Does "Higher Wall" Hinder Immigration?

Yasunori Fujita[1]

[1] Department of Economics, Keio University, Tokyo, Japan

Correspondence: Yasunori Fujita, Department of Economics, Keio University, 2-15-45 Mita, Minato-ku, Tokyo, Japan. E-mail: yfujita@econ.keio.ac.jp

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Abstract

In the present paper, we examine if "higher wall" really hinders immigration *i.e.*, if tightening of border enforcement reduces immigration. The framework we construct is a stochastic one where an individual intends immigration under uncertainty that is expressed by geometric Brownian motion. It is revealed that "higher wall", contrary to the intention of regulatory authorities, does not hinder immigration.

Keywords: higher wall, immigration, optimal stopping theory, value of waiting

JEL Classification: G11, J08, J60

1. Introduction

Studies on immigration control, theoretical basis of which was laid out by Todaro and Maruszko (1987), have entered a new stage where numerous attempts are made to investigate the reason why border enforcement has little, sometimes even backfiring, effect in reducing migration. Main articles include Hanson and Spilimbergo (1999), Davila, Pagan and Soydemir (2002), Hanson, Robertson and Spilimbergo (2002), Hanson and McIntosh (2009, 2010), Massey and Riosmena (2010), Angelucci (2012), Massey Durand and Pren (2014), Triandafyllidou (2018) and so on.

In the present paper, we attempt to push forward these studies by combining, as in Fujita (2007), Fujita (2016) and so on, the standard microeconomic theory with the optimal stopping theory that has been used to develop stochastic strategies on optimal timing since McDonald and Siegel (1986), Dixit (1989), Farzin, Huisman and Kort (1988) etc. revealed the importance of the value of waiting. More precisely, by incorporating labor demand function and immigrant's disutility function explicitly into the optimal stopping model, we examine if tightening of border enforcement, *i.e.*, "higher wall", accelerates the immigration.

Structure of this paper is as follows. After constructing a basic model to derive the equilibrium benefit of the immigrant in Section 2, section 3 formulates the immigrant's objective function. Based on these analyses, in section 4 we demonstrate that the tightening of border enforcement, contrary to the intention of regulatory authorities, accelerates the immigration. Concluding remarks are made in section 5.

2. Basic Model

Let us consider an individual who is planning to immigrate in an intertemporal economy where time passes continuously with importance of the future diminishing with discount rate ρ. We assume the individual takes wage rates after the immigration as given, and letting $x(t)$ denote her/his labor supply in period t, we specify the wage rate in period t as $w(t) = Ax(t)^{-\varepsilon}$, where A is a positive parameter that expresses market size, while ε is a parameter that satisfies $0<\varepsilon<1$ and expresses elasticity of labor demand. Let us also assume that the individual immigrates in period t^* with a cost of K.

Taking notice of the growing political uncertainty in the United States of America and so on, we assume that the disutility of labor increases stochastically with time. In the following, we specify the disutility of labor when supplying $x(t)$ units of labor in period t as $\frac{c}{\varphi(t)}x(t)^{\eta}$, where c, η and $\varphi(t)$ are parameters that satisfy $c>0$, $\eta>1$ and $0 \leqq$

$\varphi(t)\leqq 1$ with the following geometric Brownian motion,

$$\frac{d\varphi}{\varphi(t)}=\theta dz, \tag{1}$$

with initial value $\varphi(0)<1$. We also assume that the individual optimizes the immigration period, t^*, as well as the amount of her/his labor supply in each period.

Since the immigrant's benefit in period t, $B(t)$, is described as $B(t)=w(t)x(t)-\frac{c}{\varphi(t)}x(t)^{\eta}$, we have its first order condition for the benefit maximization in period t as $\frac{\partial B}{\partial x}=w(t)-\frac{\eta c}{\varphi(t)}x(t)^{\eta-1}=0$, to yield the immigrant's equilibrium labor supply of in period t as $x(t)=(\frac{\varphi(t)w(t)}{\eta c})^{\frac{1}{\eta-1}}$. By combining this immigrant's labor supply function with the above inverse labor demand function $w(t)=Ax(t)^{-\varepsilon}$, we have the immigrant's equilibrium labor supply in period t as $x(t)=(\frac{A\varphi(t)}{\eta c})^{\frac{1}{\varepsilon+\eta-1}}$, to obtain the immigrant's equilibrium benefit in period t as

