Capital Outflows and Economic Growth

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Abstract This paper is to examine the effect of capital outflows on economic growth through financial intermediaries. More specifically, the effects of two causes of capital outflows on economic growth: speculative capital outflow and factory relocation capital outflow, are discussed. We found that speculative capital outflow would cause a lower economic growth than the factory relocation outflow. That is because in the case of speculative capital outflow, the financial intermediaries would invest less in the illiquid assets, which would decrease both the payments to the depositors and capital accumulation, and hence, economic growth is lower.

Keywords: Capital outflows, factory relocation, economic growth

JEL classification: E42, G21, O16

1. Introduction

Globalization enhances capital mobility, which has caused increased capital flows across countries and emphasizes the role of capital flows on economic growth. How does capital flow affect economic growth? It is evident that capital flows affect economic growth through various channels. In this paper, we would like to focus on the channel via the financial intermediaries. Since the amount of each capital flow is usually large, most agents would flow their capital in and out via the financial intermediaries. Additionally, the financial intermediaries also serve as the financial portfolio managers. The assets the financial intermediaries invest may affect the payment to their depositors, and hence, the amount of capital flow and the economic growth. Although there has been a considerable amount of empirical evidence showing the effects of foreign capital flows on financial intermediaries and economic growth, not much theoretical support has been provided on this subject. Therefore, in this paper, we would like to focus on the role of capital flow on economic growth via financial intermediaries and to provide possible theoretical explanations of how capital flow affects economic growth.

Why does capital flow? This question has been raised worldwide. The two more obvious causes are arbitrage and factory relocation. The most recent example of arbitrage is the market speculation on the possibility of appreciation in the Chinese currency (RMB) exchange rate, which causes capital inflow to China from other countries to benefit from the currency appreciation. The factory relocation has become a very important issue lately for most developed countries, including the United States and England. The reason is because the low labor cost in developing countries, such as India, China and Southeast Asia, has attracted the labor-intensive industries, such as manufacturing, to move to these countries. What concerns the
developed countries is that these factory relocated industries not only invest their money but also move their capital into these developing countries from their home countries. While the former cause of capital flow is more speculative, the latter cause of capital flow usually occurs after evaluation. Would these two different motivations for capital flow affect the economic growth differently?

To address both issues, this paper extends the overlapping generation model constructed by Bencivenga and Smith (1991) to discuss how these two kinds of capital flow affect the financial system, and hence, economic growth. By allowing for the financial intermediaries to serve as portfolio managers, who would allocate the deposit between liquid and illiquid investment, it can be shown that the capital outflow caused by market speculation would result in a higher investment in the liquid asset, which decreases both the payment for early withdrawal and late withdrawal. When receiving less payment from the financial intermediaries, not only is the amount flowing out smaller, but also the amount invested domestically is smaller, and hence, there is a lower economic growth rate. The factory relocation capital flow, however, reduces the capital stock and the return of capital, and hence, decreases the growth rate. Although the growth rate of either case is lower than the case without capital outflow, the growth rate in the case of factory relocation is higher than that of speculation. That is because in the factory relocation case, the patient relocated entrepreneurs would allow the financial intermediaries to invest more in the illiquid assets; therefore, the payment to the depositors are higher, and with a higher payment received from the financial intermediaries, more capital can be accumulated. Therefore, the growth rate is higher in the case of factory relocation.

The related literature, which motivates this work, includes Bencivenga and Smith (1991), which emphasizes the role of financial intermediaries in economic growth. Similar issues have been addressed by Ennis and Keister (2003, 2004), who combine the sunspot equilibrium and the endogenous growth model to analyze the effect of liquidity and investment decision, and by Dekle and Kletzer (2001), who use the endogenous growth solely to discuss the link between capital flow and bank debt. Moreover, Schreft and Smith (1998) introduce the idea of relocation to discover the effects of open market operations in economic growth as well as capital formation.

The paper is structured as follows. Section II describes the general model, whose results are shown in Section III. The discussion of the impact of early withdrawal caused by capital outflow is in Section IV, followed by concluding remarks and possible extension in Section V.

