Labor Migration as Price Arbitrage: Theory and Evidence from Mexican Workers in the U.S.

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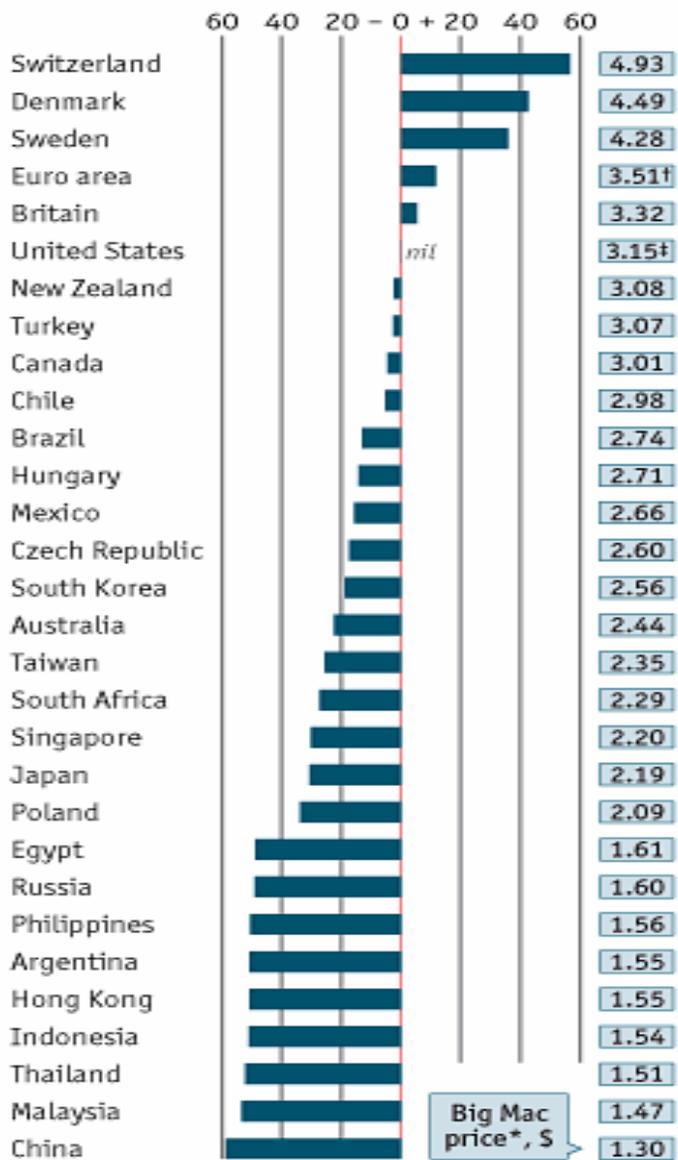# Introduction

- Migration as a phenomenon driven by real wage differentials between markets: **wage arbitrage**
- Geographic wage disparity is the focus and price parity is implicitly or explicitly assumed in most analyses of migration.
- Wide discrepancy in real price level or cost of living between countries or regions
- Migration may occur as a response to real price gap as opposed to real wage gap between markets: **price arbitrage**

Example

	Mexico (pre-migration)	US (post-migration)
Dollar price of a Big Mac	$2	$4
Real wage	1 Big Mac	1 Big Mac
Intra-household Allocation	(1/2 BM, 1/2 BM)	(1/2 BM, 1 BM)

Big Mac index

Local currency under (−)/over (+) valuation against the dollar, %

Country	Big Mac price*, $
Switzerland	4.93
Denmark	4.49
Sweden	4.28
Euro area	3.51†
Britain	3.32
United States	3.15‡
New Zealand	3.08
Turkey	3.07
Canada	3.01
Chile	2.98
Brazil	2.74
Hungary	2.71
Mexico	2.66
Czech Republic	2.60
South Korea	2.56
Australia	2.44
Taiwan	2.35
South Africa	2.29
Singapore	2.20
Japan	2.19
Poland	2.09
Egypt	1.61
Russia	1.60
Philippines	1.56
Argentina	1.55
Hong Kong	1.55
Indonesia	1.54
Thailand	1.51
Malaysia	1.47
China	1.30

*At market exchange rate (January 9th)
†Weighted average of member countries
‡Average of four cities

