The Persistence of Development Dynamics: Financial Frictions and Mobility Distortions

Ei Yang[†]

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Abstract

Successful economic reforms produce long-lasting transitional dynamics for developing countries. This paper analyzes hourban migration, and I calibrate it to China. The mobility di

tion distortion and it restricts a proportion of agents to the low-productive sector. A removal of distortions triggers the transition of the economy. The transitional path from calibration displays slow convergence. It shows persistent increases in output, productivity and urbanization, mimicking the patterns observed in data. The mobility distortion generates the slow convergence by creating more high-ability, but poor, agents. After the reform removes the distortions, it takes a long time for these agents to become entrepreneurs and to reach their e□cient scales due to the financial friction. Compared with the literature that uses tax distortions, the economy with mobility distortions generates slower convergence. The model

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JEL Classification: E21 E44 O11 O16 O18 O25 O41 O47 O53

1 Introduction

When a developing country takes on successful economic reforms, it starts to grow for decades. For example, the Asian miracle countries and China go through persistent growth after their economic reforms. There is little controversy on the fact that economic transition is triggered by economic reforms. However, the long-lasting transitional process itself is puzzling. What are the factors that lead to the persistence of the development dynamics?

merically with a finite difference method. The foundation of the model is a continuous-time version of the incomplete market models as in Aiyagari (1994), Bewley (1986) and Huggett (1993). In this type of model, individual agents choose optimal actions based on their idiosyncratic states, and their expectations are rational. The aggregate state is the joint distribution of the individual state variables. When the economy is on the transitional path, we need to track the evolution of the joint distribution. The continuous-time method has an advantage of describing the evolution of the joint distribution using the Kolmogorov Forward (KF) equation (or Fokker-Plank equation). The KF equation is also easy to solve numerically. A detailed reference is Achdou et al. (2015).

2 Related Literature

My paper is part of the large theoretical and empirical literature that study the role of financial friction on economic development. Early contributions are Banerjee and Newman (1993); Galor and Zeira (1993); King and Rebelo (1993); and Rajan and Zingales (1998). See Banerjee and Duflo (2005) and Levine (2005) for recent surveys.

The recent related literature is the strand that focuses on the macroeconomic implication of micro misallocation. Restuccia and Rogerson (2008) use an implicit tax method to argue that resource misallocation shows up as a low level of TFP for developing countries. Hsieh and Klenow (2009) empirically show that China and India can gain large TFP improvement if the distortion in the economy is removed. Different from their implicit tax approach, my paper identifies one particular type of distortions: the mobility distortion. Also, this paper studies the transitional dynamics and it illustrates that the types of initial distortions matter for the transitional dynamics, and the steady state analysis is only one side of the whole story.

hump-shaped TFP path. In their model, the initial distortions responsible for resource misallocations are modeled as taxes and subsidies on entrepreneurship. This paper builds on their insights, but it introduce mobility distortions and focuses on the rural-urban migration. Although not completely comparable due to the modeling method, my model generates longer transitional dynamics and a monotonically increasing TFP over time. Midrigan and Xu (2014) use producer-level data and emphasize the role of financial frictions on entry and entrepreneurial technology adoption. In contrast, I focus on the extensive distortion generated by the mobility distortion, and the mechanism of persistent transitional dynamics in my paper relies on this distortion.

My paper is also a part of the literature on rural-urban migration. Lewis (1954) builds a two-sector model with unlimited rural labor supply. Lewis's idea of reallocation of the labor force between sectors remains critical in my model. The difference is that the rural immigrants are now heterogeneous and limited in supply. Therefore, this paper can be thought of as describing the economy turning over the Lewis point. Todaro (1969) and Harris and Todaro (1970) address the force for migration by equating the expected wage from unemployment to the rural wage. Unemployment is abstracted away in my paper. The pulling force of the rural-urban migration comes from the increasing urban wage, which is endogenously determined by the reallocation in the economy.

The third strand of closely related literature is the one on China's economy. Recently, there is increasing interest in understanding the behavior of China's economy. Song et al. (2011) focus on the coexistence of large trade surplus and high return to capital. They build an overlapping generation model and emphasize the reallocation between the state-owned firms and privately-owned firms within the manufacturing sector. Chang et al. (2015) document the trend and cycle patterns for China and propose that the preferential credit policy for the heavy industries accounts for these patterns. Both papers focus on the reallocation in the manufacturing sector. In contrast, my paper focuses on the mobility distortion motivated by the Hukou policy and studies the rural-urban migration, a reallocation in the labor market, from the perspective of occupation choice. I view my paper as complementa0.1(m-322(.)-111(Iv)323(i)323(e)322(w)1(T3n(.)-11132351es)-261(the)-261(rH552

dynamics of China.

