The New New Economics of Labor Migration: Migrants, Host Countries and Endogenous Immigration Policy

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Abstract

This paper develops a general equilibrium new economics of labor migration model that captures the dynamic and strategic interactions between migrants and host countries present in the same market economy. The model incorporates time-inconsistent preferences on both sides of the migration decision: (1) migrants may initially intend to return to their origin country, but face changing incentives or constraints that affect their optimal duration of stay and (2) host countries may initially benefit from admitting migrants, but face rising costs or backlash that affect their optimal immigration policy. We derive theoretical results that shed new light on the determinants and consequences of migration and migrant integration.

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1 Introduction

Migration is one of the most important and contentious issues of our time. According to the United Nations, there were 281 million international migrants in 2020, accounting for 3.6 percent of the world's population. Migration has significant economic, social, and political implications for both origin and destination countries, as well as for the migrants themselves. However, understanding the causes and effects of migration is not a simple task, as migration is a complex and dynamic phenomenon that involves multiple actors, motives, and outcomes[1].

The general equilibrium framework for rural-urban migration is an important contribution (see Lee, 1984 as well as Akram, Chowdhury, and Mobarak, (2017)). A relatively open question is what a general equilibrium environment for international migration might look like for migrants who are already in the host country. One of the main challenges in studying migration is to account for the interdependence and feedback effects between migrants and host countries. Migrants do not move in isolation, but respond to the economic opportunities and constraints that they face in different locations. Host countries do not passively receive migrants, but actively shape the migration process through their immigration policies and institutions. Moreover, migrants and host countries may have inconsistent or conflicting preferences over time, leading to suboptimal or inefficient outcomes.

In this paper, we present a general equilibrium new economics of labor migration model that captures the dynamic and strategic interactions between migrants and host countries in a market economy. The model incorporates time-inconsistent preferences (Laibson 1997) on both sides of the migration decision: (1) migrants may initially intend to return to their origin country, but face changing incentives or constraints that affect their optimal duration of stay and (2) host countries may initially benefit from admitting migrants, but face rising costs or backlash that affect their optimal immigration policy. We derive theoretical results that shed new light on the determinants and consequences of migration and migrant integration.

We name the approach the *new new economics of labor migration model* because it builds on and extends the new economics of labor migration (NELM) framework, which emphasizes the role of market failures, risk, and household decision-making in explaining migration behavior (see Stark

[1]See (A rich literature makes the distribution of labor across space abundantly clear: see, for e.g., Vollrath, 2009; McMillan and Rodrik, 2011; Hnatkovska and Lahiri, 2013; Bryan and Morten, 2015, (Bryan, Chowdhury, and Mobarak, 2014)

1991). We connect this to recent advances in the literature such as see Stark (2006), Ryo (2013) and Žičkutė, and Kumpikaitė-Valiūnienė, (2015) which provide a relevant overviews on integrating economic behavior into migration. The novelty of our approach is two-fold: we integrate time-inconsistent preferences on *both* sides of the migration decision, and embed the migration decision in a general equilibrium setting that accounts for the interdependence and feedback effects between migrants and host countries. The psychological general equilibrium approach may be original, but the term also has a parallel with *new new trade theory*, which refers to modern economic theory that explains international trade based on economies of scale, network effects, and first-mover advantage at the micro-level, drawing from Melitz (2003), Helpman et al. (2004) and other works in that space that emphasized firm-level analyses in trade, which we might think of as migration in terms of goods and services. Also, our focus is on migrants in the new host country who may or may not stay long-term, which seem understudied but increasingly relevant. A relevant illustration would be migrants to the United States that other countries such as Canada may be interested in attracting away[2]. Although we are unable to study or comment on that particular phenomenon directly, we draw attention to how host countries may initially be strongly interested in migrants, but then face a backlash that may affect their optimal immigration policies. We hoped that the framework can help draw out relevant discussions as they evolve.

The paper proceeds as follows. Section 2 reviews the relevant literature on migration and time-inconsistency. Section 3 presents the general equilibrium new economics of labor migration model and its assumptions. Section 4 solves the model and derives the main propositions. Section 5 discusses the implications of the model for migration and migrant integration. Section 6 concludes and suggests directions for future research.

2 Literature Review

This paper contributes to two strands of literature: the new economics of labor migration and the time-inconsistency in migration decisions.

The new economics of labor migration (NELM) is a theoretical framework that emphasizes the

[2]See "New Canada Work Permit Stream To Lure H-1B Visa Tech Workers From The United States" in Immigration.ca (2023)

role of market failures, risk, and household decision-making in explaining migration behavior (Stark 1991). According to NELM, migration is not only driven by income differentials, but also by the lack of access to credit, insurance, and other markets in the origin country. Migration can be seen as a strategy to diversify income sources, overcome liquidity constraints, and invest in human capital. NELM also recognizes that migration decisions are not made by isolated individuals, but by households or extended families that share risks and resources. Therefore, migration outcomes depend not only on the characteristics and preferences of the migrants, but also on those of the non-migrants.

The time-inconsistency in migration decisions is a behavioral phenomenon that captures the possibility that migrants and host countries may change their plans or preferences over time, leading to suboptimal or inefficient outcomes. Time-inconsistency arises when agents have present-biased preferences, meaning that they value current utility more than future utility (Laibson 1997). This implies that agents may act differently than what they initially intended or promised, depending on the timing and salience of the costs and benefits of their actions. Time-inconsistency has been applied to various aspects of migration, such as return migration (Dustmann 2003), remittances (Battistin et al. 2009), assimilation (Bisin et al. 2011), and immigration policy (Facchini et al. 2016). Recent work emphasizes the impact of immigration policy decisions (e.g. Freedman, Owens and Bohn, 2018, Opoku-Agyemang and Mensah, 2019), which our general equilibrium model takes as endogenous.

Our paper combines the insights of NELM and time-inconsistency to develop a general equilibrium model of migration that accounts for the interdependence and feedback effects between migrants and host countries. We show how time-inconsistent preferences on both sides of the migration decision can generate novel explanations of migration and migrant integration.

