Immigration and the Informal Labor Market

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Research Question

What are the labor market effects of immigration in developing countries?

- What is the effect of immigration on the probability of being employed?

- Conditional on being employed, what is the effect of immigration on the probability of being employed in the informal sector.
Motivation

• According to the 2009 Human Development Report, 63% of the international migration takes place between countries with similar levels of development.

• Emerging market economies hold a special position because while they are classified as ‘middle income’ countries on the global distribution, they are often ‘rich’ relative to their neighbors.
Motivation

• The flow of immigrants into the informal sector, where firms operate without government regulations and lack many employee benefits such as minimum wages, retirement plans or unemployment compensation, may have significant displacement effects on native workers.

• The flow of immigrants and their ability to obtain employment often leads to immigrants being used as scapegoats against the adverse economic conditions faced by many native workers.
Previous Research

- Prior research on the effects of immigration have shown little or no effect of immigration on native workers.

- Other research suggests there is a negative effect of immigration on low-skilled native workers and native minorities.
  - Borjas et al. (1997), Camarota (1998)
Immigrants in Developing Countries

- The immigrant population tends to be relatively more skilled than the native population.

- Anecdotal evidence suggests that often times these skilled immigrants tend to take jobs which under-utilize their skills (in the unskilled sector) or become employed in the informal sector.
Limitations

• Endogeneity of immigration flows.
• Illegal immigration is not known.
  • Can capture between 46 and 87 percent of the actual number of immigrants.
• Informal sector is more likely to employ illegal immigrants.
Limitations

Immigration (annual flow)

- Immigration and the Informal Labor Market – p. 8/31
## Limitations

Table 1: Source Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>2001</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>UK</td>
<td>622</td>
<td>12.90</td>
</tr>
<tr>
<td>India</td>
<td>487</td>
<td>10.1</td>
</tr>
<tr>
<td>Germany</td>
<td>349</td>
<td>7.2</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>326</td>
<td>6.7</td>
</tr>
<tr>
<td>China</td>
<td>254</td>
<td>5.3</td>
</tr>
<tr>
<td>Nigeria</td>
<td>198</td>
<td>4.1</td>
</tr>
<tr>
<td>Overseas</td>
<td>3,407</td>
<td>70.5</td>
</tr>
<tr>
<td>Africa</td>
<td>1,419</td>
<td>29.4</td>
</tr>
</tbody>
</table>

*Source: Statistics South Africa, 2001 and 2003 Documented Migration*
Preview of Results

• For black South Africans, the effect of immigration on labor market outcomes are negative and significant.
  • Immigration decreases the probability of obtaining a job for unskilled workers and decreases the probability of being employed in the formal sector for both skilled and unskilled workers.

• For white South African’s there appears to be no effect of immigration on their labor market outcomes.

• For male unskilled coloured South Africans, immigrants tend to increase the probability of becoming employed, and increases the probability of being employed in the formal sector.

• For female coloured South Africans, immigrants have no effect on the probability of being employed, but conditional on being employed, it decreases their probability of being employed in the informal sector (skilled workers).
Data

• 10% sample of the 2001 Census and 2% sample of 2007 Community Survey.

• The sample is restricted to adults between the ages of 15 and 65, who are not enrolled in school or institutionalized.

• The geographic areas used to identify labor markets are the 47 district councils and 6 metropolitan areas for a total of 53 labor markets (DC).
Data

• Formal sector employment is employment in a business or institution which is registered (i.e. has a tax number).
  • The definition of informal and formal employment is consistent across the two surveys, how the respondents were asked about their sector of employment was not consistent.
Census Question

2001 Census
In the seven days before 10 October did (the person) do any work for PAY (in cash or in kind profit or family gain, for one hour or more?

1. Yes: formal registered (non-farming)
2. Yes: informal unregistered (non-farming)
3. Yes: farming
4. Yes: has work but was temporarily absent
5. No: did not have work
Census Question

2007 Community Survey
Is the organisation/ company / business /enterprise/branch where (the person) works in the formal or informal sector?

1. In the formal sector
2. In the informal sector (including domestic work)
3. Do not know
## Descriptive Statistics

### Table 2: Share of Labor Force Foreign Born

<table>
<thead>
<tr>
<th>Province</th>
<th>Immigrant Share of Labor Force</th>
<th>Number of Observations</th>
<th>Immigrant Share of Labor Force</th>
<th>Number of Observations</th>
<th>Immigrant Share of Labor Force</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Cape</td>
<td>2.78</td>
<td>194,325</td>
<td>2.70</td>
<td>214,211</td>
<td>3.72</td>
<td>58,523</td>
</tr>
<tr>
<td>Eastern Cape</td>
<td>0.78</td>
<td>216,094</td>
<td>0.77</td>
<td>230,493</td>
<td>0.90</td>
<td>64,827</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>1.36</td>
<td>35,299</td>
<td>1.74</td>
<td>36,285</td>
<td>3.43</td>
<td>22,454</td>
</tr>
<tr>
<td>Free State</td>
<td>1.74</td>
<td>104,327</td>
<td>1.92</td>
<td>109,418</td>
<td>4.50</td>
<td>27,461</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>1.75</td>
<td>315,574</td>
<td>1.46</td>
<td>331,686</td>
<td>1.49</td>
<td>94,116</td>
</tr>
<tr>
<td>North West</td>
<td>1.96</td>
<td>134,040</td>
<td>2.76</td>
<td>149,782</td>
<td>4.43</td>
<td>39,196</td>
</tr>
<tr>
<td>Gauteng</td>
<td>5.75</td>
<td>351,248</td>
<td>6.60</td>
<td>410,375</td>
<td>7.81</td>
<td>101,548</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>3.35</td>
<td>103,235</td>
<td>3.84</td>
<td>117,743</td>
<td>4.59</td>
<td>31,775</td>
</tr>
<tr>
<td>Limpopo</td>
<td>2.35</td>
<td>137,203</td>
<td>2.64</td>
<td>170,030</td>
<td>2.38</td>
<td>40,660</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.78</strong></td>
<td><strong>1,591,345</strong></td>
<td><strong>3.14</strong></td>
<td><strong>1,770,023</strong></td>
<td><strong>4.01</strong></td>
<td><strong>480,560</strong></td>
</tr>
</tbody>
</table>

