Brain-drain and the role of gender equality

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Extended Abstract

As the knowledge-base economy continues to grow, global competition for talent is intensifying [4]. Highly skilled immigrants constitute a major share of the U.S. innovation workforce [6, 15, 18, 8], and their decisions to remain, or return has significant economic implications both in the U.S., and their home countries [17]. Attracting the return migration of these highly skilled migrants is particularly crucial for achieving "brain gain" in emerging economies [14], leading them to invest heavily in repatriating workers from abroad [25]. While a growing number of studies examine the macroeconomic determinants for migration of highly skilled workers [11], fewer investigate the role of socio-political factors in shaping migrants' decisions to return. Why do some highly skilled migrants stay despite these efforts for repatriation, while others return? What are the socio-political barriers for emerging economies to repatriate their talents?

In this paper, we address these questions, focusing on the role of gender inequality in return migration of highly skilled workers. At the global level, the share of high-skilled female migrants has risen rapidly, exceeding the share of high-skilled male migrants for many nationalities [12, 16]. As a result, successful repatriation of highly skilled female workforce has increasing importance in migrant-sending countries. However, highly skilled female migrants often face distinct challenges in their migration process [20, 9, 3, 27]. In some cases, returning home can create disadvantages for female professionals. Cultural norms, rigid labor market structures, and institutional inequalities in many origin countries limit women's career advancement prospects relative to men's, even when they possess cutting-edge technical knowledge or advanced degrees [13, 7]. We argue that these systematic biases in coutries-of-origin tend to discourage female return migration, leading to a gender gap in return migration.

To test these, we use a dataset of over three million résumés from users of professional online networking platforms [23]. We reconstruct time-stamped education and employment sequences, U.S. entry pathway (student vs. worker), duration of stay, and return decisions, and link individuals to origin-country indicators of women's empowerment and governance from V-Dem [28] and to external measures of scholarly and technological output [19]. This traceable, person-level design addresses persistent gaps in gender-disaggregated migration statistics—often unpublished and blind to irregular returnees [7, 12, 13]—and complements survey-based evidence with digital trace data [2]. Our empirical framework compares return, doctoral enrollment, and scientific productivity across gender and mobility strata, conditioning on year, region, and macroeconomic context to identify how gender equality at origin shapes outcomes.

Who returns as gender equality rises—and what conditions shape that decision differently for women and men? As shown in Figure 1, in origins with *low* Women's Empowerment (WE) (gender equality), women are *less* likely to return than men; as WE improves, the gender gap narrows and can flip, with women becoming *more* likely to return. Table 1 shows that two structural forces shape this decision for both pathways: more time in the United States lowers the odds of return (consistent with employability frictions at home [22]), and migrants from wealthier origins are less likely to return. Proximate triggers differ by pathway: among students, having a job at last action is associated with higher return; among workers, recent education is linked to higher return. In short, as gender equality rises, institutions at home make returning both more feasible and more attractive—especially for women.

How does gender equality in the home country affect immigrants' decisions to begin a U.S. PhD—especially for women? Across entry paths presented in Table 2, women are on average less likely than men to begin a U.S. PhD after arrival, even with timing and region accounted for. As home-country WE rises, the incentive to start a U.S. PhD weakens for everyone—especially for women—suggesting credible home alternatives (funding, roles, recognition). Those who ultimately return are far less likely to start a U.S. PhD; among students, stronger WE at origin partially offsets this drop, while among workers, higher WE further tilts choices away from re-entering as a student.

How do gender and migration status condition the association between women's empowerment and scientific productivity? Across the full range of WE, immigrants consistently show higher predicted publication output than comparable non-immigrants (see Table 3 and Figure 2). WE is positively associated with productivity for all, but its benefits are not distributed equally. The gender story flips with migration status: among immigrants, men lead women; among non-immigrants, women lead men. Returnees resemble immigrants more than non-immigrants, while stayers track domestic benchmarks, indicating that mobility and empowerment are complements in translating experience into output.

Our results recast "brain drain" as a policy choice. Gender equality at origin is not background noise; it is the lever that changes *who* returns, *where* advanced training is pursued, and *how* international experience converts into scientific output. When women's economic and civic agency is expanded at home, women are more likely to return and translate global skills into local innovation, shifting losses into gains for source-country science and growth [5, 24, 12]. The stakes are concrete: persistent female outflows weaken human capital and strain sectors such as healthcare [1], while the absence of women from research and entrepreneurship narrows the diversity that fuels innovation and institutional reform [21, 10, 26].