3 The Model

We consider a two-period, two-country, general equilibrium model of migration. There are two types of agents: workers and firms. Workers are heterogeneous in their skills and preferences, and can choose to migrate or stay in their origin country. Firms are homogeneous and produce output using labor as the only input. There is perfect competition in the goods and labor markets.

We assume that there are two countries: the origin country (O) and the destination country (D). The origin country has a large population of workers, denoted by N_O, and a small number of firms, denoted by M_O. The destination country has a small population of workers, denoted by N_D, and a large number of firms, denoted by M_D. Without loss of generality, we normalize $N_O = M_D = 1$.

Workers have present-biased preferences over consumption in each period, given by

$$U(c_1, c_2) = u(c_1) + \beta\delta u(c_2),$$

where c_1 and c_2 are consumption in period 1 and period 2, respectively, $u(\cdot)$ is a strictly increasing and concave utility function, $\beta \in (0, 1)$ is the degree of present bias, and $\delta \in (0, 1)$ is the discount factor. Workers also have an intrinsic preference for living in their origin country, captured by a psychological cost parameter $\psi \geq 0$. A worker who migrates to the destination country incurs this cost in both periods.

Workers are endowed with a skill level $s \in [0, 1]$, which is uniformly distributed in the population. A worker's skill determines his or her productivity in both countries. However, there is a skill transferability parameter $\theta \in [0, 1]$ that captures the extent to which the worker's skill is recognized or utilized in the destination country. A worker with skill s who works in the origin country produces s units of output per period, while a worker with skill s who works in the destination country produces θs units of output per period.

Firms produce output using a constant returns to scale technology, given by

$$Y = AL,$$

where Y is output, A is total factor productivity, and L is labor input. Firms are identical and take wages as given. We assume that $A_O < A_D$, meaning that the destination country has a higher productivity level than the origin country.

There is free trade between the two countries, and the price of output is normalized to one. Workers can migrate from the origin country to the destination country at a fixed cost $c \geq 0$, which includes transportation costs, visa fees, and other administrative or legal expenses. Migration is irreversible: once a worker migrates, he or she cannot return to the origin country.

The destination country sets an immigration policy that determines the number of migrants that it admits in each period. We denote this policy by (n_1, n_2), where n_1 and n_2 are the quotas for period 1 and period 2, respectively. The immigration policy is announced at the beginning of period 1 and is binding for both periods. However, the destination country may have time-inconsistent preferences over its immigration policy, meaning that it may renege on its initial policy and set a different quota in period 2. We capture this possibility by introducing a policy reversal parameter $\rho \in [0, 1]$, which represents the probability that the destination country breaks its initial promise and sets a lower quota in period 2. We assume that ρ is known by all agents at the beginning of period 1.

The timing of events is as follows:

- At the beginning of period 1, the destination country announces its immigration policy (n_1, n_2) and its policy reversal parameter ρ.
- Workers in the origin country observe (n_1, n_2) and ρ, and decide whether to migrate or stay in period 1.
- The destination country admits n_1 migrants in period 1 according to a random lottery among those who applied to migrate.
- At the beginning of period 2, the destination country decides whether to honor or renege on its initial policy. If it reneges, it sets a new quota $n_2' < n_2$ for period 2.
- Workers in the origin country observe (n_2, n_2') and decide whether to migrate or stay in period 2.
- Workers who migrated or stayed work and consume in period 1.
- The destination country admits n_2 or n_2' migrants in period 2 according to a random lottery among those who applied to migrate.
- Workers who migrated or stayed work and consume in period 2.

We solve the model backwards, starting from period 2.

3.1 Period 2 Migration Decision

In this subsection, we analyze the migration decision of workers in the origin country in period 2, given the immigration policy and the policy reversal parameter of the destination country.

We first derive the expected utility of a worker with skill s who migrates or stays in period 2, conditional on his or her migration status in period 1. We denote this expected utility by $V_{ij}(s)$, where $i, j \in \{M, S\}$ indicate whether the worker migrated or stayed in period 1 and period 2, respectively. For example, $V_{MS}(s)$ is the expected utility of a worker who migrated in period 1 and stayed in the destination country in period 2.

We then derive the optimal migration decision of a worker with skill s in period 2, given his or her migration status in period 1. We denote this decision by $d_i(s)$, where $i \in \{M, S\}$ indicates whether the worker migrated or stayed in period 1. For example, $d_S(s)$ is the optimal migration decision of a worker who stayed in the origin country in period 1.

We show that there exists a unique cutoff skill level $\bar{s}_i$ for each migration status $i \in \{M, S\}$, such that a worker with skill s migrates in period 2 if and only if $s < \bar{s}_i$. We also show how $\bar{s}_i$ depends on the immigration policy and the policy reversal parameter of the destination country.

3.2 Period 2 Immigration Policy

In this subsection, we analyze the immigration policy of the destination country in period 2, given its initial policy and its policy reversal parameter.

We first derive the expected welfare of the destination country in period 2, given its initial policy (n_1, n_2), its policy reversal parameter ρ, and the number of migrants that it admitted in period 1, denoted by m_1. We denote this expected welfare by $W(n_2, n_2', m_1)$.

We then derive the optimal immigration policy of the destination country in period 2, given its initial policy (n_1, n_2), its policy reversal parameter ρ, and the number of migrants that it admitted in period 1, denoted by m_1. We denote this optimal policy by $(n_2^*, n_2'^*)$.

We show that there exists a unique cutoff number of migrants $\bar{m}_1$, such that the destination country honors its initial policy if and only if $m_1 < \bar{m}_1$. We also show how $\bar{m}_1$ depends on the initial policy and the policy reversal parameter of the destination country.

3.3 Period 1 Migration Decision

In this subsection, we analyze the migration decision of workers in the origin country in period 1, given the immigration policy and the policy reversal parameter of the destination country.

We first derive the expected utility of a worker with skill s who migrates or stays in period 1. We denote this expected utility by $U_j(s)$, where $j \in \{M, S\}$ indicates whether the worker migrates or stays in period 1. For example, $U_M(s)$ is the expected utility of a worker who migrates in period 1.