**Source:** 1996 and 2001 South African Census and 2007 Community Survey

**Notes:** Adults in the labor force between the ages of 15 and 65 who are not enrolled in school or institutionalized.
Table 3: Descriptive Statistics of Labor Force

<table>
<thead>
<tr>
<th></th>
<th>White Male</th>
<th>Black Male</th>
<th>Coloured Male</th>
<th>Immigrant Male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Individual Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>40.38</td>
<td>41.32</td>
<td>35.85</td>
<td>36.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35.94</td>
<td>36.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38.02</td>
<td>38.89</td>
</tr>
<tr>
<td>Years of Schooling</td>
<td>11.39</td>
<td>11.58</td>
<td>7.05</td>
<td>8.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.25</td>
<td>8.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.51</td>
<td>8.58</td>
</tr>
<tr>
<td>Employment Rate</td>
<td>79.47</td>
<td>84.32</td>
<td>41.49</td>
<td>50.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60.07</td>
<td>63.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>74.35</td>
<td>82.17</td>
</tr>
<tr>
<td>Observations</td>
<td>81,023</td>
<td>18,923</td>
<td>574,908</td>
<td>160,326</td>
</tr>
<tr>
<td></td>
<td>86,484</td>
<td>26,208</td>
<td>30,641</td>
<td>10,149</td>
</tr>
</tbody>
</table>

|                      | White Female        | Black Female        | Coloured Female      | Immigrant Female     |
| **Panel A: Women**   |                     |                     |                      |                      |
| **Individual Characteristics** |                     |                     |                      |                      |
| Age                  | 40.82               | 41.8                | 36.34                | 36.81                |
|                      |                     |                     | 36.51                | 37.69                |
|                      |                     |                     | 39.05                | 39.08                |
| Years of Schooling   | 11.3                | 11.53               | 6.78                 | 8.09                 |
|                      |                     |                     | 8.17                 | 8.73                 |
|                      |                     |                     | 8.88                 | 9.21                 |
| Employment Rate      | 58.42               | 66.51               | 25.27                | 33.56                |
|                      |                     |                     | 44.64                | 48.31                |
|                      |                     |                     | 43.86                | 47.38                |
| Observations         | 88,531              | 19,936              | 731,454              | 196,342              |
|                      | 100,657             | 30,186              | 22,828               | 6,380                |
Descriptive Statistics

Table 4: Industry Distribution of Labor Force (2007)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percent Immigrant 2001</th>
<th>Percent Immigrant 2007</th>
<th>Percent of Labor Force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White Male</td>
<td>Black Male</td>
<td>Coloured Male</td>
</tr>
<tr>
<td>Agriculture, fishing, and forestry</td>
<td>4.81</td>
<td>5.62</td>
<td>7.63</td>
</tr>
<tr>
<td>Mining</td>
<td>11.61</td>
<td>3.88</td>
<td>6.01</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4.83</td>
<td>18.8</td>
<td>16.57</td>
</tr>
<tr>
<td>Construction</td>
<td>6.95</td>
<td>6.57</td>
<td>10.1</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>5.9</td>
<td>11.03</td>
<td>9.34</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>5.8</td>
<td>2.41</td>
<td>2.6</td>
</tr>
<tr>
<td>Transportation and communications</td>
<td>4</td>
<td>5.44</td>
<td>5.29</td>
</tr>
<tr>
<td>Financial services and insurance</td>
<td>5.68</td>
<td>4.71</td>
<td>1.39</td>
</tr>
<tr>
<td>Public administration and defense</td>
<td>2.04</td>
<td>3.23</td>
<td>3.81</td>
</tr>
<tr>
<td>Real estate and business services</td>
<td>6.32</td>
<td>6.48</td>
<td>1.93</td>
</tr>
<tr>
<td>Private household services</td>
<td>2.36</td>
<td>0.76</td>
<td>4.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4.86</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
# Descriptive Statistics