There is other literature on the Hukou policy. For example, Dollar and Jones (2013)

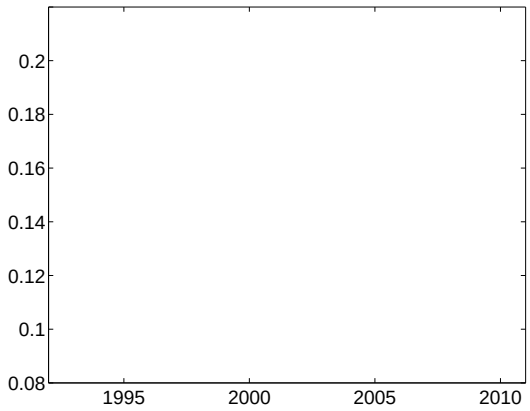
time model. My paper is complementary to these papers and illustrates the importance of mobility distortions and rural-urban migration.

3 Motivation Evidence from China

There are two major features of China: a long-lasting growth after reform and the Hukou policy.

Over the last 20 years, China has gone through a persistent economic transition after economic reforms, and has achieved huge success in economic outcomes. The output per capita relative to the US increases from 8.05% in 1992, to 20.36% in 2011, and the TFP level relative to the US increases from 32.70% to 40.66% (see Figure 1). The economy's capital-output ratio increases from 2.67 to 3.20 during the same period. The slow speed of the gradual urbanization is another salient feature. The rural employment share of the

Figure 1: Economic Variables for China from 1992 to 2011



impact of the Hukou policy is on the rural-urban migration and the supply of urban labor force. Another impact, usually ignored but critical, is on the allocation of talents: some smart agents with rural Hukou cannot utilize their talents when the Hukou policy is strictly implemented. Both impacts are important for the development dynamics after the economic reform.

4 Model

generated by this process is a lognormal distribution $\log z \quad N(\mu, \frac{\sigma^2}{2\psi})$. By Ito's lemma, the process of z is derived as $dz = \psi(\mu - \log z) + \frac{\sigma^2}{2} zdt + \sigma z dW$. I denote this as $dz = \mu(z)dt + \sigma(z)dW$.

There are three occupations: rural farmer, urban worker and urban entrepreneur. The earnings of a farmer are u, independent of the individual ability z. The ability z is important because it enters the earnings of the last two occupations.

The earnings of an urban worker are wz^{θ}, where w is the urban wage rate. The ability z enters work's earning with a monotone transformation z^{θ}, which can be interpreted as an e

entrepreneur is defined as

$$\pi(a, z; w, R) = \max_{k \leq \lambda a, l} f(z, k, l) - Rk - wl.$$

These are the instant earnings for being an entrepreneur.

The asset market is incomplete as the ABH model. There is only risk-free bond trading in the economy. It pays with interest rate r. All agents can save with bonds, but agents cannot borrow money to smooth their consumption. The borrowing constraint for a risk-free bond is set as $\underline{a} = 0$.

The asset market is competitive. The financial intermediaries receive deposits from

and labor hiring. These factor demand functions depend on the individual state (a, z), because the financial friction restricts the production scale of poor entrepreneurs. Given rental rate R and wage rate w, the optimal capital holding can be computed from the first-order condition as

$$k(a, z; w, R) = \min$$

4.4 Equilibrium

The equilibrium in this economy is a competitive equilibrium. The equilibrium is the time paths for prices $r(t)$, $w(t)$, $t \geq 0$, and corresponding quantities such that given the initial distribution $g(a, z, 0)$:

(1) given the time paths of prices $r(t)$ and $w(t)$, each agent chooses an occupation based on individual state (a, z), and chooses how much to consume $c(a, z, t)$ and save $s(a, z, t)$ to maximize discounted utility;

where $\kappa(z)$ is the lump-sum tax, specified as $\kappa(z) = z^{q_2}$ and $q_2 > 0$. The lump-sum tax directly distorts the entry decision of urban labor force. It also distorts capital and labor allocation among entrepreneurs indirectly through general equilibrium prices.

4.6 Two Alternative Economies for Comparison

To illustrate the role of mobility distortions in the benchmark model, I create two alternative economies. The transitional dynamics from those two economies will be compared

because there is no aggregate production function for the model economy.