Source: *The Economist* using McDonald's price data

Table: Costs of Living in Selected Cities

City	Price excl rent Zurich=100	Food USD	Rent (3 BR) USD
Oslo	117.8	571	1270
New York	104.5	612	3650
Zurich	100.0	558	1460
London	97.6	387	3530
Paris	89.3	453	1970
Los Angeles	84.3	498	1360
Seoul	76.5	568	1250
Miami	74.6	377	1200
Tel Aviv	70.2	388	720
Mexico City	61.1	246	990
Jakarta	50.4	279	1840
Sao Paulo	41.7	230	460
Prague	40.5	164	480
Manila	36.8	182	1020
Buenos Aires	30.6	153	230
Mumbai	28.7	131	470

Source: UBS Prices and Earnings (2003)

The Penn Effect/Balassa-Samuelson Effect (PWT, 2000)

Migration as Price Arbitrage: Real World Examples

- American retirees' migration to Panama, Costa Rica and Mexico (NYT, 2005)
  - Housing and labor-intensive services (health care, nursing aids) much cheaper
  - Enjoy better standards of living with a fixed retirement income (in US dollars)
  - Price arbitrage

- Migrant workers from Mexico and Central America working in US farms (NYT, 1998)
  - Goal is to send as much remittances to their families left behind (or repatriated savings).
  - Willing to put up with living conditions and wages that few Americans would accept
  - Wage arbitrage + price arbitrage

Research Question

- Most migration occurs from low to high income countries.
- Price arbitrage motive as well as wage arbitrage motive
- How to isolate price effect from wage effect on migration in a setting like Mexico-US migration?
- Convince quantitatively that real price gap matters over and above the impact of real wage gap on migration

Identification Strategy

- A theory of migration with remittances motive embedded.
- Derive testable implications in observables
- Look at temporary migrants and their labor market outcome in the US (high-paying vs. low-paying jobs)
    1. (Level effect) "When dollar is high in Mexico, I am willing to take a worse job in the US."
    2. (Difference in differences) Level effect is stronger for "José 1" who spends most of his US income in Mexico than "José 2" who does not send any remittances.
- Note that wage arbitrage motive won't predict these effects.
    - Wage arbitrage: dollar wage in US basket and peso wage in Mexican basket
    - Price arbitrage: dollar wage in Mexican basket

Relation to the Literature

- Djajić (1989); Dustmann (1995, 1997, 2003)
  - Optimal duration of migration for guest workers

- Massey and Espinosa (1997)
  - Mexican inflation and devaluation of pesos reduce the likelihood of illegal migration from Mexico to the US
  - Each factor moves the real exchange rate in the opposition direction

- Hanson and Spilimbergo (1999)
  - Predicts flow of illegal migration from Mexico to the US at the aggregate level.
  - Do not isolate the price arbitrage effect from the effect of host country wage effect (w^*Q vs Q)

- Real exchange rate and migration

- First study on the effects of real exchange rate on the occupational outcomes of migrant workers

A Model of Migration

Environment

- A continuum of Mexican households of mass 1
- Real wages $\begin{cases} w & \text{in Mexico} \\ w^* \in \{w_H, w_L\} & \text{in the US} \end{cases}$
- US-Mexico real price ratio/real exchange rate:

