STRATEGIES *for* MONETARY POLICY

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CHAPTER NINE

Optimal Monetary Policy and Inequality

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The remarks presented here are based on "Optimal Monetary Policy for the Masses" (Bullard and DiCecio 2019), which talks about nominal-GDP targeting in a specific framework. In his 2012 Jackson Hole talk (Woodford 2012), Mike Woodford talked about nominal GDP targeting as being the right sort of forward commitment that the central bank needs to make in order to have a better monetary policy and, in particular, to handle monetary policy at the zero lower bound. I'm going to look at nominal GDP targeting here as optimal monetary policy in a different type of model that you're not used to. Part of this comes from my thinking that the profession is overcommitted to the New Keynesian framework, as beautiful as it is and as much as I've written papers about it. We do practically everything in that particular context. There are other models out there in the world. So, let's see what we get out of other models.

Our model is different, but the policy recommendation is similar to that of the New Keynesian model. Because of that I think you might conclude that nominal GDP targeting might be a pretty robust way to approach optimal monetary policy in worlds with the kinds of nominal frictions that we want to talk about. I'm hopeful that we can stimulate more research with the model presented here. I certainly wouldn't take it directly to policy today. On the other hand, I think it is promising. About the discussion and about the framework, what I see happening is that ideas in central banking are gradually shifting. Some of the ideas are brought into the policy discussion and that's how frameworks change over longer periods of time. I think that gives you a better picture of what might happen here, as opposed to the Fed suddenly switching to a different framework on a particular day.

What do we do in this paper? It's a stylized economy. We're going to make simplifying assumptions that will allow for paper-and-pencil solutions. There are going to be private credit markets that are critical and a whole lot of heterogeneity in this economy. I want all of us to work more on heterogeneity, because I think heterogeneous agents are an important frontier for macroeconomics. The role of monetary policy is to make sure that these private credit markets work well, as complete markets, and it's going to look like nominal GDP targeting. The main point of this paper—there are companion papers to this one—is that nominal GDP targeting succeeds in fixing credit market frictions even when there's a whole lot of heterogeneity in the economy, enough to match the Gini coefficients for the US economy (Azariadis et al. 2019).

I'm going to advertise a model by briefly describing the construct and then I'm going to show you some pictures. This is an overlapping generations (OLG) structure. I don't think you should take life and death in the model literally. We're keeping track of people only when they're age twenty; we're not keeping track of them before. We're going to quit keeping track of them when they get to age eighty. They're going to live for 241 quarters, so that we can talk about a quarterly model. Sometimes when people do OLG models, they start to think about long-run issues, but I want to think business-cycle issues. Households have very simple log-log preferences, defined over consumption and leisure.

The key feature is that when you come into this model at age twenty, you're randomly assigned a productivity profile over your lifetime (see figure 9.1). This productivity profile starts low. It rises up exactly in the middle of life, peaks in the middle of life and then goes down to the previous level; this symmetry feature is going to

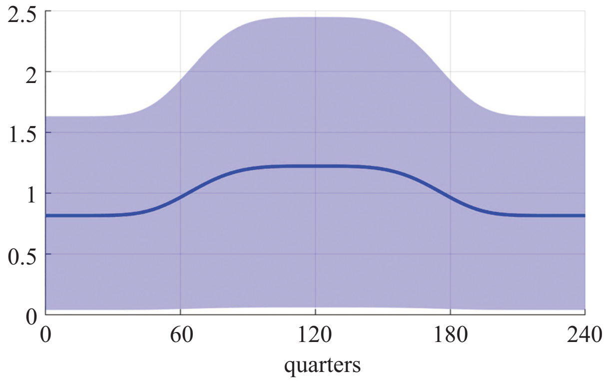

FIGURE 9.1. Endowment Profiles Mass by Cohort

Note: Endowment profiles mass shown as the blue shaded area; the solid line represents a typical endowment profile. The scaling factor is drawn from a uniform distribution. Drawing from a low-normal distribution is harder to visualize, but such a distribution would include arbitrarily rich and arbitrarily poor households.

help us with the math. We are drawing these for the continuum of agents in the incoming cohort from a uniform distribution in the figures below. But you could draw the productivity profiles from a log-normal distribution and have arbitrarily poor and arbitrarily rich households. Elon Musk would be in this economy if we did the log-normal distribution.