5 Quantitative Analysis

Three economies are calibrated in this section: the benchmark economy, the economy with only mobility distortions, and the economy with only revenue tax distortions. Each of them initially is at stationary equilibrium. They are di□erent in the initial conditions created by di□erent distortions. The benchmark economy has two types of distortions while the other two counterfactual economies have only one type of distortion. The distortions are removed at the beginning of reform. Even though the initial conditions are di□erent across economies, the ending stationary equilibria are same.

ψ, the standard deviation of shock σ and wage function parameter θ. The parameters are chosen to jointly match the following moments: share of entrepreneurs 7.5% calculated from Survey of Consumer Finances (SCF) (Cagetti and Nardi, 2006), the wealth share of the top 10 percent household 76.7% in 2010 calculated from SCF (Wol□, 2012), the employment share of top 16% establishments (US census 2012), and the top5 earning share 30% in 1998 (Buera and Shin, 2013). When the persistence parameter ψ is larger, the high ability stays longer and the wealth share of the top 10% will be large. For a given ψ

capitalization to GDP.

benchmark as possible. In this sense, the three economies have a similar distortion in

have to become workers. To overcome the collateral constraint and take advantage of high productivity, the high-ability agents will save more as their firms are expanding from small scale. As the firms become larger, the return to saving decreases. At some level of asset holding, the firm will reach its unconstrained scale. The return from saving

5.3.1 The Long-Run E□ects of Financial Frictions

The first dimension under investigation is financial friction. The results confirm the insight from the literature that financial frictions greatly depress economy outcomes (see Figure 5).

The experiments start from an economy with no financial friction to a sequence of ones with increasing degrees of financial frictions. All the economies are at thier stationary equilibria and they are free of other distortions. Therefore, all the negative e□ects are coming from financial frictions. With a stricter collateral constraint, the economy experiences drops in total output, total capital, entrepreneurship, and external finance-to-GDP ratio as in Buera and Shin (2013). This is the emphasis of the literature and it is confirmed in my model.

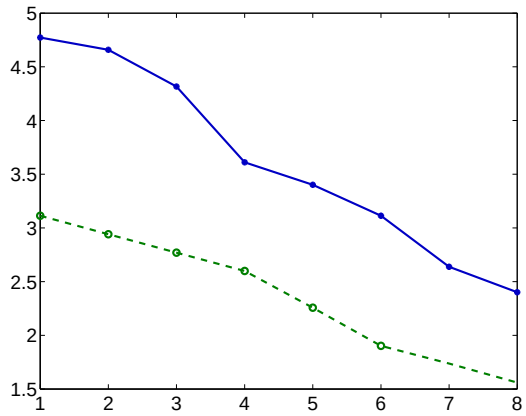
Financial frictions lead to a low level of entrepreneurship. The steep drop in the external finance-to-GDP ratio reflects the channel financial friction a□ecting the economy. Given the collateral constraint, some of the talented, but poor, agents cannot be entrepreneurs, and some are operating on a small scale. The lower level and low quality of entrepreneurship generate the decrease in output, TFP and capital level. In addition, some low ability, but rich, agents enter as entrepreneurs when financial frictions increase. The entry of low-ability entrepreneurs can be larger than the number of exits of high-ability entrepreneurs during some degree of financial frictions. This produces a hump-shaped path for the numbers of entrepreneurs.

Di□erent from the literature, my model has an additional rural sector. This factor creates more non-linearity in occupation choice. When the financial fractions are low, no farmers show up in the model. When the financial frictions increase to a certain degree, the low levels of TFP and capital lead to a low urban wage. The low-ability agents begin to prefer being farmers.

5.3.2 The Long-Run E□ects of Distortions

The e□ects of distortions are evaluated under a fixed degree of financial friction $\lambda = 1.446$, which is the calibrated value used in the benchmark. Both mobility distortions and

Figure 5: Long-run E□ect of Financial Friction and Distortions



revenue tax distortions can change outcomes of the stationary equilibrium. See Figure 5.