$$Q \begin{cases} = 1 \text{ if PPP} \\ > 1 \text{ if the dollar is overvalued against the peso} \\ < 1 \text{ if the dollar is undervalued against the peso} \end{cases}$$
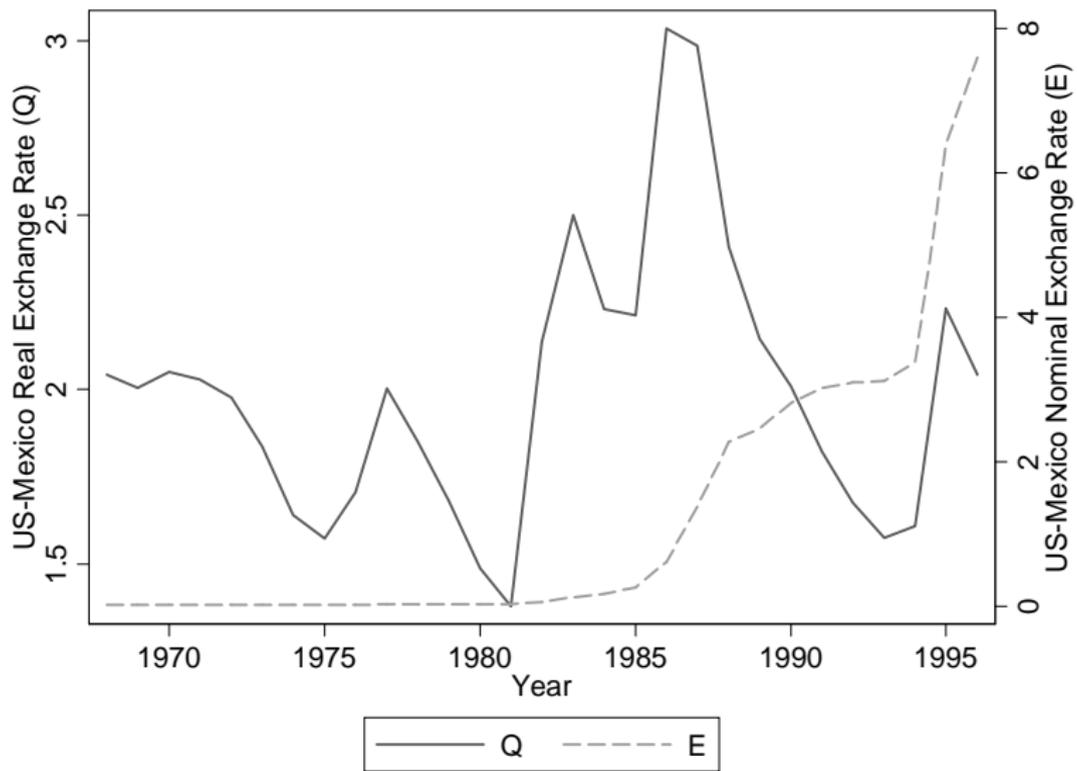
Preferences of Mexican Households

- Households are indexed by $\alpha \sim u[0,1]$
- Each household consists of a worker (1) and a dependent (2)
- Utility function of household α

$$U_\alpha = \begin{cases} \sigma C_1^{1-\alpha} C_2^\alpha & \text{if the worker } (1) \text{ stays in Mexico} \\ \sigma C_1^{1-\alpha} C_2^\alpha - \theta & \text{if the worker } (1) \text{ migrates to the US} \end{cases} ,$$

where $\sigma \equiv [\alpha^\alpha (1-\alpha)^{1-\alpha}]^{-1}$

- Psychic costs of being abroad: $\theta \sim u[-c, c]$ with $c > 0$.
- Transportation costs $\tau > 0$ when moving from Mexico to the US; zero when moving from the US to Mexico.

Technology

- Mexico: $X = \beta n$, $\beta > 0$
- US $\begin{cases} \text{informal sector:} \quad X_L = \beta n_L, \ \beta > 0 \\ \text{formal sector:} \ X_H = f(n_H), \ f^{'} > 0; f^{''} < 0 \end{cases}$
- Wage in the US formal sector is fixed at $\overline{w}(> \beta)$. Hence,

$$w_H = \overline{w} = f^{'}(n_H).$$

- Wages in Mexico and the US informal sector:

$$w = w_L = \beta$$

- Labor market clearing:

$$n + n_L + n_H = 1; n, n_L, n_H \geq 0$$

The Migration Problem

- ▶ Ex ante, workers do not know which job offer they will encounter if they migrate to the U.S. Thus, w^* is a random draw from $\{w_H, w_L\}$.

- ▶ Workers believe that with a probability μ they will be offered the formal sector job and with $1 - \mu$ the informal sector job.

- ▶ Timing of the model:

1. Workers in Mexico decide whether to migrate to the US or not.

2. Psychic cost θ and job/wage offer w^* are realized for those who arrive in the US.

3. Migrants decide whether to accept the job offer (and stay in the US) or return to Mexico immediately.

Key Theoretical Results (1)

Proposition 2: (Migration) As the purchasing power of the US dollar in Mexico, Q, goes up, the total level of Mexico-US migration, m, rises.

Proposition 3: (Occupational Outcomes) As the purchasing power of the US dollar in Mexico, Q, goes up, the ratio of the informal sector to total US employment of Mexican workers,

$$\frac{n_L}{n_L + n_H},$$

rises.