The productivity units that you have at every stage in your life are sold in a competitive market at an economy-wide wage. Aggregate production is linear. The economy grows over time at a stochastic rate. So, there's an aggregate shock here. For those of you who are technically minded—a few students in here—this is a heterogeneous-agent economy with an aggregate shock that you can solve with pencil and paper. So that's the technical side of this that is interesting. You could also consider the effective lower bound in this setting. I'm not going to talk about it here so you will have to go to the companion paper for that (Azariadis et al. 2019).

What's going on in this economy? There are peak earning years and the young people aren't earning very much, but they want to pull consumption forward in the life cycle, so they want to borrow. People who are middle aged want to save for retirement, so they want to lend to the young people. These forces generate a big household credit market. You could think of the services that are being pulled forward in the life cycle by younger households as housing services. And you could think of the one asset in this economy as being mortgage-backed securities. Mortgage-backed securities in the United States are about $9 trillion today, maybe $10 trillion. Household debt total is about $13.5 trillion today. So, this is a big private credit market that's out there in the real world.

There's going to be something wrong in this credit market, as there is in the real world. There's non-state-contingent nominal contracting, which means that the contracts are set up in nominal terms and they're not contingent on any shocks that occur in the economy or among borrowers and lenders. There are two parts to that. Resources are misallocated because of the non-state contingency. The fact that contracting is in nominal terms means that the monetary policy maker might be able to do something about that and fix this problem in the credit market.

Enough about the structure. Let's just go to what you get out of this. You get a monetary policy that follows a nominal GDP targeting rule. It delivers complete-markets consumption allocations, which means it essentially cancels out the uncertainty for the households going forward. So it's a form of insurance for the households, similar to the findings from Evan Koenig (Koenig 2013). Kevin Sheedy also has a great paper about this (Sheedy 2014). One thing out of the Sheedy paper is the crucial role of the non-state-contingent nominal contracting—nine times more important than the sticky price friction according to his calibrated model. So, that's food for thought.

This policy induces equity-share contracting, which means we all get our own slice of the pie, no matter how much we produce or how much we get paid on a given day. We all consume the same amounts because the borrowing and lending works perfectly in this economy, provided the policy maker pursues optimal policy. I'm going to show you cross-sectional pictures, but this is a stochastic economy: consumption does move around, and wages move around, everything moves around, but all in proportion to the real wage. Household consumption growth is equalized across all these agents—rich and poor, young and old, everybody's getting the same consumption growth rate—and it's equal to the aggregate growth rate.

This has really nice properties. The real interest rate is exactly equal to the output growth rate at every date even in the stochastic economy. That's the key theorem in the paper. This is actually a real business cycle economy underlying this model. But you can only get there by pursuing the optimal monetary policy. You could also think of this in terms of the "Wicksellian natural rate of interest." So, what the optimal policy is doing is getting you back to the Wicksellian natural rate of interest. The natural rate of interest is the one that would occur if there were no frictions in the economy, which is the case in the Kydland-Prescott economy. So in that sense, the New Keynesian policy advice and the policy advice coming out of here are exactly the same thing. You want to get the interest rate to be an undistorted interest rate in the economy, the real interest rate.

Because of the preferences we have, all households, rich and poor, will work exactly the same number of hours at each stage in the life cycle (figure 9.2). In figures 9.1–9.4, the horizontal axis goes from zero to 240, i.e., the quarters that you live. But think of this as a cross section. At any point in time, there's a cohort that's just entering the economy. That's the zero over there on the left. And there are other cohorts, like the 120 in the middle, and so on. So, the blue line says that people work more in the middle of the life cycle, and they don't work much at the beginning and the end of the life cycle. We actually ruled out corner solutions here, but they work very little at the beginning and end without retiring. So,

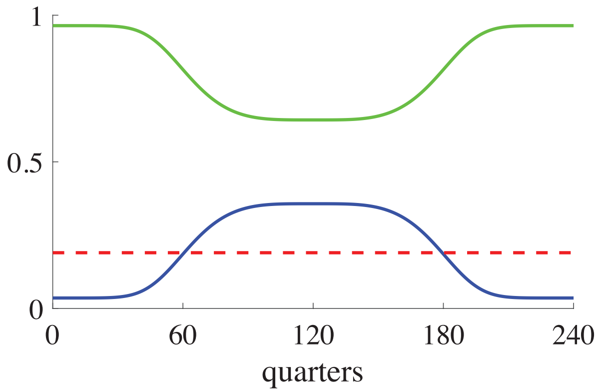

FIGURE 9.2. Labor and Leisure Decisions by Cohort

Note: The blue line shows labor supply by age. The green line represents leisure decisions by age. The red line shows the fraction of time worked in US data, 19 percent. The labor/leisure choices depend on age only. High-income households work the same hours as low-income households at each age.

doctors work forty hours a week. Taxi drivers work forty hours a week. Everybody works forty hours a week in the middle of the life cycle, because that's when you have your peak productivity, and you'd better work while the sun shines.