$$B(t)=\Lambda\varphi(t)^{\frac{\eta}{\varepsilon+\eta-1}} \quad \text{where} \quad \Lambda\equiv(\eta-1)(\frac{A}{\eta})^{\frac{\eta}{\varepsilon+\eta-1}}c^{\frac{\varepsilon-1}{\varepsilon+\eta-1}} \tag{2}$$

3. Formulation of the Immigrant's Objective Function

From Equation (2), we have its first derivative and second derivative with respect to $\varphi(t)$ as $\frac{dB}{d\varphi}=\frac{\eta\Lambda}{\varepsilon+\eta-1}\varphi(t)^{\frac{-\varepsilon+1}{\varepsilon+\eta-1}}$ and $\frac{d^2B}{d\varphi^2}=\frac{\eta(-\varepsilon+1)\Lambda}{(\varepsilon+\eta-1)^2}\varphi(t)^{\frac{-\varepsilon+1}{\varepsilon+\eta-1}-1}$, respectively. Thus, by making use of Ito's lemma, we can express the stochastic process of the immigrant's benefit as

$$\frac{dB}{B}=\mu dt+\sigma dz, \tag{3}$$

where $\mu=\frac{\eta(-\varepsilon+1)\theta^2}{2(\varepsilon+\eta-1)^2}$ and $\sigma=\frac{\eta\theta}{\varepsilon+\eta-1}$ with initial value of $B(0)=\Lambda\varphi(0)^{\frac{\eta}{\varepsilon+\eta-1}}$.

By making use of this stochastic process of the immigrant's benefit, as in Fujita (2017), let us express the immigrant's objective function to maximize in period 0, $V=E[\int_{t^*}^{\infty}e^{-\rho t}B(t)dt-e^{-\rho t^*}K]$, as a function of φ^* that is defined as the level of φ in period t^*. For this purpose, if we let $G(B(0))$ denote the expected value of one unit of the immigrant's benefit in period t^* (*i.e.*, the expected value of $e^{-\rho t^*}$) as a function of its initial benefit $B(0)$, the general solution to $G(B(0))$ is expressed as

$$G(B(0))=\alpha(B(0))^{\gamma_1}+\beta(B(0))^{\gamma_2}, \tag{4}$$

where $\gamma_1<0$ and $\gamma_2>0$ are solutions to the characteristic equation $\frac{\sigma^2}{2}x(x-1)+\mu x-\rho=0$. Since $G(B(0))$ satisfies $G(\infty)=0$ and $G(B^*)=1$ where B^* is defined as the immigrant's benefit in period t^*, it follows that $\alpha=0$ and $\beta=(\frac{1}{B^*})^{\gamma}$ where $\gamma\equiv\gamma_2=\frac{\varepsilon+\eta-1+\sqrt{(\varepsilon+\eta-1)^2+\frac{8\rho}{\theta^2}}}{2\eta}$, which combined with Equation (4) yields

$$G(B(0)) = (\frac{B(0)}{B*})^{\gamma}. \tag{5}$$

Thus, the immigrant's objective function to maximize in period 0 is calculated as $V = (\frac{B(0)}{B*})^{\gamma}(\frac{B*}{\rho-\mu} - K)$, which is rewritten as

$$V = (\frac{\varphi(0)}{\varphi*})^{\frac{\gamma\eta}{\varepsilon+\eta-1}}(\frac{1}{\rho-\mu}\Lambda\varphi*^{\frac{\eta}{\varepsilon+\eta-1}} - K), \tag{6}$$

by substituting $B(0) = \Lambda\varphi(0)^{\frac{\eta}{\varepsilon+\eta-1}}$ and $B* = \Lambda\varphi*^{\frac{\eta}{\varepsilon+\eta-1}}$ into $V = (\frac{B(0)}{B*})^{\gamma}(\frac{B*}{\rho-\mu} - K)$.