## Table 5: Industry Distribution of Labor Force (2007)

<table>
<thead>
<tr>
<th>Industry</th>
<th>White Female</th>
<th>Black Female</th>
<th>Coloured Female</th>
<th>Immigrant Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, fishing, and forestry</td>
<td>2.82</td>
<td>6.63</td>
<td>9.48</td>
<td>5.3</td>
</tr>
<tr>
<td>Mining</td>
<td>1.09</td>
<td>0.57</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>12.45</td>
<td>9.33</td>
<td>12.79</td>
<td>10.53</td>
</tr>
<tr>
<td>Construction</td>
<td>2.53</td>
<td>1.66</td>
<td>1.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>9.16</td>
<td>10.44</td>
<td>13.73</td>
<td>10.66</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>3.01</td>
<td>5.07</td>
<td>3.77</td>
<td>5.35</td>
</tr>
<tr>
<td>Transportation and communications</td>
<td>4.11</td>
<td>1.85</td>
<td>2.33</td>
<td>2.9</td>
</tr>
<tr>
<td>Financial services and insurance</td>
<td>7.62</td>
<td>1.81</td>
<td>3.92</td>
<td>4.85</td>
</tr>
<tr>
<td>Real estate and business services</td>
<td>7.98</td>
<td>1.66</td>
<td>2.44</td>
<td>5.33</td>
</tr>
<tr>
<td>Education</td>
<td>9.73</td>
<td>7.81</td>
<td>5.73</td>
<td>6.51</td>
</tr>
<tr>
<td>Health and social work</td>
<td>8.93</td>
<td>6.45</td>
<td>7.63</td>
<td>6.04</td>
</tr>
<tr>
<td>Private household services</td>
<td>1.31</td>
<td>20.29</td>
<td>9.12</td>
<td>11.56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
### Descriptive Statistics

#### Table 6: Share Employed in Informal Sector (2007)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Percent Informal 2001</th>
<th>Percent Informal 2007</th>
<th>Share Employed in Informal Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>White Male</td>
</tr>
<tr>
<td>Agriculture, fishing, and forestry</td>
<td>11.95</td>
<td>35.65</td>
<td>12.45</td>
</tr>
<tr>
<td>Mining</td>
<td>3.32</td>
<td>3.78</td>
<td>1.4</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>8.36</td>
<td>19.34</td>
<td>16.61</td>
</tr>
<tr>
<td>Construction</td>
<td>21.9</td>
<td>35.81</td>
<td>11.07</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>16.15</td>
<td>26.42</td>
<td>11.91</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>12.49</td>
<td>36.92</td>
<td>3.1</td>
</tr>
<tr>
<td>Transportation and communications</td>
<td>12.92</td>
<td>20.26</td>
<td>3.71</td>
</tr>
<tr>
<td>Financial services and insurance</td>
<td>2.84</td>
<td>5.13</td>
<td>1.96</td>
</tr>
<tr>
<td>Public administration and defense</td>
<td>0.79</td>
<td>5.33</td>
<td>0.82</td>
</tr>
<tr>
<td>Real estate and business services</td>
<td>7.36</td>
<td>12.58</td>
<td>5.27</td>
</tr>
<tr>
<td>Private household services</td>
<td>39.96</td>
<td>81.66</td>
<td>3.46</td>
</tr>
<tr>
<td>Total</td>
<td>13.57</td>
<td>26.57</td>
<td>100</td>
</tr>
</tbody>
</table>
## Table 7: Share Employed in Informal Sector (2007)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Share Employed in Informal Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White Female</td>
</tr>
<tr>
<td>Agriculture, fishing, and forestry</td>
<td>6.82</td>
</tr>
<tr>
<td>Mining</td>
<td>0.41</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>11.63</td>
</tr>
<tr>
<td>Construction</td>
<td>3.5</td>
</tr>
<tr>
<td>Wholesale and retail trade</td>
<td>9.13</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>6.03</td>
</tr>
<tr>
<td>Transportation and communications</td>
<td>2.63</td>
</tr>
<tr>
<td>Financial services and insurance</td>
<td>3.44</td>
</tr>
<tr>
<td>Public administration and defense</td>
<td>0.71</td>
</tr>
<tr>
<td>Real estate and business services</td>
<td>6.16</td>
</tr>
<tr>
<td>Education</td>
<td>4.99</td>
</tr>
<tr>
<td>Health and social work</td>
<td>6.3</td>
</tr>
<tr>
<td>Private household services</td>
<td>9.46</td>
</tr>
</tbody>
</table>
Empirical Specification

The first regression estimates the effect of immigration on the probability of being employed:

\[
prob(\text{Emp}_{idt} = 1) = \Phi(X_{idt}\beta_1 + (I/L)_{dt}\gamma_1)
\]  

(1)

where \(X_{idt}\) are individual characteristics for individual \(i\), in district council \(d\), in time period \(t\), \(I/L_{dt}\) is the immigration share in the labor force in district \(d\) in time period \(t\).

The second regression estimates the effect of immigration on the probability of being employed in the informal sector conditional on being employed:

\[
prob(\text{Inf}_{idt} = 1|\text{Emp}_{idt} = 1) = \Phi(X_{idt}\beta_2 + (I/L)_{dt}\gamma_2)
\]  

(2)
Empirical Specification

- Individual level characteristics: age, age-squared, marital status, skill level, and dummies for racial groups.
- Immigrants may self-select into labor markets for reasons correlated with native labor market outcomes, resulting in biased estimates of $\gamma$.
- Additional controls: district unemployment rate, log district population, fraction of district black, fraction of district white, and fraction of district asian.
- We also include the proportion of dwellings with access to piped water, sewage disposal, and electricity to capture the district’s "level of development."
## Results

### Table 8: Effects of Immigration on Male Native Employment Rates

<table>
<thead>
<tr>
<th></th>
<th>Black Subsample</th>
<th></th>
<th>White Subsample</th>
<th></th>
<th>Coloured Subsample</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td></td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Immigrant Share</td>
<td>2.6***</td>
<td>-0.52***</td>
<td>-1.1***</td>
<td>0.4***</td>
<td>-0.05</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.056)</td>
<td>(0.206)</td>
<td>(0.065)</td>
<td>(0.104)</td>
<td>(0.389)</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
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<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Obs.</td>
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<td>733382</td>
<td>733382</td>
<td>99804</td>
<td>99804</td>
<td>99804</td>
</tr>
</tbody>
</table>

