We see that it is only for teenagers that conditioning on education even works in the right direction. The reason for this is the secular increase in educational attainment over the period of study, which means that workers in their late 20s and 30s tend to have more education, and thus lower predicted business cycle response, than workers in their 40s and 50s.

Another, more promising, variation in human capital across age groups is in specific human capital, or experience. Younger workers have less experience and lower tenure, on average, than their older counterparts. This experience includes knowledge about a particular firm, industry, or occupation, but it also includes knowledge about the worker’s own ability or fit.

One way to demonstrate this lower level of specific human capital is to look at labor-
market mobility by age. Figure 3 plots the monthly separation rate by age, conditional on staying in the labor force, using data from the Basic Monthly CPS between 1994 and 2003. It is clear that younger workers have much higher mobility levels than older workers even when conditioning on remaining in the labor force, i.e. disregarding the fact that younger workers are more likely to move in and out of the labor force.

4.1 Looking for a good match when young

In this section, I sketch a model that relies on differences in a particular notion of specific human capital — differences in the knowledge about own ability/fit — to explain the higher response of young workers to business-cycle shocks.\(^{10}\) Its primary goal is to demonstrate, at least qualitatively, that differential amounts of specific human capital is a promising mechanism to consider. To keep the discussion simple, I abstract from the other channels considered in the GRRW model: the agents in the model are infinitely lived (no time-horizon channel), face no retirement (no time-to-retirement channel), have the same potential productivity irrespective of age (no life-cycle-profile channel) and are risk-neutral (no asset-market channel, since there is no precautionary savings motive).

4.1.1 The environment

Consider the following extension of the model of Mortensen and Pissarides (1994). There is a unit mass of workers of two types, half of them \textit{round} and half of them \textit{square}.\(^{11}\) Workers are risk-neutral and discount future income at a rate \(r\). New workers are born and enter the

\(^{10}\)A more detailed exposition is available upon request.

\(^{11}\)There is no conceptual difficulty in extending the model to more than two types.
labor market at a rate $\sigma$, which is also the Poisson arrival rate of death, so that the size of the population remains constant over time. Newly born workers start out unemployed and do not know their type, although they know that they have probability one half of being round and probability one half of being square.

There are two labor markets: one for round people and one for square people. If a round person is matched in the round market, she produces $px$, while, if a square person is matched in the round market, she produces $\varphi px$, where $\varphi < 1$. Here, $p$ is aggregate productivity, while $x$ is the idiosyncratic productivity of the match, the evolution of which is discussed below. Equivalently, if a square person is matched in the square market, she produces $px$, while, if a round person is matched in the square market, she produces $\varphi px$. Unemployed workers enjoy a flow utility of $b$.

There is a large measure of potential firms who are risk-neutral and have the same discount rate $r$. These firms can open a vacancy in either market and keep the vacancy open at a flow cost of $c$. Vacancies do not see, prior to matching, whether a worker is round or square. There is a single matching function in each market with the usual properties. Once a worker and a firm are matched, the type of the worker is revealed. The idiosyncratic productivity $x$ takes on its highest value of 1 when the worker and the firm match. While matched, new realizations of $x$ arrive at rate $\delta$ and are drawn from distribution $F : [0, 1] \rightarrow [0, 1]$. A worker and a firm can separate at any point in time, and will generally choose to do so when the idiosyncratic productivity is low. Finally, wages are determined by Nash bargaining.
4.1.2 Equilibrium

It is straightforward to show that, in the steady-state equilibrium of this model for a given level of aggregate productivity, half of new workers are lucky and enter the market where they are well matched \( i.e. \), they enter the market of their own type). They learn their type during their first employment spell and never switch from that market again. The other half of new workers are unlucky and enter the market where they are badly matched. They go through one employment spell, learn their type and the fact that they are better matched in the other market, switch to the market where they are well matched, and stay there until they die. Moreover, it can be shown that there is a distinct reservation productivity of a match depending on whether the worker is well-matched or not: \( R_{well} < R_{badly} \). In other words, matches that find out that they are badly matched do not end their relationship immediately, since they find it beneficial to take advantage of their high idiosyncratic productivity. They are more stringent, however, about the level of idiosyncratic productivity required to continue the relationship, since they know that the worker will be better matched in the other market once the relationship dissolves.