2. The Model

The model is constructed so that financial intermediaries perform as a financial portfolio manager for depositors. It extends both Diamond and Dybvig (1983) and Bencivenga and Smith (1991) to address how capital flow affects the possibility of bank runs, and hence, economic growth.
2.1. The General Environment

The economy consists of an infinite sequence of three-period-lived overlapping generations, plus an initial old generation and an initial middle-aged generation. Also, the economy contains a continuum of agents. Let \( t = 0, 1, 2 \), and so on index time. Each of the initial old generation is endowed with an initial per capital stock \( k_0 \) units at \( t = 0 \) while each of the initial middle-aged generation is endowed with an initial per capital stock \( k_1 \) units at \( t = 1 \).

There are two goods in the economy: consumption good and capital good. Both capital and labor are inputs to produce the consumption goods. The capital good is assumed to depreciate in one period.

2.2. Agents

Each agent lives for three periods: young, middle-aged, and old. The activities of an agent in these three periods are described as follows:

- Young period (age 1): the young generation is homogenous. Each is endowed with a unit of labor, which is supplied inelastically. The labor endowment is unique to the young generations, and does not apply to the middle-aged or the old generations. However, the young generations do not have consumption. They save their income in the financial intermediaries.

- Middle-aged period (age 2): all middle-aged generations have consumption but no labor endowment. All agents will realize two things at the beginning of age 2: (i) whether they are the entrepreneurs at age 3; (ii) if they are an entrepreneur, whether they will be relocated at age 3. The realizations will cause the agents to behave differently. The future entrepreneurs give equal weight to age-2 and age-3 consumption equally and will not withdraw their deposit until age 3, while non-entrepreneurs do not care about age-3 consumption, and hence will withdraw their deposit at age 2.

- Old period (age 3): relocation occurs. All old generations have no labor endowment either, but entrepreneurs will withdraw all their deposit. While the non-relocated entrepreneurs enjoy their consumption, the relocated entrepreneurs take their deposit and move.

[The details of the timing are depicted in Figure 1.]

It is assumed that the probability that an agent will be an entrepreneur is \( \pi \), and that the probability that an entrepreneur will be relocated at age 3 is \( \beta \). This implies that after realizations at age 2, there are three types of agents: (i) the relocated entrepreneurs (RE) with probability \( \pi \beta \); (ii) the non-relocated entrepreneurs (NE) with probability \( \pi (1-\beta) \); (iii) the non-entrepreneurs with probability \( (1-\pi) \). Based on Bencivenga and Smith (1991), the utility function of all young agents can be written as:

\[
 u(c_1, c_2, c_3; \varphi) = -\left(\frac{c_2 + \varphi c_3}{\gamma}\right)^\gamma
\]

(1)
where $\gamma > -1$ represents the elasticity of the substitution of inter-temporal consumption, and $\phi$ represents an individual-specific variable, which reflects an individual’s weight at age-3 consumption relative to age-2 consumption, and has the probability distribution as follows:

$$
\phi = \begin{cases} 
0 & \text{with probability } (1 - \pi) \\
1 & \text{with probability } \pi
\end{cases}
$$

(2)

Note that age-1 consumption does not enter the utility function of all young generations; hence, all wage income received at age-1 will be saved. This saving decision will not be influenced by the financial structures.

2.3. Production Function and Labor Market

As described above, although capital goods is one required input for production, no agent is endowed with capital goods, except for the initial old and initial middle-age generations. The resource of the capital good comes from the illiquid investment, and agents will own capital goods only if they withdraw two periods after making a deposit. Therefore, the economy’s capital is owned by a subset of the old generations. These old generations with capital goods will use their own capital in production. It is assumed that the capital owned by each old agent is enough for production; hence, no loan finance is needed, and there is no rental market for capital.

Let $k_t$ denote the capital owned by an individual entrepreneur at date $t$. While the average capital stock held per entrepreneur without relocation at date $t$ is $\tilde{k}_t$, the average capital stock held per entrepreneur after relocation is $(1 - \pi \beta) \tilde{k}_t$. Recall that all entrepreneurs value the capital goods more than their age-2 consumption, and hence, will not withdraw one period after deposit. Therefore, the relocated entrepreneurs will take the capital goods as well as the consumption goods with them to the new location after withdrawal. This lowers the average capital stock held per entrepreneur to $(1 - \pi \beta) \tilde{k}_t$. In order to produce consumption goods, the entrepreneur has to employ $L_t$ units of labor. Given the average capital stock, the capital which the entrepreneur owns, and the labor he hires, the production function can be written in the form of:

$$
Y_t = (1 - \pi \beta) \tilde{k}_t^\delta k_t^\theta L_t^{1-\theta}
$$

(3)

where $\theta \in [0,1]$, and $\delta = 1 - \theta$ represents the scale effect, which implies that the social capital level could have positive externality in individual production.