4. Optimal Timing of Immigration

Now, we are ready to determine the individual's optimal timing of immigration.

Since the model of the present paper is stochastic, the optimal timing of immigration is expressed by the cut off level of $\varphi*$. Since typical relationship between $\varphi*$ and V is depicted as a one-peaked trajectory that has the optimal value at $\varphi*^{O}$ on $\varphi*$-V space as in Figure 1, by differentiating Equation (6) with respect to $\varphi*$ and setting it to zero, we have the immigrant's optimal cut off level $\varphi*^{O}$ as

$$\varphi*^{O} = \{\frac{K}{\Lambda}\frac{\rho - \frac{\eta(-\varepsilon+1)\theta^2}{2(\varepsilon+\eta-1)^2}}{1 - \frac{1}{\varepsilon+\eta-1+\sqrt{(\varepsilon+\eta-1)^2+\frac{8\rho}{\theta^2}}}}\}^{\frac{\varepsilon+\eta-1}{-\varepsilon+1}}, \tag{7}$$

which makes it possible for us to examine how the optimal timing of immigration is affected by the tightening of border enforcement that is expressed by increase in K.

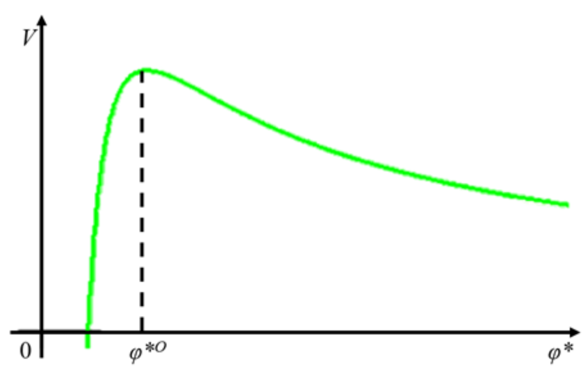

Figure 1. Relationship between uncertainty and sum of present value of the benefit

Since Equation (7) tells us that increase in K increase $\varphi*^{O}$, which means acceleration of immigration, we have the following proposition.

Proposition: Tightening of border enforcement accelerates immigration.

This proposition reveals that the "higher wall", contrary to the intention of regulatory authorities, does *not* hinder immigration, since the "higher wall" in the present model increases the cost of immigration, to decrease the value of waiting.

Graphically, as Figure 2 shows, increase in K shifts the one-peaked trajectory to the lower right, to make the optimal cut off level increase from $\varphi*^{O}$ to $\varphi*^{O}$'.

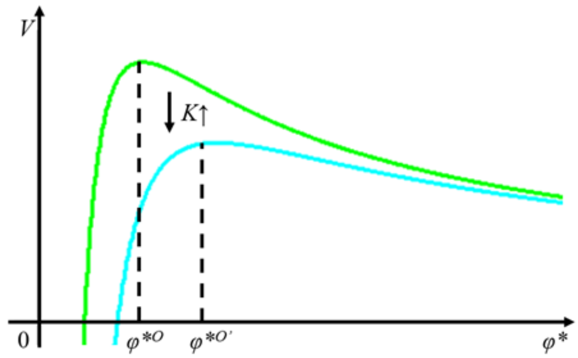

Figure 2. Effect of tightening of border enforcement on the optimal timing of immigration

5. Conclusions

In the present paper, we attempted to show the importance of the value of waiting in considering the effect of the "higher wall". More precisely, we examined if the "higher wall" really hinders immigration, *i.e*., if the tightening of border enforcement reduces immigration. The framework we invented was a model that combined the optimal stopping theory with the standard microeconomic theory. It was revealed that the "higher wall", contrary to the intention of regulatory authorities, does *not* hinder the immigration, *i.e.*, the tightening of border enforcement, due to the decrease in the value of waiting, accelerates the immigration.

In order to derive explicit results, we made simplifying assumptions on labor demand function, disutility function and stochastic motion. It is necessary to construct a general framework by relaxing those assumptions to examine the robustness of the present paper's results. It is also of interest to consider the interaction of the immigrants by extending the framework of the present paper. We will take up such analyses in our next research.

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