4.1.3 Comparative statics

It is well known that, due to the high job finding rate that these type of models are generally calibrated to, analyzing a full dynamic stochastic version of the model with an explicit stochastic process for aggregate productivity gives results similar to analyzing the comparative static responses to changes in aggregate productivity. For the sake of simplicity, then, I resort to the latter. It is easy to show that, just as in the standard Mortensen-Pissarides
model, a decrease in the aggregate productivity $p$ gives rise to an increase in the reservation productivities. Moreover, for a uniform distribution, the increase in the reservation productivity is higher for badly-matched workers than for well-matched workers. Hence, the impact of a negative shock is larger on the destruction margin for badly-matched workers than for well-matched workers. Since badly-matched workers are disproportionately young, this means that the impact of a negative shock is larger on young workers. The mechanism of the model thus works in the right direction for explaining the larger response of the hours of the young to aggregate shocks.

4.1.4 Simulation results

To demonstrate the above claim, I simulate the above economy and study the response of the hours of the different age groups to aggregate shocks. In particular, I use the following approximations. I assume that aggregate productivity follows a two-state Markov process. Instead of trying to determine the history-dependent optimal policies of the workers, I approximate their optimal policies by the steady-state optimal policies corresponding to the two levels of aggregate productivity.\textsuperscript{12}

In Figure 4, I report statistics that correspond to the statistics constructed using the actual data in Figure 1. In particular, I report the share in total hours in the peak year and the share in the drop in total hours during the downturn for each age group. As can be seen,\textsuperscript{12} in the standard Mortensen-Pissarides model, all decision variables are forward-looking, and market tightness can adjust instantaneously, so it turns out that the optimal policies simply depend on the current aggregate state. In the variant of the model considered here, this is no longer true, because the distribution of well-matched and badly-matched workers enters the state space of the firms.
this model is able to qualitatively generate the main pattern in the data, namely, that young workers are more responsive to business cycle shocks than older workers. In other words, in the model, the burden of a downturn falls disproportionately on the young, just as in the data.

Since the model is one that features bilaterally efficient separations, it is not possible to distinguish between quits and layoffs. The results regarding cyclical variation can be understood, however, both from the firm’s and from the worker’s perspective. From the firm’s perspective, during a boom, a firm is willing to employ even relatively unproductive and relatively poorly matched workers. During a recession, however, a firm becomes more stringent, and separates from workers who are relatively unproductive or are relatively poorly matched. Being relatively unproductive is a risk that all workers face, while the risk of being poorly matched falls on young workers. Hence young workers face larger risk of separation during a recession. From a worker’s perspective, during a boom, she is willing to work even in relatively unproductive jobs and in relatively poor matches, since the opportunity cost of searching for a more productive job or a better match is high. During a recession, however, the opportunity cost of searching for a better match becomes lower. So, if a worker is relatively unproductive or badly matched, she separates and starts looking for a more productive match. Again, being badly matched is a risk that only young workers face; hence, they have larger separation rates in a recession.
5 Conclusions

The work of GRRW directs attention to a new and very exciting avenue of research regarding the heterogeneous labor-market impact of business cycle shocks. They focus on heterogeneity in age, which, together with education, seems to be the most important dimension along which workers differ in their response to business cycle shocks. While much work remains to be done, the work of GRRW demonstrates some of the mechanisms that could result in differing business cycle responses across the life cycle.

Understanding demographic heterogeneity over the business cycle is relevant for several reasons. As the authors point out, the heterogeneous impact of business-cycle shocks is an important testing ground for theories of fluctuations. There are other reasons, beyond methodological ones, too. For example, political-economy considerations implied by demographic heterogeneity could be crucial for understanding stabilization policies. Also, labor-market heterogeneity could have important consequences for economists’ understanding of the cost of business cycles. In particular, if business-cycle shocks have larger and potentially lasting effects on the labor-market performance of young workers, this could significantly increase macroeconomists’ estimates of the costs of business cycles. Overall, demographic heterogeneity in the labor-market response to aggregate shocks is something that is long overdue in arriving on the research agenda of macro-labor economists.
References


Figure 1: Share of different age groups in total hours in the peak year and in the drop in total hours during the subsequent downturn averaged over the downturns in the data between 1962 and 2003.
Figure 2: Share of different age groups in the drop in total hours during a downturn predicted by education variation.
Figure 3: Monthly separation rate by age conditional on staying in the labor force.
Figure 4: Model simulated share by age in total hours compared to model simulated share in drop in total hours during downturns.