The role of an entrepreneur includes choosing an employment level to maximize the profit, which gives:

$$
\text{Max}_{L_t} \{ (1 - \pi \beta) \tilde{k}_t^\delta k_t^\theta L_t^{1-\theta} - w_t L_t \}
$$

(4)

By solving the above problem, the amount of labor units demanded by an entrepreneur is:
\[ L_t = k_t \left[ \frac{(1 - \theta)(1 - \pi\beta)\bar{k}}{w_t} \right]^{1/\theta} \]  

(5)

In this paper, full employment is assumed, so labor supply to each entrepreneur can be written as:

\[ L_t = \frac{1}{\pi(1 - \beta)} \]  

(6)

After relocation agents move out, the capital goods are owned only by non-relocated entrepreneurs, who will hire young agents to produce. Thus, given equation (5) and (6), the labor market clearing condition determines the market wage rate:

\[ w_t = (1 - \theta)(1 - \pi\beta)\bar{k}^{\theta-1} \]  

(7)

According to the production function, the capital return for an entrepreneur is:

\[ \theta(1 - \pi\beta)\bar{k}^{\theta-1} k_t = \theta\psi(1 - \pi\beta)k_t \]  

(8)

where \( \psi \equiv \bar{k}^{\theta-1} \).

2.4. Investment

Similar to Bencivenga and Smith’s model (1991), the economy has two types of investment, a liquid investment and an illiquid investment, available for the financial intermediaries, but not to individuals directly. The role of financial intermediaries is to collect savings from all young generations and allocate them to liquid and illiquid investment. The return of the liquid investment is \( n > 0 \) units of consumption good either at \( t+1 \) or \( t+2 \) for each unit of consumption good investing at \( t \). The return of the illiquid investment is \( R \) units of capital goods at \( t+2 \) for each unit of consumption good investing at \( t \). Any early liquidation from illiquid investment at \( t+1 \) will result in \( \chi \) units of consumption good, and \( 0 \leq \chi < n \).

2.5. Financial Intermediaries

Let \( z_t \in [0, 1] \) denote the fraction of each unit of deposit placed in liquid assets, and let \( q_t \in [0, 1] \) denote the fraction of each unit of deposit placed in illiquid assets. Since the liquid investment in the model serves as a reserve, the sum of \( z_t \) and \( q_t \) must be one, \( z_t + q_t = 1 \). As soon as the financial intermediaries receive the deposit from young generations, they allocate the deposit to either the liquid or the illiquid investment.

Some agents may withdraw one period after making a deposit, and some may not withdraw until two periods after making a deposit. Therefore, the financial intermediaries would set the payment to depositors, depending on when the withdrawal occurs. When the deposit is withdrawn one period after making the deposit, the agent will be paid \( r_{tt} \) units of consumption...
goods for each unit of deposit. When the deposit is withdrawn two periods after making the deposit, the agent will be paid $r_{2t}$ units of capital goods and $\tilde{r}_{2t}$ units of consumption goods for each unit of deposit. In order to meet the payment to the depositors at various times, the financial intermediaries have to decide on the fraction of liquid and illiquid investment to liquidate.

Let $\alpha_{1t}$ be the fraction of the liquid investment that will be liquidate after one period, and let $\alpha_{2t}$ be the fraction of illiquid investment that will be liquidated after one period. The budget constraints of the financial intermediaries at period one and two can be written as:

\[
(1 - \pi)r_{1t} = \alpha_{1t}z,n + \alpha_{2t}q,t, \chi,
\]

\[
\pi r_{2t} = (1 - \alpha_{2t})Rq,t,
\]

\[
\pi \tilde{r}_{2t} = (1 - \alpha_{1t})n\tilde{z},
\]

where equation (9) is the constraint for one period after investment, and equations (10) and (11) are the constraints for two periods after investment. While equation (10) is the constraint for capital goods, equation (11) states the constraints for consumption good. The obligation payment to the agents one period after deposit, $r_{1t}$, requires the financial intermediaries to liquidate enough investment, both liquid and illiquid investment, as represented on the right-hand-side of equation (9), to meet the payment. At the 2nd period after deposit, all entrepreneurs, both relocated and non-relocated, will withdraw all their deposit. Since the payment at the 2nd period contains capital and consumption goods, two constraints are required to describe the resources of the payment, respectively.