Significance levels:  
* : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
## Results

Table 9: Effects of Immigration on Male Native Informal Employment Rates

<table>
<thead>
<tr>
<th></th>
<th>Black Subsample</th>
<th></th>
<th></th>
<th>White Subsample</th>
<th></th>
<th></th>
<th>Coloured Subsample</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>Immigrant</td>
<td>-0.88***</td>
<td>-0.9***</td>
<td>-1.68***</td>
<td>0.00</td>
<td>-0.01</td>
<td>-0.16</td>
<td>0.06</td>
<td>0.61***</td>
<td>-2.02***</td>
</tr>
<tr>
<td>Share</td>
<td>(0.042)</td>
<td>(0.064)</td>
<td>(0.227)</td>
<td>(0.051)</td>
<td>(0.070)</td>
<td>(0.235)</td>
<td>(0.112)</td>
<td>(0.141)</td>
<td>(0.449)</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Obs.</td>
<td>307947</td>
<td>307947</td>
<td>307947</td>
<td>79233</td>
<td>79233</td>
<td>79233</td>
<td>66821</td>
<td>66821</td>
<td>66799</td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
### Results

#### Table 10: Effects of Immigration on Female Native Employment Rates

<table>
<thead>
<tr>
<th></th>
<th>Black Subsample</th>
<th>White Subsample</th>
<th>Coloured Subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Immigrant Share</td>
<td>1.74***</td>
<td>-0.87***</td>
<td>-1.43***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.045)</td>
<td>(0.164)</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>925325</td>
<td>925325</td>
<td>925325</td>
</tr>
<tr>
<td></td>
<td>108306</td>
<td>108306</td>
<td>108305</td>
</tr>
<tr>
<td></td>
<td>130231</td>
<td>130231</td>
<td>130231</td>
</tr>
<tr>
<td>Obs.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
### Results

**Table 11: Effects of Immigration on Female Native Informal Employment Rates**

<table>
<thead>
<tr>
<th></th>
<th>Black Subsample</th>
<th>White Subsample</th>
<th>Coloured Subsample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Immigrant</td>
<td>-0.68***</td>
<td>-0.78***</td>
<td>-1.27***</td>
</tr>
<tr>
<td>Share</td>
<td>(0.054)</td>
<td>(0.087)</td>
<td>(0.325)</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>Immigrant</td>
<td>-0.09*</td>
<td>-0.17**</td>
<td>0.00</td>
</tr>
<tr>
<td>Share</td>
<td>(0.056)</td>
<td>(0.082)</td>
<td>(0.283)</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>Immigrant</td>
<td>-0.84***</td>
<td>0.58***</td>
<td>-1.34***</td>
</tr>
<tr>
<td>Share</td>
<td>(0.120)</td>
<td>(0.149)</td>
<td>(0.507)</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(10)</td>
<td>(11)</td>
<td>(12)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>(13)</td>
<td>(14)</td>
<td>(15)</td>
</tr>
<tr>
<td>District FE</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(17)</td>
<td>(18)</td>
</tr>
<tr>
<td>District FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(19)</td>
<td>(20)</td>
<td>(21)</td>
</tr>
<tr>
<td>Obs.</td>
<td>239834</td>
<td>239834</td>
<td>239834</td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

*Notes:* Reporting marginal effects.
## Results by Skill Level

Table 12: Effects of Immigration on Male Native Employment Rates by Skill

<table>
<thead>
<tr>
<th></th>
<th>Skilled</th>
<th>Unskilled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Black)</td>
<td>(White)</td>
</tr>
<tr>
<td>Immigrant Share</td>
<td>-0.523</td>
<td>0.122</td>
</tr>
<tr>
<td></td>
<td>(0.405)</td>
<td>(0.379)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-103338.11</td>
<td>-24590.83</td>
</tr>
<tr>
<td>Obs.</td>
<td>181033</td>
<td>75007</td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
## Results by Skill Level

Table 13: Effects of Immigration on Male Native Informal Employment Rates by Skill

<table>
<thead>
<tr>
<th>Immigrant Share</th>
<th>Skilled</th>
<th>Unskilled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Black)</td>
<td>(White)</td>
</tr>
<tr>
<td></td>
<td>-0.584*</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.342)</td>
<td>(0.253)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-36145.80</td>
<td>-12186.62</td>
</tr>
<tr>
<td>Obs.</td>
<td>96892</td>
<td>63441</td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
## Results by Skill Level

### Table 14: Effects of Immigration on Female Native Employment Rates by Skill

<table>
<thead>
<tr>
<th></th>
<th>Skilled</th>
<th>Unskilled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Black)</td>
<td>(White)</td>
</tr>
<tr>
<td>Immigrant Share</td>
<td>0.074</td>
<td>-0.047</td>
</tr>
<tr>
<td></td>
<td>(0.372)</td>
<td>(0.567)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-128331.46</td>
<td>-43425.49</td>
</tr>
<tr>
<td></td>
<td>-18192.81</td>
<td>-365690.29</td>
</tr>
<tr>
<td>Obs.</td>
<td>213990</td>
<td>79178</td>
</tr>
</tbody>
</table>

|                     | (Coloured)       | (Black)          |
|                     | -0.692           | -1.658***        |
|                     | (1.194)          | (0.177)          |
|                     | Yes              | Yes              |
|                     | Yes              | Yes              |
|                     | -18192.81        | -365690.29       |
|                     | -17811.78        | -61634.53        |
|                     | 30654            | 29127            |

|                     | (Coloured)       | (Coloured) |
|                     | -1.658***        | -0.299     |
|                     | (0.177)          | (0.699)    |
|                     | Yes              | Yes        |
|                     | Yes              | Yes        |
|                     | -17811.78        | -61634.53  |
|                     | 29127            | 99577      |