Proposition 4: (High and Low Remitting Types and Occupational Outcomes) Consider Mexican migrants α_1 and α_2 such that $\alpha_1 > \alpha_2$. When the purchasing power of the US dollar in Mexico, Q, goes up, α_1 becomes more likely than α_2 to be working in the informal (low-paying) sector.

Data

- US-Mexico real exchange rates, 1968-1996
  - International Financial Statistics of the IMF
  - PPP conversion factor from the Penn World Table
- Mexican Migration Project 107
- Survey households in Mexico when seasonal migrants are back during winter months
- Recall-based panel data ("person-year" as unit of observation)
- Migration outcome: 1 if the person is in the US; 0 if the person is in Mexico
- Occupational outcome in the US: 1 if the migrant is in the high-paying (non-agricultural) job; 0 if the migrant is in the low-paying (agricultural) job
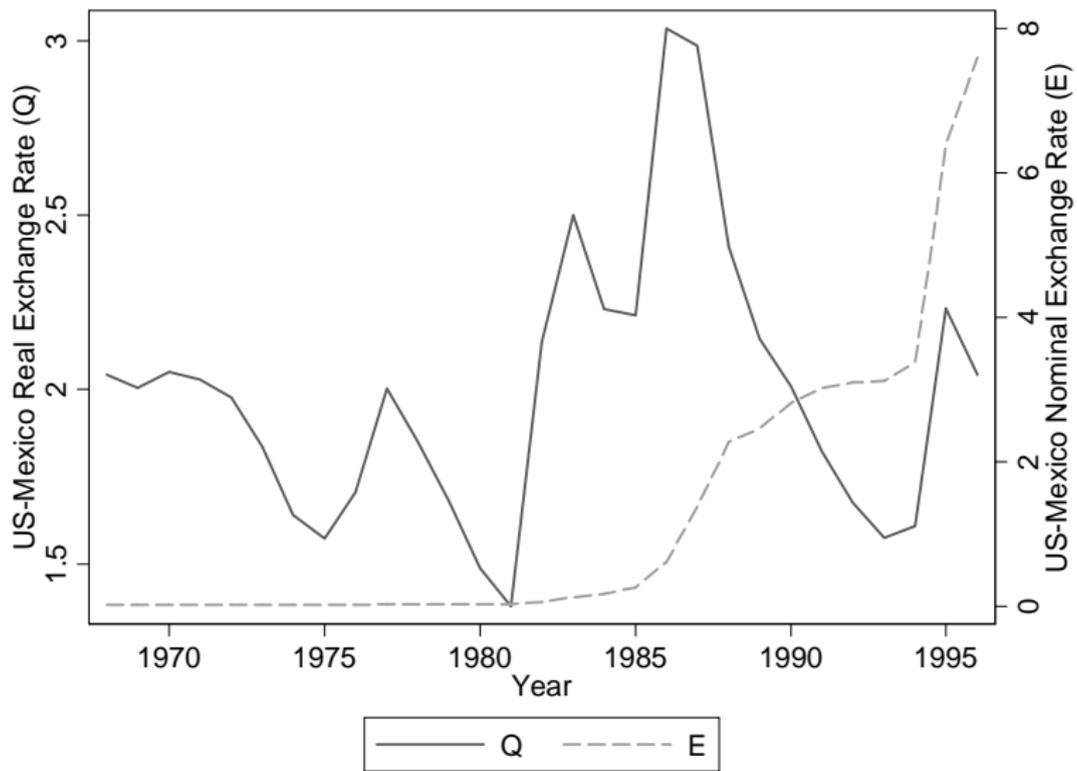- Male household heads between 18 and 64 years of age

Table 1: Characteristics of Mexican Workers

	All Workers	Migrant Workers		
		All Migrants	New Migrants	Established Migrants
Migration status	0.082			
	(0.274)			
Undocumented		0.583	0.652	0.495
		(0.493)	(0.476)	(0.500)
Unemployed	0.006	0.007	0.009	0.005
	(0.080)	(0.085)	(0.096)	(0.069)
Agricultural job	0.340	0.395	0.493	0.269
	(0.474)	(0.489)	(0.500)	(0.444)
Age	38.089	34.722	33.798	35.913
	(12.100)	(11.060)	(10.456)	(11.686)
Education	5.631	5.218	4.909	5.616
	(4.515)	(3.507)	(3.350)	(3.660)
Married	0.790	0.786	0.815	0.749
	(0.407)	(0.410)	(0.389)	(0.434)
Have children under 18 years of age	0.777	0.751	0.774	0.721
	(0.416)	(0.433)	(0.418)	(0.449)
Land ownership	0.196	0.233	0.292	0.157
	(0.497)	(0.558)	(0.618)	(0.458)
Property ownership	0.615	0.623	0.634	0.608
	(0.569)	(0.619)	(0.612)	(0.628)
Business ownership	0.179	0.096	0.111	0.076
	(0.419)	(0.328)	(0.345)	(0.303)
Obs	162932	13373	7529	5844