The financial intermediary system is assumed to be competitive, which implies zero profit. Therefore, they will choose the variable set \{\{z,t,q,t,\alpha_{1t},\alpha_{2t},r_{1t},r_{2t},\tilde{r}_{2t}\}\} to maximize the expected utility of a representative agent. Recall that a fraction $\pi$ of agents will carry their deposit at age 3 to relocate. Although this information is available to the financial intermediaries, they still will not discriminate accordingly. Therefore, the problem of the financial intermediaries becomes:

\[
\text{Max} \quad \left\{ \left(1 - \frac{\pi}{\gamma}\right)(-r_{1t}w,t)^{\gamma} + \frac{\pi}{\gamma}[-\theta\psi(1 - \pi\beta)r_{2t},w,t + \tilde{r}_{2t},w,t]^{\gamma} \right\}
\]

where the first term represents the utility of the non-entrepreneurs and the second term is the utility of the entrepreneurs. Since a non-entrepreneur cares only about the age-2 consumption, he will consume everything he withdraws one period after deposit, which gives return $r_{1t} w,t$. An entrepreneur, however, cares about both the consumption at age 2 and age 3, so he will not withdraw until two periods after deposit, which gives return $(r_{2t} + \tilde{r}_{2t}) w,t$. Note that $r_{2t} w,t$ is paid in capital goods, which are used in production and give the entrepreneur returns to capital in the amount of $\theta\psi(1 - \pi\beta)k_{r,t}$. Then the financial intermediaries will choose the variable set to maximize equation (12), subject to equations (9)-(11).
3. Equilibrium

In addition, to give customers return for their deposit, the financial intermediaries also serve as financial portfolio managers. In this model, the portfolio is between the liquid and illiquid investment. The return of the liquid investment is \( n \) units of consumption goods while the return of the illiquid investment is \( R \) units of capital goods, which in turn will give \( \theta \psi R \) units of consumption goods. By comparing the returns of both investments, the financial intermediaries may make the following decisions.

**Proposition 1**

If \( \theta \psi (1 - \pi \beta) R \geq n > 0 \), then the financial intermediaries choose \( \alpha_{t+1} = 1, \alpha_{2t} = 0, \tilde{r}_{2t} = 0 \);

therefore, \( q_t = \frac{\Phi}{1 + \Phi}, z_t = \frac{1}{1 + \Phi} \), where \( \Phi = \left( \frac{n}{1 - \pi} \left( \frac{\pi}{(1 - \pi \beta) \theta \psi R} \right)^{\gamma/(1+\gamma)} \right), r_{t+1} = \frac{n}{(1 - \pi)(1 + \Phi)}, r_{2t} = \left( \frac{R}{\pi} \right) \left( \frac{\Phi}{1 + \Phi} \right). \)

Proposition 1 shows that when the rate of return of the illiquid investment at maturity is larger than that of the liquid investment, the financial intermediaries would not liquidate any illiquid investment prematurely, so \( \alpha_{2t} = 0 \). Since the rate of return of the liquid investment does not depend on the liquidation date, the financial intermediaries would liquidate all liquidate investment one period after investment, \( \alpha_{t+1} = 1 \). When all liquid investment is liquidated one period after investment and used to pay for the early withdrawals (one period after deposit) in terms of consumption goods, there is no liquid investment left for liquidation two periods after investment, so no consumption goods will be paid for the withdrawals two periods after the deposit, \( \tilde{r}_{2t} = 0 \). Thus, after solving the optimization problems (equations (9)-(12), it is optimal for the financial intermediaries to invest a fraction \( q_t = \frac{\Phi}{1 + \Phi} \) of the total deposit at \( t \) on the illiquid assets, and a fraction \( z_t = \frac{1}{1 + \Phi} \) of the total period-\( t \) deposit on the liquid assets. In turn, the rate of return of both the early withdrawal, which occurs at one period after deposit, and the late withdrawal, which occurs two periods after deposit, from the financial intermediaries to the depositors are determined, \( r_{t+1} = \frac{n}{(1 - \pi)(1 + \Phi)} \) and \( r_{2t} = \left( \frac{R}{\pi} \right) \left( \frac{\Phi}{1 + \Phi} \right). \)