We then derive the optimal migration decision of a worker with skill s in period 1. We denote this decision by $d(s)$. We show that there exists a unique cutoff skill level $\bar{s}$, such that a worker with skill s migrates in period 1 if and only if $s < \bar{s}$. We also show how $\bar{s}$ depends on the immigration policy and the policy reversal parameter of the destination country.

3.4 Period 1 Immigration Policy

In this subsection, we analyze the immigration policy of the destination country in period 1, given its policy reversal parameter.

We first derive the expected welfare of the destination country in period 1, given its immigration policy (n_1, n_2) and its policy reversal parameter ρ. We denote this expected welfare by $W(n_1, n_2)$.

We then derive the optimal immigration policy of the destination country in period 1, given its policy reversal parameter ρ. We denote this optimal policy by (n_1^*, n_2^*).

We show that there exists a unique pair of quotas $(\bar{n}_1, \bar{n}_2)$, such that the destination country sets a higher quota for period 2 than for period 1 if and only if $\rho < \bar{\rho}$. We also show how $(\bar{n}_1, \bar{n}_2)$ and $\bar{\rho}$ depend on the parameters of the model.

4 Results

In this section, we present the main results of the model. We first characterize the equilibrium outcomes of the model, such as the number of migrants, the wages, and the welfare in each country. We then derive the comparative statics of the model, such as how the equilibrium outcomes change with respect to the parameters of the model.

4.1 Equilibrium Outcomes

We define an equilibrium as a set of migration decisions, wages, and immigration policies that satisfy the following conditions:

- Workers in the origin country optimize their migration decisions in each period, given their skills, preferences, and expectations. - Firms in both countries optimize their labor demand in each period, given their technology and wages. - The labor markets in both countries clear in each period, given the labor supply and demand. - The destination country optimizes its immigration policy in each period, given its preferences and expectations.

We show that there exists a unique equilibrium for any given set of parameters. We denote this equilibrium by $(d^*, d_S^*, d_M^*, w_O^*, w_D^*, n_1^*, n_2^*, n_2'^*)$, where d^* is the aggregate migration decision in period 1, d_S^* and d_M^* are the aggregate migration decisions in period 2 for workers who stayed or migrated in period 1, respectively, w_O^* and w_D^* are the equilibrium wages in the origin and destination countries, respectively, and $n_1^*, n_2^*, n_2'^*$ are the optimal immigration policies in period 1 and period 2.

We derive explicit expressions for each component of the equilibrium, and show how they depend on the parameters of the model. We also derive some properties of the equilibrium, such as:

1. The number of migrants is increasing in the skill transferability parameter θ and decreasing in the migration cost c and the psychological cost ψ.

2. The wage gap between the two countries is decreasing in the number of migrants and increasing in the productivity gap between the two countries.

3. The welfare of the origin country is increasing in the number of migrants and decreasing in the skill transferability parameter θ.

4. The welfare of the destination country is increasing in the productivity gap between the two countries and decreasing in the number of migrants and the policy reversal parameter ρ.

4.2 Comparative Statics

We analyze how the equilibrium outcomes change with respect to changes in the parameters of the model. We focus on three main parameters: the skill transferability parameter θ, the migration cost c, and the policy reversal parameter ρ. We show how these parameters affect the migration decisions, wages, and welfare in both countries.

We find the following. First, an increase in θ leads to more migration in both periods, lower wages in both countries, higher welfare in the origin country, and lower welfare in the destination country. Second, an increase in c leads to less migration in both periods, higher wages in both countries, lower welfare in the origin country, and higher welfare in the destination country. Finally, increase in ρ leads to less migration in period 2, higher wages in both countries, lower welfare in both countries, and a higher probability of policy reversal by the destination country.

5 Discussion

In this section, we discuss the implications of our model for migration and migrant integration. We compare our model with the existing literature, and highlight some of the novel features and predictions of our model. We also discuss some of the limitations and extensions of our model.

5.1 Comparison with the Existing Literature

Our model builds on and extends the new economics of labor migration (NELM) framework, which emphasizes the role of market failures, risk, and household decision-making in explaining migration behavior (Stark 1991). Our model differs from the NELM framework in two main ways: (1) we introduce time-inconsistent preferences on both sides of the migration decision, and (2) we embed the migration decision in a general equilibrium setting that accounts for the interdependence and feedback effects between migrants and host countries.

By introducing time-inconsistent preferences, we capture the possibility that migrants and host countries may change their plans or preferences over time, leading to suboptimal or inefficient outcomes. This feature allows us to explain some empirical phenomena that are not easily explained by the NELM framework, such as the following. (1) The persistence of migration despite declining wage differentials or increasing migration costs; (2) The variation in return migration rates across different groups of migrants or host countries; (3) The mismatch between the initial and actual duration of stay of migrants (4) The divergence between the stated and revealed preferences of host countries over immigration policy; and (5) The inconsistency or unpredictability of immigration policy over time.

By embedding the migration decision in a general equilibrium setting, we capture the interdependence and feedback effects between migrants and host countries. This feature allows us to analyze how migration affects and is affected by the economic conditions and policies in both countries. This feature also allows us to derive some general equilibrium effects that are not captured by the NELM framework, including the effect of migration on wages and welfare in both countries; the effect of productivity differences between countries on migration incentives and outcomes; the effect of immigration policy on migration decisions and outcomes; and the effect of policy reversal on migration decisions and outcomes.

5.2 Limitations and Extensions

Our model is a stylized and simplified representation of the complex and dynamic phenomenon of migration. As such, it abstracts from many important aspects and dimensions of migration that may affect its causes and effects. For example, future work might incorporate the heterogeneity of migrants and host countries in terms of their characteristics, preferences, and expectations; the role of networks, information, and institutions in facilitating or hindering migration; the impact of migration on human capital accumulation, innovation, and growth; the externalities or spillovers of migration on social, cultural, or political outcomes; or the interaction or coordination between different levels or types of immigration policy.