Policy follows directly from the patterns we document. Investments that raise Women's Empowerment (e.g., legal protections, enforcement against workplace discrimination, childcare and family supports, equal access to finance and leadership) complement mobility by making return *attractive* and *productive* for women. Targeted reentry mechanisms—return fellowships, portable grants, recognition of foreign credentials, dual-career placements, and pathways into research-intensive roles—help convert international experience into local impact. For students, linking scholarships to home-country research opportunities; for workers, supporting skill upgrading tied to domestic labs and firms; and for all, activating diaspora networks through joint appointments and cross-border projects can turn circulation into lasting capability. Finally, because policy is hampered by scarce gender-disaggregated migration statistics, integrating administrative sources with digital trace data is essential for monitoring outcomes and designing evidence-based interventions [7, 12, 13, 2]. In short, mobility creates possibilities, but gender-equal institutions determine how fully those possibilities are realized at home.

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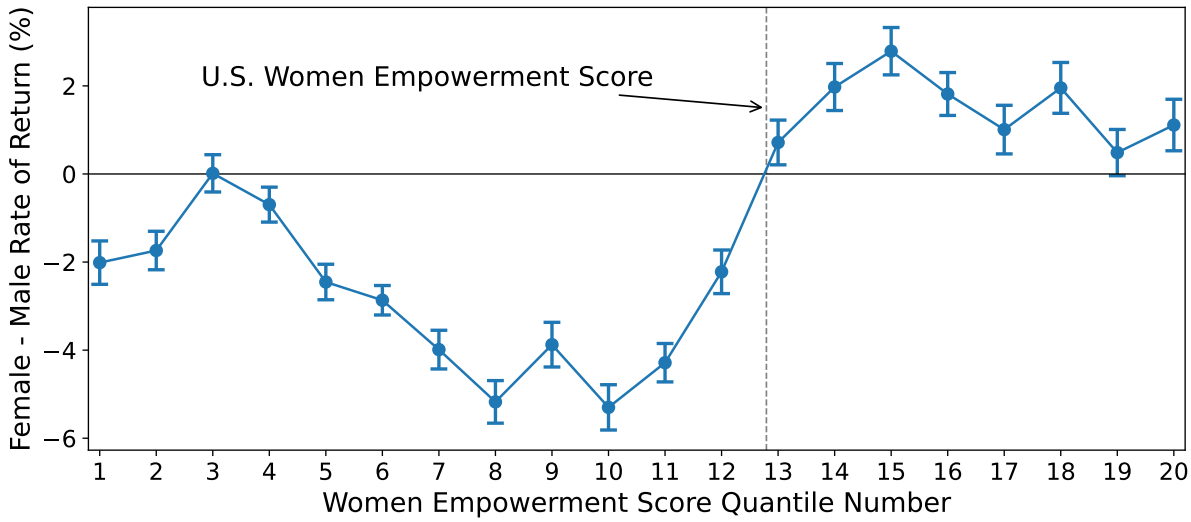


Figure 1: **Who returns as empowerment rises?** Points show the female-minus-male difference in return rates among U.S.-trained skilled immigrants, by quantile of home-country Women's Empowerment. Negative values indicate men return more than women; positive values indicate women return more than men. Error bars are 95% CIs. The dashed line marks the U.S. WE score as a reference. The pattern flips from female disadvantage at low WE to female advantage at high WE, highlighting empowerment as the factor that changes *who* returns.

Table 1: **Gendered return migration and women's empowerment (students vs. workers).** Logistic regression analysis on the gendered return Patterns of U.S. skilled immigrants coming to the U.S. for study or work considering gender, gender-related indicator (here, "Women Empowerment"), and various job and education related indicators. Omitted values for the fixed effects include Year="1990" and Region="Europe & Central Asia".