The credit market reallocates the uneven income (figure 9.3). People work more in the middle of life, when they're more productive, represented here by a blue mass. That's the income section at a point in time in this economy. Notice that the figure portrays only labor earnings and it doesn't show capital earnings. It's very uneven over the life cycle. The red bar and the red box show how much all these different agents are consuming. The way to think of this is to imagine a family of doctors—a young doctor, a middle-aged doctor, the grandfather's a doctor, everybody's a doctor—but only the middle-aged doctor is earning a lot of income. The young doctor's still in medical school and the old doctor is retired. Yet, they're all consuming exactly the same amount because the credit market is working perfectly. So, they are at the very top of the red box there. You could say the same thing about a family of taxi drivers—old

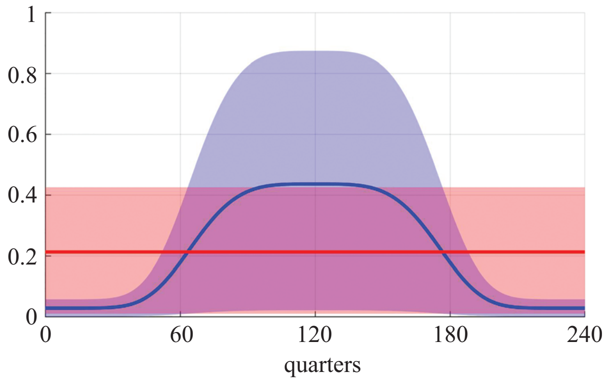

FIGURE 9.3. Consumption Mass and Labor Income Mass by Cohort

Note: Consumption mass, shown as the red shaded area, and labor income mass, shown as the blue shaded area, along the complete-markets balanced growth path. The red line and the blue line represent a typical consumption and labor income profile, respectively. Under optimal monetary policy, the private credit market reallocates uneven labor income into perfectly equal consumption for each productivity profile. The consumption Gini is 31.8 percent, similar to values calculated from US data.

taxi driver, middle-aged taxi driver, and young taxi driver. Only the middle-aged guy's earning any income, but they're all consuming exactly the same amount. So, if you're on the same life cycle productivity profile, you're going to consume the same amount no matter where you are in the age distribution. These things shift up over time because this is a growing economy, but this is the basic story here. So, the blue line shows the income of the typical guy in the middle and the red line shows the consumption associated with that. We're going to calculate Gini coefficients of labor income and consumption, so that would be off these shaded regions here.

And this is my favorite picture, the net asset–holding mass in this economy (figure 9.4). Maximum indebtedness occurs around period 60, that's like age thirty-five, so you'd be buying your house at that point. Maximum savings is around period 180, that's age sixty-five in this model; after that age, you run down your assets. If you're going to calculate the Gini coefficient off here, it's going to be

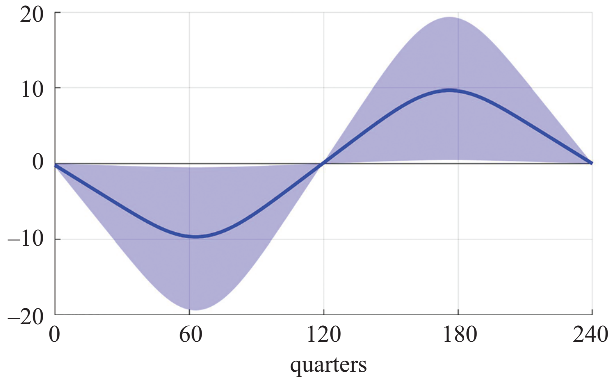

FIGURE 9.4. Net Asset–Holding Mass by Cohort

Note: Net asset–holding mass shown as the blue shaded area; the solid line represents a typical net asset–holding profile. Borrowing, the negative values to the left, peaks at stage 60 of the life cycle (age ~35), while positive assets peak at stage 180 of life (age ~65). The financial wealth Gini is 72.7 percent, similar to values calculated in US data.

TABLE 9.1. Gini Coefficients in the US Data and in the Model

	Wealth*	**Income****	**Consumption**
US data	80%†	51%††	32%§
Model	72.7%	51.6%	31.8%

Sources: † Davies et al. (2011). †† Congressional Budget Office (2016). § Heathcote, Perri, and Violante (2010).