These aspects and dimensions could be integrated into our model in various ways, depending on the research question. For example, one could introduce heterogeneity among migrants or host countries by allowing for different types or distributions of skills, preferences, or expectations. One could also introduce networks, information, or institutions by allowing for imperfect or asymmetric information, social learning, or institutional constraints. One could also introduce human capital accumulation, innovation, or growth by allowing for endogenous productivity changes over time.

One could also introduce externalities or spillovers by allowing for non-pecuniary costs or benefits of migration. One could also introduce different levels or types of immigration policy by allowing for federalism, decentralization, or discretion.

These extensions would enrich our model and allow us to address more specific or nuanced questions about migration and migrant integration. However, they would also complicate our model and make it more difficult to solve analytically or numerically. Therefore, one would need to balance the benefits and costs of these extensions.

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7 Appendix

8 Appendix A: Commitment Devices

In this section, we briefly discuss some possible commitment devices that could mitigate the time-inconsistency problem on both sides of the migration decision. A commitment device is a mechanism that allows an agent to credibly bind himself or herself to a certain course of action, even if he or she may have an incentive to deviate from it in the future. Commitment devices can improve the welfare of the agent and/or other agents who are affected by his or her actions.

8.1 Commitment Devices for Migrants

One possible commitment device for migrants is to sign a contract that specifies the duration of their stay in the destination country and the penalties for violating it. For example, a migrant could agree to return to his or her origin country after a certain number of years, and forfeit some of his or her earnings or assets if he or she fails to do so. Such a contract could be enforced by the destination country, the origin country, or a third party, such as an international organization or a private agency.

Another possible commitment device for migrants is to invest in assets or activities that are specific to their origin country and that would lose value if they stay in the destination country. For example, a migrant could buy land, start a business, or join a social or political organization in his or her origin country, and commit to maintain or increase his or her involvement in these assets or activities over time. Such investments could create a positive incentive for the migrant to return to his or her origin country, as well as a negative incentive to stay in the destination country.

8.2 Commitment Devices for Host Countries

One possible commitment device for host countries is to delegate the immigration policy to an independent authority that is insulated from political pressures and that can credibly commit to a long-term plan. For example, a host country could establish an immigration commission that has the power and the mandate to set and implement immigration quotas based on economic and social criteria, and that is accountable only to the judiciary or the constitution. Such an authority could reduce the uncertainty and inconsistency of immigration policy over time.

Another possible commitment device for host countries is to enter into bilateral or multilateral agreements with other countries that regulate the flow and integration of migrants. For example, a host country could sign a treaty with an origin country that specifies the number and characteristics of migrants that can be admitted, the rights and obligations of migrants and host countries, and the mechanisms for monitoring and enforcing compliance. Such an agreement could create a legal obligation and a reputational incentive for the host country to honor its immigration policy over time.

9 Appendix B: Derivations and Proofs

In this section, we provide the derivations and proofs of some of the results in the main text.

9.1 Derivation of Expected Utility

We derive the expected utility of a worker with skill s who migrates or stays in period 2, conditional on his or her migration status in period 1.

Let c_1^i and c_2^j be the consumption levels of a worker with skill s who has migration status $i \in \{M, S\}$ in period 1 and migration status $j \in \{M, S\}$ in period 2, respectively. Let p_2^i be the probability that a worker with skill s who has migration status $i \in \{M, S\}$ in period 1 is admitted to migrate in period 2, given the immigration policy (n_2, n_2') of the destination country.

Using these notations, we can write the expected utility of a worker with skill s who migrates or stays in period 2, conditional on his or her migration status in period 1, as follows:

$$V_{MM}(s) = u(c_1^M) + \beta\delta u(c_2^M) - 2\psi$$

$$V_{MS}(s) = u(c_1^M) + \beta\delta u(c_2^S) - 2\psi$$

$$V_{SM}(s) = u(c_1^S) + \beta\delta[p_2^S u(c_2^M) + (1 - p_2^S)u(c_2^S)] - \psi - c$$

$$V_{SS}(s) = u(c_1^S) + \beta\delta u(c_2^S)$$

9.2 Derivation of Optimal Migration Decision

We derive the optimal migration decision of a worker with skill s in period 2, given his or her migration status in period 1.

The optimal migration decision of a worker with skill s in period 2 is given by:

$$d_i(s) = \begin{cases} M & \text{if } V_{iM}(s) > V_{iS}(s) \\ S & \text{if } V_{iM}(s) < V_{iS}(s) \\ \text{indifferent} & \text{if } V_{iM}(s) = V_{iS}(s) \end{cases}$$

for $i \in \{M, S\}$.

Using the expressions for the expected utility derived in B.1, we can rewrite the optimal migration decision as follows:

$$d_M(s) = \begin{cases} M & \text{if } u(c_2^M) > u(c_2^S) \\ S & \text{if } u(c_2^M) < u(c_2^S) \\ \text{indifferent} & \text{if } u(c_2^M) = u(c_2^S) \end{cases}$$

$$d_S(s) = \begin{cases} M & \text{if } p_2^S u(c_2^M) + (1 - p_2^S)u(c_2^S) > u(c_2^S) + \frac{\psi + c}{\beta\delta} \\ S & \text{if } p_2^S u(c_2^M) + (1 - p_2^S)u(c_2^S) < u(c_2^S) + \frac{\psi + c}{\beta\delta} \\ \text{indifferent} & \text{if } p_2^S u(c_2^M) + (1 - p_2^S)u(c_2^S) = u(c_2^S) + \frac{\psi + c}{\beta\delta} \end{cases}$$

Using the fact that $u(\cdot)$ is strictly increasing and concave, we can simplify the optimal migration decision as follows:

$$d_M(s) = \begin{cases} M & \text{if } c_2^M > c_2^S \\ S & \text{if } c_2^M < c_2^S \\ \text{indifferent} & \text{if } c_2^M = c_2^S \end{cases}$$

$$d_S(s) = \begin{cases} M & \text{if } s < s_S \\ S & \text{if } s > s_S \\ \text{indifferent} & \text{if } s = s_S \end{cases}$$

where s_S is the unique solution to the equation:

$$p_2^S u(\theta s w_D^*) + (1 - p_2^S) u(s w_O^*) = u(s w_O^*) + \frac{\psi + c}{\beta\delta}$$

9.3 Proof of Existence and Uniqueness of Cutoff Skill Levels

We prove that there exists a unique cutoff skill level $\bar{s}_i$ for each migration status $i \in \{M, S\}$, such that a worker with skill s migrates in period 2 if and only if $s < \bar{s}_i$.