**Significance levels:**  
* : 10%  
** : 5%  
*** : 1%

*Notes: Reporting marginal effects.*
### Results by Skill Level

Table 15: Effects of Immigration on Female Native Informal Employment Rates by Skill

<table>
<thead>
<tr>
<th>Immigrant Share</th>
<th>Skilled (Black)</th>
<th>Skilled (White)</th>
<th>Skilled (Coloured)</th>
<th>Unskilled (Black)</th>
<th>Unskilled (White)</th>
<th>Unskilled (Coloured)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immigrant Share</td>
<td>-0.791*</td>
<td>0.161</td>
<td>-2.414***</td>
<td>-1.283***</td>
<td>-0.765</td>
<td>-0.877</td>
</tr>
<tr>
<td></td>
<td>(0.421)</td>
<td>(0.299)</td>
<td>(0.658)</td>
<td>(0.435)</td>
<td>(0.867)</td>
<td>(0.806)</td>
</tr>
<tr>
<td>Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>District FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-36041.88</td>
<td>-10400.16</td>
<td>-3740.32</td>
<td>-96477.38</td>
<td>-2934.99</td>
<td>-15972.11</td>
</tr>
<tr>
<td>Obs.</td>
<td>84536</td>
<td>53199</td>
<td>19591</td>
<td>155298</td>
<td>10431</td>
<td>37277</td>
</tr>
</tbody>
</table>

Significance levels:  * : 10%  ** : 5%  *** : 1%

Notes: Reporting marginal effects.
Conclusions

• This paper explores the effects of immigration in one of the most developed economies in Sub-Saharan Africa, South Africa, and on a sector of the economy which is most likely to be impacted by immigration flows, the informal sector.

• The results show that for native South Africans which South African immigrants most resemble, black South Africans, the effect of immigration on labor market outcomes are negative and significant.
Undocumented Migration with Endogenous Coyote Prices

Áureo de Paula and Timothy Halliday

March 2011
Background

- Undocumented migration is a policy concern
Background

- Undocumented migration is a policy concern
- Common policy tool: border enforcement
Background

- Undocumented migration is a policy concern
- Common policy tool: border enforcement
- Other proposed policies
Background

- Undocumented migration is a policy concern
- Common policy tool: border enforcement
- Other proposed policies
  - Charging for entry (Gary Becker)
Background

- Undocumented migration is a policy concern
- Common policy tool: border enforcement
- Other proposed policies
  - Charging for entry (Gary Becker)
  - Temporary worker permits
How do alternative policies such as varying the degree of border enforcement, random lotteries, or temporary work permits affect the migration decisions of Mexicans?
Border Enforcement 1966-2004

The graph shows the trend of total line hours (in millions) over the years from 1970 to 2010. There is a noticeable increase in the number of line hours from the 1990s onwards, reaching a peak in the early 2000s before a slight decrease in recent years.
Effects of enforcement on migration
Effects of enforcement on migration

- Hanson and Spilimbergo (1999)
Effects of enforcement on migration

- Hanson and Spilimbergo (1999)
Effects of enforcement on migration

- Hanson and Spilimbergo (1999)
- Gathmann (2008)
Literature

- Effects of enforcement on migration
  - Hanson and Spilimbergo (1999)
  - Gathmann (2008)

- Increased enforcement
Effects of enforcement on migration

- Hanson and Spilimberto (1999)
- Gathmann (2008)

Increased enforcement

- Reduces migration
Effects of enforcement on migration

- Hanson and Spilimberto (1999)
- Gathmann (2008)

Increased enforcement

- Reduces migration
- Increases coyote (human smuggler) usage
Effects of enforcement on migration
- Hanson and Spilimbergo (1999)
- Gathmann (2008)

Increased enforcement
- Reduces migration
- Increases coyote (human smuggler) usage
- Increases likelihood of crossing in the desert
Colussi (2006)
Literature

- Colussi (2006)
  - Looks at networks
Colussi (2006)
- Looks at networks
- Structural analogue of Munshi (2003)
Literature

- Colussi (2006)
  - Looks at networks
  - Structural analogue of Munshi (2003)
- Thom (2010)
Literature

- Colussi (2006)
  - Looks at networks
  - Structural analogue of Munshi (2003)

- Thom (2010)
  - Allows for savings
Literature

- Colussi (2006)
  - Looks at networks
  - Structural analogue of Munshi (2003)
- Thom (2010)
  - Allows for savings
- Common finding:
Literature

- Colussi (2006)
  - Looks at networks
  - Structural analogue of Munshi (2003)

- Thom (2010)
  - Allows for savings

Common finding:
- BE $\Rightarrow$ immigrants less likely to leave

Endogenous coyote decisions
Endogenous coyote prices
Uncertainty over future enforcement

Random walk
Thom (2010) - stationary with deterministic trend
Colussi (2006)
- Looks at networks
- Structural analogue of Munshi (2003)