	Dependent Variable: Returned							
	Students				*Workers*			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Female	-0.127***	-0.145***	-0.124***	-0.081***	-0.029***	-0.076***	-0.044***	-0.092***
Women Empowerment (Z-score)		0.193***	-0.080***	-0.044***		0.269***	0.001	0.003***
Female*Women Empowerment		0.075***	1.002***	0.527***		0.147***	0.874***	0.600***
GDP per Capita (Log10)			-0.688	-0.236***			-1.223	-0.320***
No. of Years in U.S.				-0.657***				-0.616***
Having a Job before Last Action				0.062***				
Having an Education before Last Action								0.128***
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
pseudo R^2	0.06	0.063	0.079	0.229	0.069	0.076	0.086	0.257
adj. pseudo R^2	0.06	0.063	0.078	0.229	0.069	0.076	0.086	0.257
Observations	1,050,983	1,050,983	1,050,983	1,050,983	1,485,963	1,485,963	1,485,963	1,485,963

Table 2: **Logistic regression estimates of factors associated with enrolling in a U.S. PhD program, shown separately for immigrants who first entered as students and as workers.** Models progressively introduce women's empowerment in the home country (WE), return-migration status, their pairwise interactions, and a three-way interaction with gender; the final specification adds log GDP per capita.

Dependent Variable: Enroll in a Ph.D. Program in the US												
	Students						*Workers*					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Female	-0.194***	-0.179***	-0.240***	-0.228***	-0.229***	-0.243***	-0.063***	-0.011***	-0.066***	-0.067***	-0.024***	-0.031***
Women Empowerment (Z-score)		-0.332***	-0.296***	-0.335***	-0.344***	-0.184***		-0.386***	-0.312***	-0.304***	-0.340***	-0.305***
Female*Women Empowerment		-0.005***			-1.300***	-1.223***		0.075***			-2.390***	-2.375***
Returned			-1.325***	-1.292***	0.024***	-0.368***			-2.363***	-2.413***	0.097***	-0.109***
Female*Returned			0.060***		0.023***	0.031***			-0.067***		-0.059***	0.096***
Women Empowerment*Returned				0.118***	0.125***	0.023***				-0.173***	-0.159***	-0.053***
Female*Women Empowerment*Returned					-0.019***	0.083***					-0.028***	-0.163***
GDP per Capita (Log 10) (Z-score)						-0.007***						-0.022***
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
pseudo R^2	0.066	0.072	0.112	0.112	0.112	0.118	0.062	0.069	0.108	0.108	0.109	0.109
adj. pseudo R^2	0.066	0.072	0.112	0.112	0.112	0.117	0.061	0.069	0.108	0.108	0.108	0.109
Observations	901,654	901,654	901,654	901,654	901,654	901,654	1,317,332	1,317,332	1,317,332	1,317,332	1,317,332	1,317,332

Table 3: **Gender, migration, and women's empowerment in relation to scientific productivity.** Ordinary least squares estimates for the natural log of total publications. Each column reports a separate specification that contrasts two mobility groups: Immigrants vs Non-Immigrants; Returnees vs Non-Immigrants; Stayers vs Non-Immigrants; Movers vs Non-Immigrants; and Stayers vs Returnees.

Dependent Variable: Total publication (Natural Log)					
	Immigrants vs. Non-Immigrants	**Returnees vs. Non-Immigrants**	**Stayers vs. Non-Immigrants**	**Movers vs. Non-Immigrants**	**Stayers vs. Returnees**
Female	0.134***	0.134***	0.134***	0.134***	-0.194***
Women Empowerment (Z-score)	0.000	0.001**	0.001*	0.001**	0.082***
Female*WE	0.662***	0.531***	0.684***	0.785***	0.181***
Immigrant	0.042***	0.041***	0.042***	0.041***	0.077***
Female*Immigrant	0.074***	0.074***	0.074***	0.074***	0.042**
Immigrant*WE	-0.372***	-0.373***	-0.360***	-0.439***	0.006
Female*WE*Immigrant	0.057***	0.099***	0.050***	0.065***	-0.002
GDP per Capita (Log10)	-0.011**	-0.001	-0.016**	0.022*	-0.013
First Publication Year FE	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes	Yes
R^2	0.072	0.070	0.071	0.070	0.158
adj. R^2	0.072	0.070	0.071	0.070	0.158
Observations	25,877,096	25,741,838	25,803,384	25,718,626	158,470