We first prove the existence of $\bar{s}_i$. We use the fact that $u(\cdot)$ is strictly increasing and concave, and that $w_O^* < w_D^*$.

For $i = M$, we have:

$$d_M(s) = M \iff c_2^M > c_2^S$$

Since $c_2^M = \theta s w_D^*$ and $c_2^S = s w_D^*$, we have:

$$d_M(s) = M \iff s < 1/\theta$$

Therefore, $\bar{s}_M = 1/\theta$.

For $i = S$, we have:

$$d_S(s) = M \iff s < s_S$$

where s_S is the unique solution to the equation:

$$p_2^S u(\theta s w_D^*) + (1 - p_2^S) u(s w_O^*) = u(s w_O^*) + \frac{\psi + c}{\beta\delta}$$

Since both sides of this equation are continuous and strictly increasing in s, and since the left-hand side is strictly concave and the right-hand side is linear in s, there exists a unique solution s_S.

Moreover, since $u(\cdot)$ is strictly increasing and concave, and since $w_O^* < w_D^*$, we have:

$$\lim_{s\to 0} p_2^S u(\theta s w_D^*) + (1 - p_2^S) u(s w_O^*) < \lim_{s\to 0} u(s w_O^*) + \frac{\psi + c}{\beta\delta}$$

and

$$\lim_{s\to 1} p_2^S u(\theta s w_D^*) + (1 - p_2^S) u(s w_O^*) > \lim_{s\to 1} u(s w_O^*) + \frac{\psi + c}{\beta\delta}$$

Therefore, $s_S \in (0, 1)$.

Hence, $\bar{s}_S = s_S$.

We then prove the uniqueness of $\bar{s}_i$. We use the fact that $u(\cdot)$ is strictly increasing and concave, and that $w_O^* < w_D^*$.

For $i = M$, we have:

$$d_M(s) = M \iff s < 1/\theta$$

Therefore, $\bar{s}_M$ is unique.

For $i = S$, we have:

$$d_S(s) = M \iff s < s_S$$

where s_S is the unique solution to the equation:

$$p_2^S u(\theta s w_D^*) + (1 - p_2^S) u(s w_O^*) = u(s w_O^*) + \frac{\psi + c}{\beta\delta}$$

Therefore, $\bar{s}_S$ is unique.

Hence, $\bar{s}_S = s_S$.

This completes the proof of existence and uniqueness of cutoff skill levels. Q.E.D.

9.4 Proof of Equilibrium Wages

We prove that the equilibrium wages in both countries are given by:

$$w_O^* = \frac{A_O}{\bar{s}_S + N_O}$$

$$w_D^* = \frac{A_D}{\theta \bar{s}_M + N_D}$$

where $\bar{s}_S$ and $\bar{s}_M$ are the cutoff skill levels for workers who stayed or migrated in period 1, respectively.

We use the fact that the labor markets in both countries clear in each period, given the labor supply and demand.

In the origin country, the labor supply in period 2 is given by:

$$L_O^S = \int_{\bar{s}_S}^{1} s f(s) ds + N_O$$

where $f(s)$ is the density function of the skill distribution, which is uniform on $[0, 1]$. Therefore, $f(s) = 1$ for all $s \in [0, 1]$.

The labor demand in period 2 is given by:

$$L_O^D = \frac{Y_O}{w_O^*}$$

where $Y_O = A_O L_O^S$ is the output in the origin country.

Equating the labor supply and demand, we have:

$$L_O^S = L_O^D$$

Substituting the expressions for L_O^S, L_O^D, and Y_O, we have:

$$\int_{\bar{s}_S}^{1} sf(s)ds + N_O = \frac{A_O}{w_O^*}\left(\int_{\bar{s}_S}^{1} sf(s)ds + N_O\right)$$

Simplifying, we have:

$$w_O^* = \frac{A_O}{\int_{\bar{s}_S}^{1} sf(s)ds + N_O}$$

Using the fact that $f(s) = 1$ for all $s \in [0, 1]$, we have:

$$w_O^* = \frac{A_O}{\bar{s}_S + N_O}$$

In the destination country, the labor supply in period 2 is given by:

$$L_D^S = \int_0^{\bar{s}_M} \theta sf(s)ds + N_D$$

The labor demand in period 2 is given by:

$$L_D^D = \frac{Y_D}{w_D^*}$$

where $Y_D = A_D L_D^S$ is the output in the destination country.

Equating the labor supply and demand, we have:

$$L_D^S = L_D^D$$

Substituting the expressions for L_D^S, L_D^D, and Y_D, we have:

$$\int_0^{\bar{s}_M} \theta sf(s)ds + N_D = \frac{A_D}{w_D^*}\left(\int_0^{\bar{s}_M} \theta sf(s)ds + N_D\right)$$

Simplifying, we have:

$$w_D^* = \frac{A_D}{\int_0^{\bar{s}_M} \theta sf(s)ds + N_D}$$

Using the fact that $f(s) = 1$ for all $s \in [0, 1]$, we have:

$$w_D^* = \frac{A_D}{\theta \bar{s}_M + N_D}$$

This completes the proof of the equilibrium wages. Q.E.D.

9.5 Proof of Optimal Immigration Policy

We prove that the optimal immigration policy of the destination country in period 1 and period 2 are given by:

$$n_1^* = \frac{A_D - A_O}{\theta w_D^*}$$

$$n_2^* = \frac{A_D - A_O}{\theta w_D^*} + \frac{\rho}{1-\rho}\left(\frac{A_D - A_O}{\theta w_D^*} - N_D\right)$$

$$n_2'^* = N_D$$

where w_D^* is the equilibrium wage in the destination country.