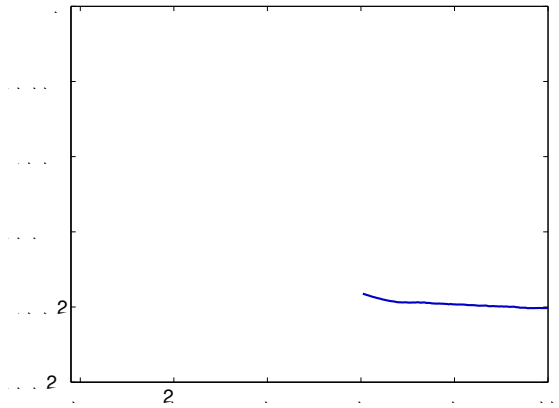
The mobility distortions lower the output by restricting more agents in the low-productivity sector. Under no lump-sum taxes $q_2 = 0$, the stationary equilibria are computed under the different levels of mobility distortions. The proportions of agents restricted to the rural sector increase from 0 to 90%. The mobility distortion allocates agents regardless of their ability. This creates a direct impact on the TFP. The huge amount of farmer tracks the degree of mobility distortion closely.

The last distortion under scrutinization is the revenue tax distortion. It is evaluated under the financial friction level of $\lambda = 1.446$, and no mobility distortion $q_1 = 0$. When q_3 increases from 0 to 0.1, the revenue tax rates change from a zero and flat tax rate scheme to an upward sloping nonzero one. The larger is q_3, the higher is the tax rate for all agents, and the larger is the slope of the tax rate. That is, the tax rates increase and they increase more for the agents with higher ability. The revenue tax distortion directly creates large distortions on the entry of entrepreneurs among the high-ability agents. An indirect effect comes from the misallocation of the resource. The larger is q_3, the more the economy is distorted.

Even though both distortions create a drop in GPD, TFP, capital and labor supply, the channels are different. The difference in transitional dynamics from different types of initial distortion is the one of key points of the next subsection.

5.4 Transition Dynamics

Figure 6: Price Evolutions in the Benchmark



crucial reason why mobility distortion contributes to the persistence of transition.

Those who are initially relative poor workers but now choose to become entrepreneurs are the second group of agents. Facing the lump-sum tax distortion, the pre-reform profits for their small firms would be low, so they do not enter as entrepreneurs. When the lump-sum tax distortion is lifted, the profit is high enough. Due to the existence of financial friction, the scale and profit of their firms are still below their unconstrained counterparts.

The last group in the extensive margin is a quitting group. Among this group, agents initially are entrepreneurs. Although their abilities are low, they are rich enough to operate a large enough firm such that the entrepreneurial profits are larger than the earnings from being workers. As the economy grows, the interest rate is driven up by capital demand from more productive agents. Additionally, the wage is rising too. The increase in both prices squeeze the profit for these entrepreneurs. At the same time, they could earn more as workers. Thus, along the transitional path, their firm scales will decrease and they gradually quit from engaging in production.

The intensive margin describes the reallocation of factors among the active entrepreneurs.

Figure 7: Transitional Dynamics in the Benchmark

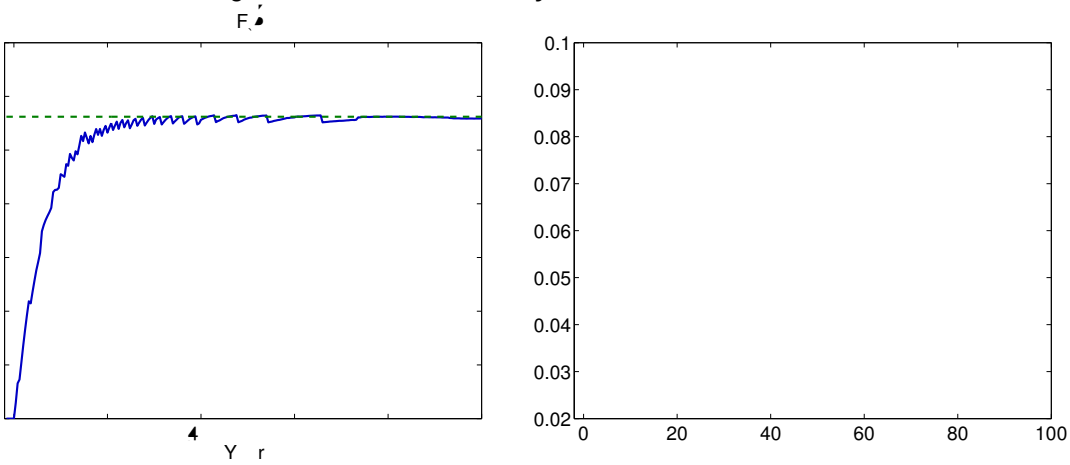
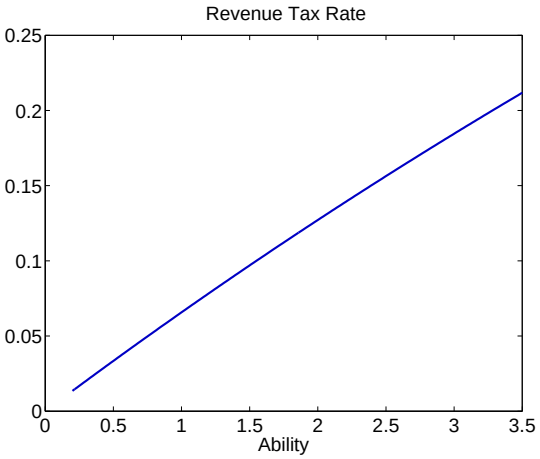