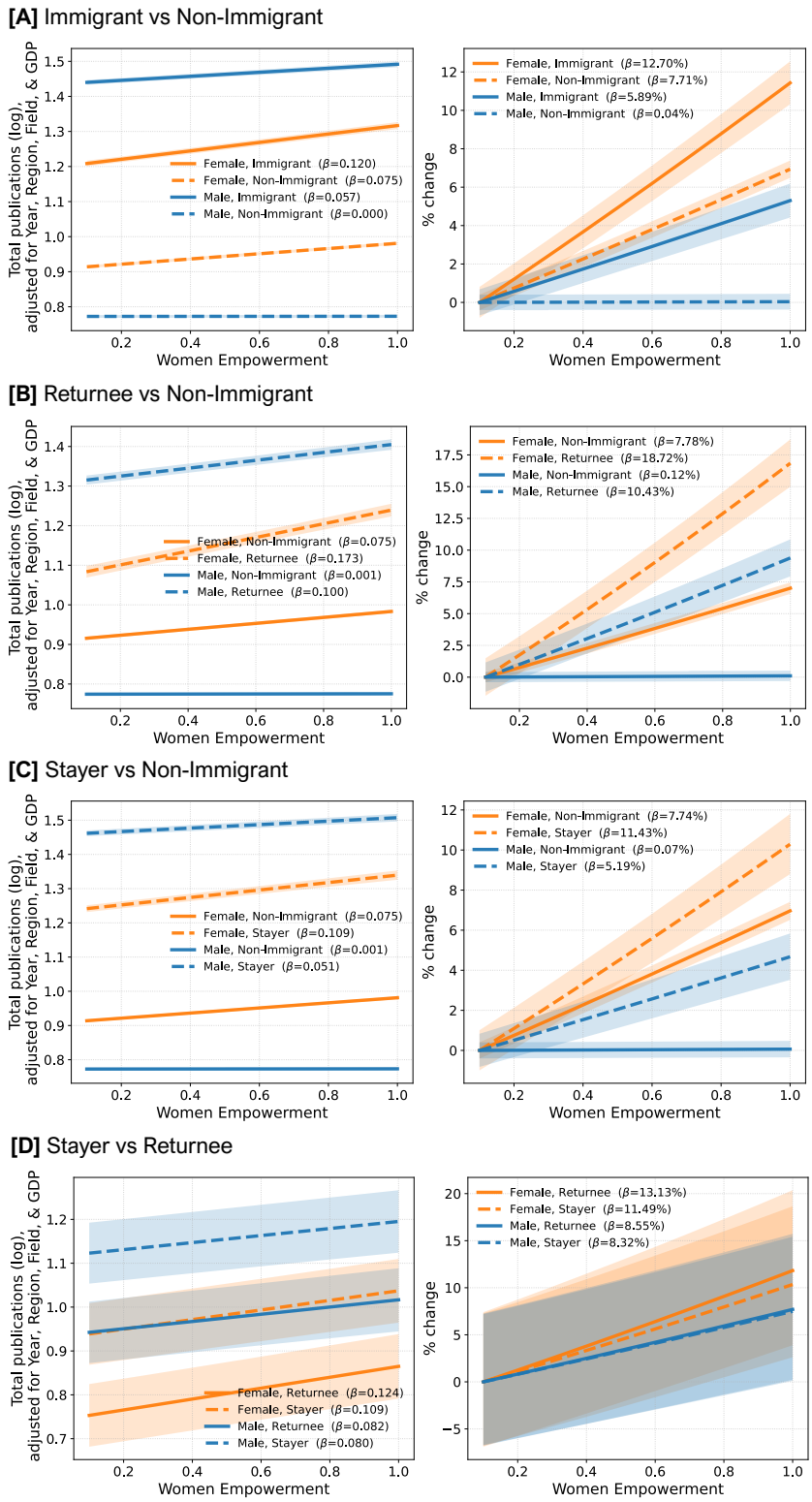


Figure 2: **Women's empowerment, gender, and migration status jointly shape predicted scientific productivity.** Predicted outcomes from an OLS model of yearly publications including Year and Region fixed effects and GDP per capita as a control (see Table 3 for the corresponding regression table). The left panel plots adjusted predicted *logged publications per year* across Women's Empowerment (z-score); the right panel shows percent change in predicted publications relative to each line's lowest Women's Empowerment value. Shaded ribbons indicate 95% confidence intervals. Panels depict four groups comparison: **(A)** Immigrant vs Non-Immigrant, **(B)** Returnee vs Non-Immigrant, **(C)** Stayer vs Non-Immigrant, **(D)** Stayer vs Returnee.

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