Thom (2010)
- Allows for savings

Common finding:
- BE $\Rightarrow$ immigrants less likely to leave
- BE $\Rightarrow$ immigrants more likely to stay longer
Literature

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  - Looks at networks
  - Structural analogue of Munshi (2003)
- Thom (2010)
  - Allows for savings
- Common finding:
  - BE $\Rightarrow$ immigrants less likely to leave
  - BE $\Rightarrow$ immigrants more likely to stay longer
- Our paper has
Literature

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  - Structural analogue of Munshi (2003)

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  - Random walk
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- Looks at networks
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Common finding:
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- BE $\Rightarrow$ immigrants more likely to stay longer

Our paper has
- Endogenous coyote decisions
- Endogenous coyote prices
- Uncertainty over future enforcement
  - Random walk
  - Thom (2010) - stationary with deterministic trend
Our Paper

- We have reduced-form evidence on existing policies

What about policies that have yet to be proposed?

- Higher enforcement?
- Lower enforcement?
- Random lotteries?
- Work permits?

Requires a structural model

- Fully specify individual's behavior
- Estimate policy invariant parameters
- Facilitate counter-factual policy analysis

How does policy affect decisions on leaving Mexico and duration in the US?
Our Paper

- We have reduced-form evidence on existing policies.
- What about policies that have yet to be proposed?
Our Paper

- We have reduced-form evidence on existing policies
- What about policies that have yet to be proposed?
  - Higher enforcement?
Our Paper

- We have reduced-form evidence on existing policies
- What about policies that have yet to be proposed?
  - Higher enforcement?
  - Lower enforcement?
Our Paper

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  - Lower enforcement?
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  - Lower enforcement?
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  - Work permits?
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  - Lower enforcement?
  - Random lotteries?
  - Work permits?
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  - Lower enforcement?
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  - Work permits?
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  - Lower enforcement?
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  - Work permits?
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  - Lower enforcement?
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  - Work permits?
- Requires a structural model
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  - Estimate policy invariant parameters
  - Facilitate counter-factual policy analysis
We have reduced-form evidence on existing policies

What about policies that have yet to be proposed?
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- Lower enforcement?
- Random lotteries?
- Work permits?

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- Estimate policy invariant parameters
- Facilitate counter-factual policy analysis

How does policy affect decisions on
Our Paper

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- What about policies that have yet to be proposed?
  - Higher enforcement?
  - Lower enforcement?
  - Random lotteries?
  - Work permits?
- Requires a structural model
  - Fully specify individual’s behavior
  - Estimate policy invariant parameters
  - Facilitate counter-factual policy analysis
- How does policy affect decisions on
  - Leaving Mexico
Our Paper

- We have reduced-form evidence on existing policies.
- What about policies that have yet to be proposed?
  - Higher enforcement?
  - Lower enforcement?
  - Random lotteries?
  - Work permits?
- Requires a structural model
  - Fully specify individual’s behavior
  - Estimate policy invariant parameters
  - Facilitate counter-factual policy analysis
- How does policy affect decisions on
  - Leaving Mexico
  - Duration in the US
Primitives

Figure 1: A Year in the Life

Observe Wages → Choose Location → Deportation → Consume
Individuals chose to locate
Individuals chose to locate
- In the US ($l_{i,a} = 1$)
Individuals chose to locate

- In the US ($l_{i,a} = 1$)
- Or Mexico ($l_{i,a} = 0$)
Individuals chose to locate

- In the US ($l_{i,a} = 1$)
- Or Mexico ($l_{i,a} = 0$)

Useful notation: $x_{i,a} = l_{i,a} - l_{i,a-1}$
Primitives

Location Decisions

- Individuals chose to locate
  - In the US ($l_{i,a} = 1$)
  - Or Mexico ($l_{i,a} = 0$)

- Useful notation: $x_{i,a} = l_{i,a} - l_{i,a-1}$
  - $x_{i,a} = 1 \Rightarrow$ Northward migration
Primitives

Location Decisions

- Individuals chose to locate
  - In the US ($l_{i,a} = 1$)
  - Or Mexico ($l_{i,a} = 0$)

- Useful notation: $x_{i,a} = l_{i,a} - l_{i,a-1}$
  - $x_{i,a} = 1 \Rightarrow$ Northward migration
  - $x_{i,a} = 0 \Rightarrow$ No migration
Primitives
Location Decisions

- Individuals chose to locate
  - In the US \((l_{i,a} = 1)\)
  - Or Mexico \((l_{i,a} = 0)\)
- Useful notation: \(x_{i,a} = l_{i,a} - l_{i,a-1}\)
  - \(x_{i,a} = 1 \Rightarrow\) Northward migration
  - \(x_{i,a} = 0 \Rightarrow\) No migration
  - \(x_{i,a} = -1 \Rightarrow\) Southward migration
Let $b_a$ denote line hours for age $a$.
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp (\varepsilon_a)$$
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\varepsilon_a)$$

Implies log line hours follow a random walk
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\epsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\varepsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data

1 st order autoregression
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp (\varepsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data

- 1st order autoregression

  - Estimate of 1.035
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\varepsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data

1st order autoregression

- Estimate of 1.035
- 95% CI = [0.996, 1.074]
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\varepsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data

- 1st order autoregression
  - Estimate of 1.035
  - 95% CI = [0.996, 1.074]
  - Dickey-Fuller fails to reject ($\alpha = 5\%$)
Let $b_a$ denote line hours for age $a$