Figure 8: Revenue Tax Distortions



the mechanism and shows the quantitative di□erences through the comparisons between three economies.

Three economies are presented here: the benchmark, the economy with only mobility distortions, and the economy with only revenue tax distortions. All economies face the same level of financial friction throughout the transition. They also share the same terminal state. Therefore, after the distortions are removed in the economies, they all evolve to the same destination.

Figure 9: Comparisons between Economies

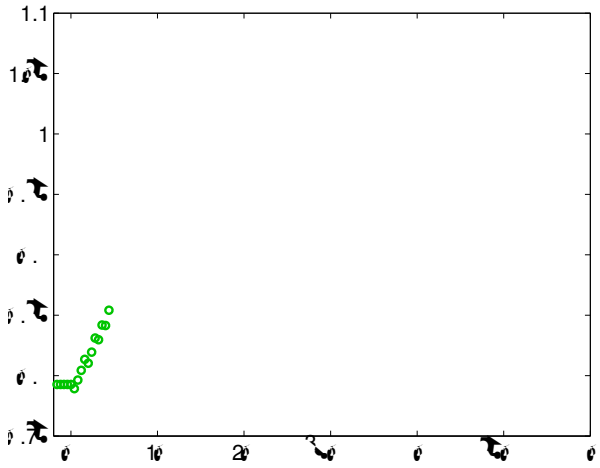
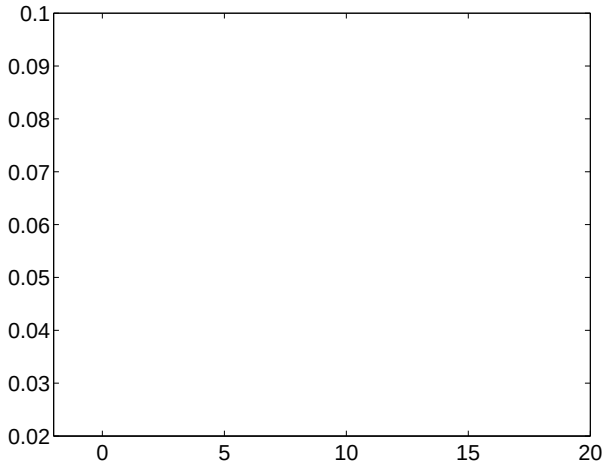


Figure 10: Comparisons between Economies



data.

In sum, the mobility distortion creates more persistence in the transitional dynamics compared with the economy with only revenue tax distortions. The difference stems from the initial joint distribution of assets and abilities. The mobility distortion restricts some high-ability agents in the rural sector and makes them poor. These high-ability agents need more time to engage in production and produce at efficient scales. As a result, the economy grows more slowly.

The diverse post-reform performances also highlight the need to investigate the types of distortion. We need to understand not only the direct effect of the distortion but also the endogenous behavior that comes with it. In terms of the mobility distortion, it has a more direct impact on the extensive margin of entrepreneurship. More importantly, it also produces endogenous asset-holding behavior, which has a long effect even after the distortion is removed.

6 Conclusion

This paper analyzes how financial frictions and mobility distortions can generate the persistent development dynamics after economic reforms in a heterogeneous-agent occupation choice model. The mobility distortion restricts a proportion of agents to the low-productive occupation. Being calibrated to China, the model produces the slow con-

workers but also potential entrepreneurs to the economy. Therefore, the rural-urban migration itself is a source for the persistence of development dynamics.

One limitation in the model is that all the initial distortions are removed together at the beginning of the period. It is a simplification to illustrate the idea and solve the model. A slow and gradual removal pace is closer to the reality and should produce a slower urbanization result than the current paper.