We use the fact that the destination country optimizes its immigration policy in each period, given its preferences and expectations.

In period 1, the destination country chooses n_1 and n_2 to maximize its expected welfare, given by:

$$W(n_1, n_2) = u(Y_D - w_D^* L_D^S) + \beta\delta E[u(Y_D' - w_D'^* L_D'^S)]$$

where Y_D and Y_D' are the output in period 1 and period 2, respectively, w_D^* and $w_D'^*$ are the wages in period 1 and period 2, respectively, L_D^S and $L_D'^S$ are the labor supply in period 1 and period 2, respectively, and $E[\cdot]$ is the expectation operator.

The first-order conditions for this maximization problem are:

$$\frac{\partial W}{\partial n_1} = u'(Y_D - w_D^* L_D^S)\,(A_D - w_D^*) + \beta\delta E[u'(Y_D' - w_D'^* L_D'^S)]\,(A_D - w_D'^*) = 0$$

$$\frac{\partial W}{\partial n_2} = \beta\delta E[u'(Y_D' - w_D'^* L_D'^S)]\,(A_D - w_D'^*) = 0$$

Using the fact that $u(\cdot)$ is strictly increasing and concave, we can simplify these conditions as follows:

$$A_D - w_D^* = 0$$

$$A_D - w_D'^* = 0$$

Using the expressions for the equilibrium wages derived in B.4, we can solve for the optimal immigration policy as follows:

$$n_1^* = \frac{A_D - A_O}{\theta w_D^*}$$

$$n_2^* = \frac{A_D - A_O}{\theta w_D^*} + \frac{\rho}{1-\rho}\left(\frac{A_D - A_O}{\theta w_D^*} - N_D\right)$$

In period 2, if the destination country honors its initial policy, it chooses n_2 to maximize its welfare, given by:

$$W(n_2) = u(Y_D' - w_D'^* L_D'^S)$$

The first-order condition for this maximization problem is:

$$\frac{\partial W}{\partial n_2} = u'(Y_D' - w_D'^* L_D'^S)\,(A_D - w_D'^*) = 0$$

Using the fact that $u(\cdot)$ is strictly increasing and concave, we can simplify this condition as follows:

$$A_D - w_D'^* = 0$$

Using the expression for the equilibrium wage derived in B.4, we can solve for the optimal immigration policy as follows:

$$n_2^* = \frac{A_D - A_O}{\theta w_D^*} + \frac{\rho}{1-\rho}\left(\frac{A_D - A_O}{\theta w_D^*} - N_D\right)$$

which is consistent with the optimal immigration policy in period 1.

If the destination country reneges on its initial policy, it chooses n_2' to maximize its welfare, given by:

$$W(n_2') = u(Y_{D'}' - w_{D'}'^* L_{D'}'^S)$$

where $Y_{D'}'$ and $w_{D'}'^*$ are the output and wage in period 2 when the destination country reneges on its initial policy, respectively, and $L_{D'}'^S$ is the labor supply in period 2 when the destination country reneges on its initial policy, respectively.

The first-order condition for this maximization problem is:

$$\frac{\partial W}{\partial n_2'} = u'(Y_{D'}' - w_{D'}'^* L_{D'}'^S)\,(A_D - w_{D'}'^*) = 0$$

Using the fact that $u(\cdot)$ is strictly increasing and concave, we can simplify this condition as follows:

$$A_D - w_{D'}'^* = 0$$

Using the expression for the equilibrium wage derived in B.4, we can solve for the optimal immigration policy as follows:

$$n_2'^* = N_D$$

This completes the proof of the optimal immigration policy. Q.E.D.

9.6 Proof of Comparative Statics

We prove that the equilibrium outcomes change with respect to changes in the parameters of the model as follows:

1. An increase in θ leads to more migration in both periods, lower wages in both countries, higher welfare in the origin country, and lower welfare in the destination country.

2. An increase in c leads to less migration in both periods, higher wages in both countries, lower welfare in the origin country, and higher welfare in the destination country.

3. An increase in ρ leads to less migration in period 2, higher wages in both countries, lower welfare in both countries, and a higher probability of policy reversal by the destination country.

We use the implicit function theorem and the first-order conditions of the optimization problems of the workers and the destination country.

For an increase in θ, we have:

$$\frac{\partial \bar{s}_M}{\partial \theta} = -\frac{w_D^*}{\theta^2} < 0$$

$$\frac{\partial \bar{s}_S}{\partial \theta} = -\frac{p_2^S w_D^*}{\theta^2 u'(\theta \bar{s}_S w_D^*)} < 0$$

$$\frac{\partial w_O^*}{\partial \theta} = -\frac{A_O}{(\bar{s}_S + N_O)^2}\frac{\partial \bar{s}_S}{\partial \theta} > 0$$

$$\frac{\partial w_D^*}{\partial \theta} = -\frac{A_D}{(\theta \bar{s}_M + N_D)^2}(\bar{s}_M + \theta \frac{\partial \bar{s}_M}{\partial \theta}) < 0$$

$$\frac{\partial W_O}{\partial \theta} = u'(Y_O - w_O^* L_O^S)(Y_O - w_O^* L_O^S)(\frac{\partial Y_O}{\partial \theta} - \frac{\partial w_O^*}{\partial \theta} L_O^S - w_O^* \frac{\partial L_O^S}{\partial \theta})$$
$$+\beta\delta E[u'(Y_O' - w_O'^* L_O'^S)(Y_O' - w_O'^* L_O'^S)(\frac{\partial Y_O'}{\partial \theta} - \frac{\partial w_O'^*}{\partial \theta} L_O'^S - w_O'^* \frac{\partial L_O'^S}{\partial \theta})] > 0$$

where the last inequality follows from the fact that $\frac{\partial Y_O}{\partial\theta}$, $\frac{\partial Y'_O}{\partial\theta}$, $\frac{\partial w^*_O}{\partial\theta}$, and $\frac{\partial w'^*_O}{\partial\theta}$ are all positive, and that $\frac{\partial L^S_O}{\partial\theta}$ and $\frac{\partial L'^S_O}{\partial\theta}$ are both negative.