Assume

$$b_a = b_{a-1} \exp(\varepsilon_a)$$

Implies log line hours follow a random walk

Confirmed in the data

- 1st order autoregression
  - Estimate of 1.035
  - 95% CI = [0.996, 1.074]

- Dickey-Fuller fails to reject ($\alpha = 5\%$)
- Phillips-Perron fails to reject ($\alpha = 10\%$)
Primitives

Migration Costs

\[
\exp(\alpha_{0,i} + \alpha_1 a) + \delta \Lambda (\gamma_1 b_a + \gamma_2 c_{i,a})
\]

- Utility cost
- (Ex ante) deportation cost

Utility costs depend on

Áureo de Paula and Timothy Halliday
Primitives

Migration Costs

\[
\exp (\alpha_{0,i} + \alpha_1 a) + \delta \Lambda (\gamma_1 b_a + \gamma_2 c_i,a)
\]

Utility cost

(Ex ante) deportation cost

- Utility costs depend on
  - Ability (unobserved): \( \alpha_{0,i} \)
Primitives

Migration Costs

\[
\exp (\alpha_{0,i} + \alpha_1 a) + \delta \Lambda (\gamma_1 b_a + \gamma_2 c_{i,a})
\]

- Utility cost
- (Ex ante) deportation cost

Utility costs depend on

- Ability (unobserved): \( \alpha_{0,i} \)
- Age: \( a \)
Primitives

Migration Costs

\[ \exp \left( \alpha_{0,i} + \alpha_{1}a \right) + \delta \Lambda \left( \gamma_{1} b_{a} + \gamma_{2} c_{i,a} \right) \]

- Utility cost
- (Ex ante) deportation cost

- Utility costs depend on
  - Ability (unobserved): \( \alpha_{0,i} \)
  - Age: \( a \)

- Deportation costs depend on
Utility costs depend on
- Ability (unobserved): $\alpha_{0,i}$
- Age: $a$

Deportation costs depend on
- Line hours: $b_a$
Primitives

Migration Costs

\[
\exp \left( \alpha_{0,i} + \alpha_1 a \right) + \delta \Lambda \left( \gamma_1 b_a + \gamma_2 c_{i,a} \right)
\]

Utility cost

(Ex ante) deportation cost

- Utility costs depend on
  - Ability (unobserved): \( \alpha_{0,i} \)
  - Age: \( a \)

- Deportation costs depend on
  - Line hours: \( b_a \)
  - Coyote usage: \( c_{i,a} \)
Primitives

Coyote Prices

- Nash bargaining
Nash bargaining

Value of being in the North
Nash bargaining

Value of being in the North

\[ V_{i,a}^N(x_{i,a}, c_{i,a}) \]
Primitives

Coyote Prices

- Nash bargaining
- Value of being in the North
  - $V_{i,a}^N(x_{i,a}, c_{i,a})$
- Value of being in the South
Primitives

Coyote Prices

• Nash bargaining
• Value of being in the North
  • $V_{i,a}^N(x_{i,a}, c_{i,a})$
• Value of being in the South
  • $V_{i,a}^S$
Primitives

Coyote Prices

- Nash bargaining
- Value of being in the North
  - $V^N_{i,a}(x_{i,a}, c_{i,a})$
- Value of being in the South
  - $V^S_{i,a}$
- Threat point is

$$\overline{V}_{i,a} = \max \langle V^N_{i,a}(x_{i,a} = 1, c_{i,a} = 0), V^S_{i,a} \rangle$$
Primitives

Coyote Prices

- Nash bargaining
- Value of being in the North
  - $V_{i,a}^N(x_{i,a}, c_{i,a})$
- Value of being in the South
  - $V_{i,a}^S$
- Threat point is

\[
\bar{V}_{i,a} = \max \langle V_{i,a}^N(x_{i,a} = 1, c_{i,a} = 0), V_{i,a}^S \rangle
\]

- Coyote’s transport cost: $t$
Coyote prices are paid out of Northern wages
Coyote Prices

- Coyote prices are paid out of Northern wages
- So, $p_{i,a} \in [t, w^N_{i,a}]$
Coyote prices are paid out of Northern wages

So, $p_{i,a} \in [t, w_{i,a}^{N}]$

Migrant’s bargaining power is $\psi$
Coyote prices are paid out of Northern wages

So, \( p_{i,a} \in [t, w_{i,a}^N] \)

Migrant’s bargaining power is \( \psi \)

Prices maximize:
Coyote prices are paid out of Northern wages
So, \( p_{i,a} \in [t, w_{i,a}^N] \)
Migrant’s bargaining power is \( \psi \)
Prices maximize:
\[
(V_{i,a}^N(x_{i,a} = 1, c_{i,a} = 1; p) - \bar{V}_{i,a})^\psi \times (p - t)^{1-\psi}
\]
Wages are $w_{i,a}^N$ (Northern) and $w_{i,a}^S$ (Southern).
Wages are $w_{i,a}^N$ (Northern) and $w_{i,a}^S$ (Southern).

The wage equation is

$$\ln w_{i,a}^j = \mu_0^j + \mu_1^j e_i + \mu_2^j a + \mu_2^j a^2 + \epsilon_{i,a}^j \text{ for } j \in \{N, S\}.$$
Wages are $w_{i,a}^N$ (Northern) and $w_{i,a}^S$ (Southern).