There are other extensions interesting to investigate. One example is to see what will happen when the distortions are removed one by one. The results will provide policy

Hsieh, C.-T., E. Hurst, C. I. Jones, and P. J. Klenow (2013). The Allocation of Talent and U.S. Economic Growth. NBER Working Papers 18693, National Bureau of Economic Research, Inc.

Hsieh, C.-T. and P. J. Klenow (2009). Misallocation and Manufacturing TFP in China and India. *The Quarterly Journal of Economics 124* (4), 1403–1448.

Huggett, M. (1993). The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies. *Journal of Economic Dynamics and Control 17* (5-6), 953–969.

Imrohoroglu, S., A. Imrohoroglu, and K. Chen (2006). The Japanese Saving Rate. *American Economic Review 96* (5), 1850–1858.

King, R. G. and S. T. Rebelo (1993). Transitional Dynamics and Economic Growth in the Neoclassical Model. *American Economic Review 83* (4), 908–31.

Levine, R. (2005). Finance and Growth: Theory and Evidence. In P. Aghion and S. Durlauf (Eds.), *Handbook of Economic Growth*, Volume 1 of *Handbook of Economic Growth*, Chapter 12, pp. 865–934. Elsevier.

Lewis, W. A. (1954). Economic Development with Unlimited Supplies of Labour. *The Manchester School 22* (2), 139–191.

Lucas, R. E. (1978). On the Size Distribution of Business Firms. *Bell Journal of Economics 9* (2), 508–523.

Midrigan, V. and D. Y. Xu (2014). Finance and Misallocation: Evidence from Plant-Level Data. *American Economic Review 104* (2), 422–58.

Moll, B. (2014). Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation? *American Economic Review 104* (10), 3186–3221.

Rajan, R. G. and L. Zingales (1998). Financial Dependence and Growth. *American Economic Review 88* (3), 559–86.

Restuccia, D. and R. Rogerson (2008). Policy Distortions and Aggregate Productivity with Heterogeneous Plants. *Review of Economic Dynamics 11* (4), 707–720.

Song, Z., K. Storesletten, and F. Zilibotti (2011). Growing Like China. *American Economic Review 101* (1), 196–233.

Stokey, N. L. (2008). *The Economics of Inaction: Stochastic Control Models with Fixed Costs*. Princeton University Press.

Todaro, M. P. (1969). A Model for Labor Migration and Urban Unemployment in Less Developed Countries. *American Economic Review 59* (1), 138–48.

Wol, E. N. (2012). The Asset Price Meltdown and the Wealth of the Middle Class. NBER Working Papers 18559, National Bureau of Economic Research, Inc.

7 Appendix A: Data Description

The date sources are the Penn World Table 8.0 and the National Bureau of Statistics of China.

The time period in Figure 1 is from 1992 to 2011. The rural employment shares of the population are taken from the National Bureau of Statistics of China.

equation iteration. This produces e□ciency in solving the model.

In my model, the grids of ability and asset are same for all economies. The ability is divided evenly among [0.2, 3.5] with grid number 200. The asset range is chosen to be [0.01, 15000] such that the saving function of the highest ability intersects the zero line before reaching the maximum asset level. I use uneven grids in asset holding to capture the nonlinear part of saving function with more accuracy.

8.1 Stationary Equilibrium

I solve the stationary equilibrium based on the method of Achdou et al (2015). The di□erence is that I have to iterate on both real interest rate r and wage w

for all a.

The state constraint boundary condition

$$\partial_a v(\underline{a}, z) \geq u(c)$$

for all z.

Let $v(a_i, z_j) = v_{i,j}$.

The discrete version of HJB equation (implicit method)

$$\frac{v_{i,j}^{n+1} - v_{i,j}^{n}}{\Delta} + \rho v_{i,j}^{n+1} = u(c_{i,j}^{n}) + \partial_a v^{n}$$

where $s_{i,j,F} = M_{i,j} + ra_i - c^n_{i,j,F}$ and $s_{i,j,B} = M_{i,j} + ra_i - c^n_{i,j,B}$ and $x^+ = \max\{x, 0\}$ and $x^- = \min\{x, 0\}$.

Substitute the definition in and simplify, we have

$$\frac{v^{n+1}_{i,j} - v^n_{i,j}}{\Delta} + \rho v^{n+1}_{i,j} = u(c^n_{i,j}) + x_{i,j} v^{n+1}_{i-1,j} + y_{i,j} v^{n+1}_{i,j} + z_{i,j} v^{n+1}_i$$

get value function $v(a, z, t)$