* Wealth is defined as the nonnegative part of net assets.

** Income is defined as labor income plus nonnegative capital income.

on the right-hand side of this picture, because we're only counting positive financial wealth.

If you look at US data, the financial wealth Gini coefficient is about 80 percent, the income Gini coefficient is 51 percent, and the consumption Gini coefficient is 32 percent (table 9.1). The model naturally ranks these Gini coefficients. We can get the income Gini and consumption Gini almost exactly right. We're a little shy on the wealth Gini, which is typical of these kinds of models. We do very

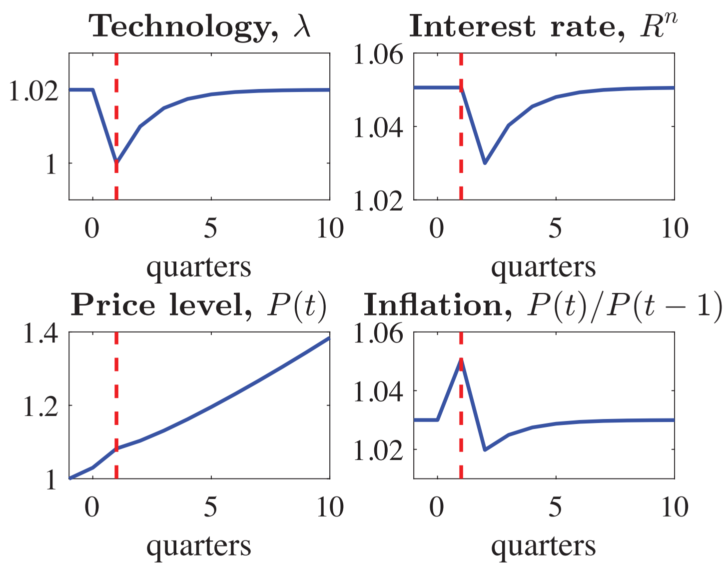

FIGURE 9.5. Impulse Responses to a Productivity Shock

Note: Monetary policy responds to a decrease in aggregate productivity growth by increasing the inflation rate in the period of the shock. Subsequently, inflation converges to its long-run equilibrium value from below. The nominal interest rate drops in the period after the shock.

well at Gini coefficients, even with a very simple, straightforward approach to income inequality.

So, people say, "Jim, why is this nominal GDP targeting?" If shocks were independent and identically distributed (i.i.d.), then you would actually stay exactly on a nominal GDP path at every date. It would actually be perfect nominal GDP targeting. If you have some serial correlation in the shocks, then you're going to go up and down around this path, but you're basically going to return to the nominal GDP path all the time.

People also wonder if this policy looks "weird" somehow? I'm going to show you a picture that says it does not (figure 9.5). Actual policy looks like what central banks already do. Both nominal and real rates fall during a recession. Let me talk to you through this picture, and then we'll get to the conclusions.

On the upper left is the shock in the model to the growth rate of aggregate technology, λ. Let's say that's growing at 2 percent, but you get a shock on day one, so it declines, and then it gradually returns to its mean. The key to optimal monetary policy is that the nominal interest rate there, in the upper right-hand corner, does not fall in the period of the shock. That's the key to nominal GDP targeting. The classic feature of nominal GDP targeting is in the bottom-right corner, where inflation goes up in the period of the shock. Subsequently, inflation falls. Nominal interest rates fall. The real interest rate is below its long-run level. All these features look just like what you would see out of a typical model. I don't think it looks all that different, depending on what you think about the nominal interest rate not falling exactly in the period of the shock. In our model, it falls one period after the shock.

In conclusion, this is a baseline benchmark-type model that could be expanded in many directions. It's based on the idea that actual households have peak earning years. They have to use credit markets to smooth life cycle consumption. There's a friction in that market—non-state-contingent nominal contracting—and the monetary authority can fix that friction. The way the monetary authority fixes that friction is by restoring the Wickesellian natural rate of interest in the model. For the real business cycle people here, that's the stochastic rate of growth of technology. The basic message is that even though there's a lot of heterogeneity in this economy—there are arbitrarily rich people and arbitrarily poor people—they all need the credit markets to smooth life cycle consumption. If you want the credit market to work well, nominal GDP targeting is a way to get the credit market to work well and fix the friction in that market. So, it's optimal monetary policy for the masses.

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