Table A2: Wages for Agricultural and Non-agricultural Jobs in the US

	Dependent variables:	
	Log Hourly wage	Log Annual Income
	(1)	(2)
Agricultural job	-0.173***	-0.286***
	(0.060)	(0.103)
Age	-0.003	-0.019
	(0.011)	(0.020)
Education	0.040**	0.072***
	(0.017)	(0.025)
Education-sq	-0.003**	-0.006***
	(0.001)	(0.002)
English	0.068***	0.191***
	(0.017)	(0.029)
Undocumented	-0.093**	-0.157**
	(0.041)	(0.076)
Year fixed effects	Yes	Yes
Origin community fixed effects	Yes	Yes
Destination MSA fixed effects	Yes	Yes
Observations	1620	1620
R-squared	0.434	0.385

Robust standard errors clustered at the year*origin community*destination MSA level are in parentheses.

Empirical Strategy 1

- ▶ Classify workers into high- and low-remittying types
- ▶ Expose both types to the same Mexico-US real exchange rate fluctuations
- ▶ According to the theory, the high remitting types should be more responsive to a given real exchange rate shock than the low remitting types in terms of
  - ▶ Migration outcomes
  - ▶ Occupational outcomes in the US
- ▶ **Econometric Specification**:

$$y_{it} = c_0 + \phi_i + \zeta_t + \beta D_{it} + \gamma(Q_t \times D_{it}) + (Z_t \times D_{it})\lambda + X_{it}\delta + \varepsilon_{it},$$

where i corresponds to the person and t to the year.

- ▶ y_{it} is the migration or occupational outcomes depending on regressions.
- ▶ D_{it} indicates whether a worker is a high or low remitting type
- ▶ Hypothesis: $\gamma > 0$ in the migration regressions; $\gamma < 0$ in the labor market regressions

Empirical Strategy 2

- ▶ Who are the high- and low-remitting types?
- ▶ Classify individuals based on their family structure in each person-year
- ▶ Unmarried with no children under 18 (group 0); married without children (group 1); unmarried with children (group 2); and married with children (group 3)
- ▶ Family structure is *predetermined* with respect to the Mexico-US real price differences
  - ▶ Mexican workers cannot systematically change their marital status or the number of children in each person-year as a response to the high frequency variation in the US-Mexico real exchange rate

Table 2: Family Status and Remittances Behavior

	Dependent variable: Remittances					
	(1)	(2)	(3)	(4)	(5)	(6)
Married with no children	0.011	-0.016	-0.014	0.013	-0.014	-0.015
	(0.061)	(0.065)	(0.065)	(0.060)	(0.063)	(0.063)
Unmarried with children	0.093*	0.062	0.064	0.104**	0.073	0.074
	(0.055)	(0.057)	(0.062)	(0.051)	(0.054)	(0.059)
Married with children	0.138***	0.103***	0.102**	0.148***	0.114***	0.113***
	(0.036)	(0.039)	(0.041)	(0.037)	(0.039)	(0.041)
Log hourly wage	Yes	Yes	Yes	No	No	No
Log annual income	No	No	No	Yes	Yes	Yes
Origin community fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Destination MSA fixed effects	No	No	Yes	No	No	No
Observations	1620	1620	1620	1620	1620	1620
R-squared	0.166	0.186	0.230	0.192	0.212	0.256

Robust standard errors clustered at the community level are in parentheses.

All regressions include age, education, education-squared, English proficiency, US visa status.