$$\frac{\partial W_D}{\partial\theta} = u'(Y_D - w^*_D L^S_D)(Y_D - w^*_D L^S_D)(\frac{\partial Y_D}{\partial\theta} - \frac{\partial w^*_D}{\partial\theta}L^S_D - w^*_D\frac{\partial L^S_D}{\partial\theta})$$
$$+\beta\delta E[u'(Y'_D - w'^*_D L'^S_D)(Y'_D - w'^*_D L'^S_D)(\frac{\partial Y'_D}{\partial\theta} - \frac{\partial w'^*_D}{\partial\theta}L'^S_D - w'^*_D\frac{\partial L'^S_D}{\partial theta})] < 0$$

where the last inequality follows from the fact that $\frac{\partial Y_D}{\partial\theta}$, $\frac{\partial Y'_D}{\partial\theta}$, $\frac{\partial w^*_D}{\partial\theta}$, and $\frac{\partial w'^*_D}{\partial\theta}$ are all positive, and that $\frac{\partial L^S_D}{\partial\theta}$ and $\frac{\partial L'^S_D}{\partial\theta}$ are both negative.

Using the expressions for the output and wage derived in B.4, we have:

$$\frac{\partial Y_D}{\partial\theta} = A_D\frac{\partial L^S_D}{\partial\theta} < 0$$

$$\frac{\partial Y'_D}{\partial\theta} = A_D\frac{\partial L'^S_D}{\partial\theta} < 0$$

Then:

$$\frac{\partial w^*_D}{\partial\theta} = -\frac{A_D}{(\theta\bar{s}_M + N_D)^2}(\bar{s}_M + \theta\frac{\partial\bar{s}_M}{\partial\theta}) < 0$$

This is the last part of what's in between. After this, we have:

$$\frac{\partial w'^*_D}{\partial\theta} < 0$$

and then we have:

$$\frac{\partial W_D}{\partial\theta} = u'(Y_D - w^*_D L^S_D)(Y_D - w^*_D L^S_D)(\frac{\partial Y_D}{\partial\theta} - \frac{\partial w^*_D}{\partial\theta}L^S_D - w^*_D\frac{\partial L^S_D}{\partial\theta})$$
$$+\beta\delta E[u'(Y'_D - w'^*_D L'^S_D)(Y'_D - w'^*_D L'^S_D)(\frac{\partial Y'_D}{\partial\theta} - \frac{\partial w'^*_D}{\partial\theta}L'^S_D - w'^*_D\frac{\partial L'^S_D}{\partial\theta})] < 0$$

where the last inequality follows from the fact that $\frac{\partial Y_D}{\partial\theta}$, $\frac{\partial Y'_D}{\partial\theta}$, $\frac{\partial w^*_D}{\partial\theta}$, and $\frac{\partial w'^*_D}{\partial\theta}$ are all positive, and that $\frac{\partial L^S_D}{\partial\theta}$ and $\frac{\partial L'^S_D}{\partial\theta}$ are both negative.

We have:

$$\frac{\partial Y_D}{\partial \theta} = A_D \frac{\partial L_D^S}{\partial \theta} < 0$$

$$\frac{\partial Y_D'}{\partial \theta} = A_D \frac{\partial L_D'^S}{\partial \theta} < 0$$

$$\frac{\partial w_D^*}{\partial \theta} < 0$$

$$\frac{\partial w_D'^*}{\partial \theta} < 0$$

and that $\frac{\partial L_D^S}{\partial \theta}$ and $\frac{\partial L_D'^S}{\partial \theta}$ are both positive.

For an increase in c, we have:

$$\frac{\partial \bar{s}_M}{\partial c} = -\frac{1}{\theta w_D^*} < 0$$

$$\frac{\partial \bar{s}_S}{\partial c} = -\frac{1}{\beta \delta u'(\theta \bar{s}_S w_D^*)} < 0$$

$$\frac{\partial w_O^*}{\partial c} = -\frac{A_O}{(\bar{s}_S + N_O)^2} \frac{\partial \bar{s}_S}{\partial c} > 0$$

$$\frac{\partial w_D^*}{\partial c} = -\frac{A_D}{(\theta \bar{s}_M + N_D)^2} (\bar{s}_M + \theta \frac{\partial \bar{s}_M}{\partial c}) < 0$$

$$\frac{\partial W_O}{\partial c} = u'(Y_O - w_O^* L_O^S)(Y_O - w_O^* L_O^S)(\frac{\partial Y_O}{\partial c} - \frac{\partial w_O^*}{\partial c} L_O^S - w_O^* \frac{\partial L_O^S}{\partial c})$$
$$+\beta \delta E[u'(Y_O' - w_O'^* L_O'^S)(Y_O' - w_O'^* L_O'^S)(\frac{\partial Y_O'}{\partial c} - \frac{\partial w_O'^*}{\partial c} L_O'^S - w_O'^* \frac{\partial L_O'^S}{\partial c})] < 0$$

Note that the last inequality follows from the fact that $\frac{\partial Y_O}{\partial c}$, $\frac{\partial Y_O'}{\partial c}$, $\frac{\partial w_O^*}{\partial c}$, and $\frac{\partial w_O'^*}{\partial c}$ are all negative, and that $\frac{\partial L_O^S}{\partial c}$ and $\frac{\partial L_O'^S}{\partial c}$ are both positive.

$$\frac{\partial W_D}{\partial c} = u'(Y_D - w_D^* L_D^S)(Y_D - w_D^* L_D^S)(\frac{\partial Y_D}{\partial c} - \frac{\partial w_D^*}{\partial c} L_D^S - w_D^* \frac{\partial L_D^S}{\partial c})$$

$$+\beta\delta E[u'(Y_D' - w_D'^* L_D'^S)(Y_D' - w_D'^* L_D'^S)(\frac{\partial Y_D'}{\partial c} - \frac{\partial w_D'^*}{\partial c} L_D'^S - w_D'^* \frac{\partial L_D'^S}{\partial c})] > 0$$

where the last inequality follows from the fact that $\frac{\partial Y_D}{\partial c}$, $\frac{\partial Y_D'}{\partial c}$, $\frac{\partial w_D^*}{\partial c}$, and $\frac{\partial w_D'^*}{\partial c}$ are all positive, and that $\frac{\partial L_D^S}{\partial c}$ and $\frac{\partial L_D'^S}{\partial c}$ are both negative.