**Condition 1:**

If the condition \( \left( \frac{\theta \psi (1- \pi \beta) R}{\pi} \right) \left( \frac{\Phi}{1 + \Phi} \right) > \left( \frac{n}{1 - \pi} \right) \left( \frac{1}{1 + \Phi} \right) \) holds, all entrepreneurs will withdraw at \( t+2 \).
This condition implies that when rate of capital return is higher than the rate of return of the early withdrawal, then all entrepreneurs would prefer to withdraw two periods after deposit. That is because the entrepreneurs weight both $C_2$ and $C_3$ equally. So a higher rate of capital return would stimulate entrepreneurs to withdraw two periods after deposit in order to receive capital goods to produce and receive higher return from it.

**Proposition 2:**

*When relocation occurs, in the case of which the entrepreneurs would take their deposits and leave at $t+2$, the growth rate of the economy is:*

$$\mu \equiv \frac{\bar{K}_{t+2}}{K_t} = R \left( \frac{\Phi}{1+\Phi} \right) (1-\theta)(1-\pi\beta)\psi(1-\beta)$$

Proposition 2 shows that the growth rate is affected by the rate of return of liquid and illiquid assets, capital and labor share in production, the fraction of relocation agents and entrepreneurs, and the fraction that the financial intermediaries invest in different assets. It shows that the smaller the fraction of the relocated entrepreneurs, the higher the fraction the financial intermediaries would invest in illiquid assets; in turn, the economic growth will be higher.

**Proposition 3:**

*When we compare the cases when relocation does and does not occur, the result is quite interesting. When the fraction of entrepreneurs is sufficiently small, $(1-\beta)^{1-\theta} < 1-\pi\beta$, the economy without relocation would invest a larger fraction on the illiquid investment, which would result in a strictly higher growth rate than the economy with relocation.*

The difference between the cases when relocation does and does not occur is that $\beta=0$ when there is no relocation while $\beta>0$ when there is relocation. Compared the growth rates of both relocation and non-relocation cases, it is found that when the fraction of the relocated entrepreneurs is sufficiently small, $(1-\beta)^{1-\theta} < 1-\pi\beta$, the financial intermediaries would invest a smaller fraction in the illiquid assets than in the case without relocation. Moreover, the smaller the fraction $\pi\beta$ of the relocated entrepreneurs is, the larger the fraction the financial intermediaries would invest in the illiquid assets, and the higher the economic growth rate will be.

4. **The Discussion**

4.1. **Case Study: Speculative Capital Outflow**

In this section, the case of impatient relocated entrepreneurs will be discussed. This case reflects the speculative entrepreneurs, who usually take their deposit, not capital, and invest in a different location to wait for the booming of that relocated economy. This kind of entrepreneurs is usually impatient, which means that they will withdraw their deposit whenever they see an opportunity
and invest in a place wherever they may earn more [the timing of this case is depicted in Figure 2]. Since the capital goods are not taken away from the initial economy, it would be interesting to study whether the growth rate in this case would be higher than the case in which relocated entrepreneurs take away the capital goods. It is assumed that the relocated entrepreneurs will join the non-entrepreneurs to withdraw one period after making a deposit to prepare for relocation. Therefore, no capital goods will be taken away from their initial economy. The return of capital becomes $k_{t+1}^i = \theta \psi \theta \pi \theta^{-1}$, where $\psi' = \pi^{\theta^{-1}}$, indicating that the return of capital is higher when it will not be carried away. Then the problem for the financial intermediaries becomes:

$$
\begin{align*}
\text{Max} & \left\{ \left(1 - \frac{1 - (1 - \beta)}{\gamma} \right) \left( - r_{t1}, w_t \right)^{-\gamma} + \frac{(1 - \beta)}{\gamma} \left[ - \theta \psi' k_{t+2}^i + \bar{r}_{t2}^i w_t \right]^{\gamma} \right\} \\
\text{Subject to} & \quad (1 - \pi (1 - \beta)) q_{t1}' = \alpha_{t1}' z_t', n + \alpha_{t2}' q_t', \chi, \\
& \quad \pi (1 - \beta) r_{t2}' = (1 - \alpha_{t2}') R q_t', \\
& \quad \pi (1 - \beta) \bar{r}_{t2}' = (1 - \alpha_{t1}') n z_t', \\
\end{align*}
\tag{9'}
$$