Empirical Strategy 3

- Modified regression:

$$
\begin{aligned}
y_{it} \;=\;& c_0 + \phi_i + \zeta_t + \sum_{k=1}^{3} \beta_k D_{it}^k + \sum_{k=1}^{3} \gamma_k (Q_t \times D_{it}^k) \\
& + \sum_{k=1}^{3} (Z_t \times D_{it}^k)\lambda_k + X_{it}\delta + \varepsilon_{it},
\end{aligned}
$$

- Coefficient of interest: $\gamma_3 > 0$ in the migration regressions; $\gamma_3 < 0$ in the labor market regressions
- For the migration regressions, use a lagged real exchange rate (Q_{t-1}) in place of the concurrent real exchange rate (Q_t)

Table 4: US-Mexico Real Price Gap and Migration Status of Skilled Workers

	Dependent variable: Migration Status						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Level specification							
Married with children (D3)	-0.003	-0.019	-0.198	-0.200	-0.200	-0.210	-0.157
	(0.017)	(0.019)	(0.226)	(0.254)	(0.252)	(0.263)	(0.261)
Q1*D3	0.002	0.014	0.019**	0.018*	0.018*	0.018*	0.022**
	(0.007)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
R-squared	0.610	0.610	0.610	0.610	0.612	0.609	0.628
Panel B: Log specification							
Married with children (D3)	-0.002	-0.010	-0.167	-0.170	-0.171	-0.181	-0.123
	(0.013)	(0.015)	(0.222)	(0.253)	(0.251)	(0.262)	0.260
Log(Q1)*D3	0.005	0.027	0.042**	0.040*	0.039*	0.039*	0.047**
	(0.016)	(0.020)	(0.020)	(0.021)	(0.021)	(0.022)	(0.022)
R-squared	0.610	0.610	0.610	0.610	0.612	0.609	0.628
IRCA and Immigration Act 1990	No	Yes	Yes	Yes	Yes	Yes	Yes
Log GDP per capita Mexico and US	No	No	Yes	Yes	Yes	Yes	Yes
Unemployment Mexico and US	No	No	No	Yes	Yes	Yes	Yes
Land, property, and business ownership	No	No	No	No	Yes	Yes	Yes
Observations	46261	46261	46261	46115	46115	43217	42522

Robust standard errors clustered at the individual level are in parentheses. All regressions include individual- and year-fixed effects.

Table 6: US-Mexico Real Price Gap and Occupational Outcomes of New Migrants

	Dependent variable: Occupational Outcome in the US							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Level specification							
Married with children (D3)	0.178**	0.186**	1.419*	1.455	1.449	1.452	1.345	1.107
	(0.081)	(0.087)	0.738	(1.132)	(1.131)	(1.133)	(1.176)	(1.194)
Q*D3	-0.079**	-0.084**	-0.068*	-0.070*	-0.071*	-0.071*	-0.077*	-0.077*
	(0.036)	(0.039)	(0.037)	(0.040)	(0.040)	(0.040)	(0.041)	(0.043)
R-squared	0.878	0.878	0.879	0.879	0.879	0.879	0.876	0.895
	Panel B: Log specification							
Married with children (D3)	0.139**	0.146**	1.305*	1.089	1.082	1.083	0.958	0.724
	(0.062)	(0.067)	(0.736)	(1.161)	(1.159)	(1.161)	(1.206)	(1.223)
Log(Q)*D3	-0.177**	-0.189**	-0.163**	-0.191**	-0.192**	-0.192**	-0.207**	-0.209**
	(0.076)	(0.084)	(0.081)	(0.090)	(0.090)	(0.089)	(0.092)	(0.096)
R-squared	0.878	0.878	0.879	0.879	0.879	0.879	0.876	0.895
IRCA and Immigration Act 1990	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log GDP per capita Mexico and US	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Unemployment Mexico and US	No	No	No	Yes	Yes	Yes	Yes	Yes
Undocumented	No	No	No	No	Yes	Yes	Yes	Yes
Land, property, and business ownership	No	No	No	No	No	Yes	Yes	Yes
Observations	7459	7459	7459	7391	7391	7391	6682	6490

Robust standard errors clustered at the individual-level are in parentheses. All regressions include individual- and year-fixed effects.

Conclusion

- As the US-Mexico real exchange rate deviates 1 SD from the mean,
    - high remitting types become 8.78 percent more likely to migrate to the US than low remitting types
    - high remitting types become 7.19 percent more likely to work in the low-paying job in the US than low remitting types

- Identify price arbitrage as a motivation for (temporary) migration

- Real exchange rate and occupational outcomes of migrant workers

- Analytical framework can be applied to other pairs of countries and regions
    - East-West migration in Europe
    - Rural-Urban migration in China