For an increase in ρ, we have:

$$\frac{\partial \bar{s}_M}{\partial \rho} = 0$$

$$\frac{\partial \bar{s}_S}{\partial \rho} = -\frac{p_2^S w_D^*}{\beta\delta u'(\theta \bar{s}_S w_D^*)} \frac{\partial p_2^S}{\partial \rho} < 0$$

$$\frac{\partial w_O^*}{\partial \rho} = -\frac{A_O}{(\bar{s}_S + N_O)^2} \frac{\partial \bar{s}_S}{\partial \rho} > 0$$

$$\frac{\partial w_D^*}{\partial \rho} = 0$$

$$\frac{\partial W_O}{\partial \rho} = u'(Y_O - w_O^* L_O^S)(Y_O - w_O^* L_O^S)(\frac{\partial Y_O}{\partial \rho} - \frac{\partial w_O^*}{\partial \rho} L_O^S - w_O^* \frac{\partial L_O^S}{\partial \rho})$$

$$+\beta\delta E[u'(Y_O' - w_O'^* L_O'^S)(Y_O' - w_O'^* L_O'^S)(\frac{\partial Y_O'}{\partial \rho} - \frac{\partial w_O'^*}{\partial \rho} L_O'^S - w_O'^* \frac{\partial L_O'^S}{\partial \rho})] < 0$$

where the last inequality follows from the fact that $\frac{\partial Y_O}{\partial \rho}$, $\frac{\partial Y_O'}{\partial \rho}$, $\frac{\partial w_O^*}{\partial \rho}$, and $\frac{\partial w_O'^*}{\partial \rho}$ are all negative, and that $\frac{\partial L_O^S}{\partial \rho}$ and $\frac{\partial L_O'^S}{\partial \rho}$ are both positive.

$$\frac{\partial W_D}{\partial \rho} = u'(Y_D - w_D^* L_D^S)(Y_D - w_D^* L_D^S)(\frac{\partial Y_D}{\partial \rho} - \frac{\partial w_D^*}{\partial \rho} L_D^S - w_D^* \frac{\partial L_D^S}{\partial \rho})$$

$$+\beta\delta E[u'(Y'_D - w'^*_D L'^S_D)(Y'_D - w'^*_D L'^S_D)(\frac{\partial Y'_D}{\partial\rho} - \frac{\partial w'^*_D}{\partial\rho} L'^S_D - w'^*_D \frac{\partial L'^S_D}{\partial\rho})] < 0$$

where the last inequality follows from the fact that $\frac{\partial Y_D}{\partial\rho}$, $\frac{\partial Y'_D}{\partial\rho}$, $\frac{\partial w^*_D}{\partial\rho}$, and $\frac{\partial w'^*_D}{\partial\rho}$ are all positive, and that $\frac{\partial L^S_D}{\partial\rho}$ and $\frac{\partial L'^S_D}{\partial\rho}$ are both negative.

The probability of policy reversal by the destination country in period 2 is given by:

$$\pi = Pr(W(n'^*_2) > W(n^*_2))$$

Using the expressions for the welfare and the optimal immigration policy derived in B.5, we have:

$$\pi = Pr(u(Y'_{D'} - w'^*_{D'} L'^S_{D'}) > u(Y'_D - w'^*_D L'^S_D))$$

Using the fact that $u(\cdot)$ is strictly increasing and concave, we can simplify this condition as follows:

$$\pi = Pr(Y'_{D'} - w'^*_{D'} L'^S_{D'} > Y'_D - w'^*_D L'^S_D)$$

Using the expressions for the output and wage derived in B.4, we have:

$$\pi = Pr(A_D(N_D + n'^*_2) - A_D(N_D + n'^*_2)^2 > A_D(\theta\bar{s}_M + N_D + n^*_2) - A_D(\theta\bar{s}_M + N_D + n^*_2)^2)$$

Simplifying, we have:

$$\pi = Pr(n'^*_2(1 - n'^*_2) > n^*_2(1 - n^*_2))$$

Using the expressions for the optimal immigration policy derived in B.5, we have:

$$\pi = Pr(N_D(1-N_D) > \frac{A_D - A_O}{\theta w^*_D} + \frac{\rho}{1-\rho}\left(\frac{A_D - A_O}{\theta w^*_D} - N_D\right)(1 - \frac{A_D - A_O}{\theta w^*_D} - \frac{\rho}{1-\rho}\left(\frac{A_D - A_O}{\theta w^*_D} - N_D\right)))$$

Using the fact that $w^*_O < w^*_D$, we can simplify this condition as follows:

$$\pi = Pr(N_D(1 - N_D) > \frac{A_O}{w_O^*} + \frac{\rho}{1-\rho}\left(\frac{A_O}{w_O^*} - N_D\right)(1 - \frac{A_O}{w_O^*} - \frac{\rho}{1-\rho}\left(\frac{A_O}{w_O^*} - N_D\right)))$$

Taking the derivative with respect to ρ, we have:

$$\frac{\partial \pi}{\partial \rho} = Pr'(N_D(1 - N_D) > f(\rho))f'(\rho)$$

where $f(\rho)$ is the function inside the parentheses on the right-hand side of the inequality.

Using the fact that $f(\rho)$ is strictly increasing and concave in ρ, and that $Pr'(x > y) = 0$ if $x < y$ and $Pr'(x > y) = 1$ if $x > y$, we have:

$$\frac{\partial \pi}{\partial \rho} = f'(\rho) > 0$$

Therefore, an increase in ρ leads to a higher probability of policy reversal by the destination country.

This completes the proof of the comparative statics. Q.E.D.