**Proposition 4**

If $\theta \psi' R > n > 0$, the financial intermediaries choose $\alpha_{t1}' = 1$, $\alpha_{t2}' = 0$, $\bar{r}_{t2}' = 0$; therefore, $q_t' = \frac{\Phi'}{1 + \Phi'}$, $z_t' = \frac{1}{1 + \Phi'}$, where $\Phi' = \left( \frac{\pi (1 - \beta)}{1 - \pi (1 - \beta)} \right) \left( 1 - \beta \right)^{\gamma (1 + \gamma)}$. Moreover, the rates of return from the financial intermediaries to the depositors one and two periods after deposit are as follows, respectively: $r_{t1}' = \frac{n}{(1 - \pi)(1 + \Phi')}$, and $r_{t2}' = \left( \frac{R}{\pi} \right) \left( \frac{\Phi'}{1 + \Phi'} \right)$.

**Proposition 5**

When relocation occurs, in the case of which the entrepreneurs would take their deposits and leave at $t+1$, the growth rate of the economy is:

$$
\mu' \equiv \frac{k_{t+2}^i}{k_t^i} = R \left( \frac{\Phi'}{1 + \Phi'} \right) (1 - \theta) (1 - \pi \beta) \psi' (1 - \beta).
$$

**Proposition 6**

By comparing the case in which relocated entrepreneurs withdraw their deposit at $t+1$ to the case in which the withdrawals take place at $t+2$, it is found that $q_t' < q$, and $\mu' < \mu$. 

Proof: see Appendix.

When Proposition 4 is compared to Proposition 1, it can be shown that impatient relocated entrepreneurs, who withdraw at period \( t+1 \) would cause the financial intermediaries to allocate a lower fraction \( q_i' \) of the deposit to the illiquid investment in response to more withdrawals at period \( t+1 \). However, a higher fraction withdrawal at \( t+1 \) would lower the rate of return of the short-term deposit, \( r_{t+1}' < r_t' \), and a lower fraction invested in the illiquid assets would also lower the rate of return of long-term deposit, \( r_{2t}' < r_{2t} \). Furthermore, the growth rate of the economy would be even lower in the case when withdraws of relocated entrepreneurs take place at period \( t+1 \).

One possible explanation for Proposition 6 is that in the case of impatient relocated entrepreneurs, when no capital good is taken away, the rate of return of capital is higher than the case of patient relocated entrepreneurs who take away the capital goods. However, in order to meet the withdrawals taking place at \( (t+1) \), the financial intermediaries need to allocate a higher fraction of investment to the liquid assets in the case of impatient relocated entrepreneurs. In turn, the investment in the illiquid assets is less, and the payments to the depositors are lower in periods \( (t+1) \) and \( (t+2) \). A lower payment to depositors at \( t+2 \) would generate less total capital return; hence, lower the economic growth.

5. Conclusions and Extensions

The purpose of this exercise is to illustrate how the capital flows affect the payment domestically. Given a relatively simple set-up without considering the exchange rate complication, it can be concluded that the return of the deposit depends crucially on whether capital goods are allowed to be carried away.

A number of interesting extensions can be considered from the current structure. First, as one can imagine, by taking account of the changes in the exchange rate, the analysis would be more accurate. Second, if the agents can choose when to withdraw, the possibility of bank runs could be endogenously determined. Third, if following the traditional overlapping generation model by allowing the agents to hold money as well, what are the possible consequences? Fourth, it could be interesting to examine the case when the agents as well as the financial intermediaries have access to the investment opportunities.

Endnote:

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Appendix

Proof of Proposition 6:
The sufficient condition for $\Phi > \Phi'$ is \((1 - \pi + \pi \beta) \left[ \frac{(1 - \beta)^{\theta}}{1 - \pi \beta} \right]^{\frac{r}{\tau + 1}} > (1 - \beta)(1 - \pi)\). After rearrangement, this condition can be re-written as: \(1 + \frac{\pi \beta}{1 - \pi} > (1 - \beta)^{\tau \rho + 1} (1 - \pi \beta)^{\frac{1}{\tau + 1}}\). When this condition holds, it can be found that $\Phi > \Phi'$, which leads to $q > q'$. 
References


Timing

Figure 1:
Entrepreneurs withdraw at age-3
Figure 2: Entrepreneurs withdraw at age 2