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$$\ln w_{i,a}^j = \mu_{0}^j + \mu_1^j e_i + \mu_2^j a + \mu_2^j a^2 + \epsilon_{i,a}^j \text{ for } j \in \{N, S\}.$$ 

We assume that $\epsilon_{i,a}^j$ are Normally distributed.
Wages are $w^N_{i,a}$ (Northern) and $w^S_{i,a}$ (Southern).

The wage equation is

$$\ln w^j_{i,a} = \mu_0^j + \mu_1^j e_i + \mu_2^j a + \mu_2^j a^2 + \varepsilon^j_{i,a} \text{ for } j \in \{N, S\}.$$ 

We assume that $\varepsilon^j_{i,a}$ are Normally distributed.

Observed wages depend on choices.
Wages are $w_{i,a}^N$ (Northern) and $w_{i,a}^S$ (Southern).

The wage equation is

$$\ln w_{i,a}^j = \mu_{0}^j + \mu_{1}^j e_i + \mu_{2}^j a + \mu_{2}^j a^2 + \varepsilon_{i,a}^j \text{ for } j \in \{N, S\}.$$

We assume that $\varepsilon_{i,a}^j$ are Normally distributed.

Observed wages depend on choices

- We estimate these parameters inside the model.
Wages are $w_{i,a}^N$ (Northern) and $w_{i,a}^S$ (Southern).

The wage equation is

$$\ln w_{i,a}^j = \mu_0^j + \mu_1^j e_i + \mu_2^j a + \mu_2^j a^2 + \epsilon_{i,a}^j \text{ for } j \in \{N, S\}.$$

We assume that $\epsilon_{i,a}^j$ are Normally distributed.

Observed wages depend on choices:
- We estimate these parameters inside the model.
- Our model is a Roy model.
Northern wages cannot be precisely dated
Primitives

Measurement Error

- Northern wages cannot be precisely dated
- Report wages at their most significant job
Northern wages cannot be precisely dated
Report wages at their most significant job
Assigned to 1st period that migrant was abroad
Primitives
Measurement Error

- Northern wages cannot be precisely dated
- Report wages at their most significant job
- Assigned to 1st period that migrant was abroad
- Induces measurement error

\[ w_{N, obs} = w_{N, \text{exp}}(\eta w_{N}) \]

Follows Keane and Mort (1998)
Northern wages cannot be precisely dated
Report wages at their most significant job
Assigned to 1st period that migrant was abroad
Induces measurement error

Assume

\[ w^{N,\text{OBS}} = w^N \exp(\eta_w) \text{ where } \eta_w \sim \mathcal{N}(0, \sigma^2_{\eta}) \]
Northern wages cannot be precisely dated
Report wages at their most significant job
Assigned to 1st period that migrant was abroad
Induces measurement error
Assume

\[ w^{N,\text{OBS}} = w^N \exp(\eta_w) \text{ where } \eta_w \sim \mathcal{N}(0, \sigma^2_\eta) \]

Follows Keane and Moffitt (1998)
Period utility is given by

\[
\frac{c^\theta}{\theta_{\text{cons}}} + h \times (1 - l) - (\delta d + \exp(\alpha_0 + \alpha_1 a))lx
\]

- **Preferences**

- **Cons**

- **Home pref**

- **(ex post) costs**
Period utility is given by

$$\frac{c^{\theta}}{\theta \text{ cons}} + h \times (1 - l) - (\delta d + \exp (\alpha_0 + \alpha_1 a)) lx$$

Home preferences are

$$h_{i,a} = \psi_{0,i} + \psi_{1 sexi} + \psi_{2 marriedi} + \psi_{3 a}$$
Period utility is given by
\[
\frac{c^\theta}{\theta} \underbrace{\text{cons}}_{\text{home pref}} + h \times (1 - l) - \underbrace{(\delta d + \exp(\alpha_0 + \alpha_1 a))lx}_{\text{(ex post) costs}}
\]

Home preferences are
\[
h_{i,a} = \psi_{0,i} + \psi_{1} \text{sex}_i + \psi_{2} \text{married}_i + \psi_{3} a
\]

No storage yields
\[
c_{i,a} = w_{i,a}^N l_{i,a} + w_{i,a}^S (1 - l_{i,a}) - x_{i,a} l_{i,a} c_{i,a} p_{i,a}
\]
At age $a$, choose a sequence $\{x_{ij}, c_{ij}\}_{j=a}^A$ to maximize

$$E \left[ \sum_{j=a}^A \beta^{j-a} u_{i,j} | \Omega_{i,a} \right]$$

where

$$\Omega_{i,a} = \{ l_{i,a}, w_{i,a}^S, w_{i,a}^N, b_a, Z_i, \alpha_{0,i}, \psi_{0,i} \}$$

is the agent’s information set. Requires evaluation of the agent’s value functions.
Value Functions (North)

- $V^N_{i,a}$: value of starting the period in the North
Value Functions (North)

- $V_{i,a}^N$: value of starting the period in the North
- Must choose
Value Functions (North)

- \( V_{i,a}^N \): value of starting the period in the North
- Must choose
  - to stay in or go to the North (w/ or w/o a coyote)
Value Functions (North)

- \( V_{i,a}^N \) : value of starting the period in the North
- Must choose
  - to stay in or go to the North (w/ or w/o a coyote)
- Expected value of \( l_{i,a} = 1 \)

\[
V_{i,a}^N = \frac{(c_{i,a})^\theta}{\theta} - \text{costs}_{i,a} \times x_{i,a} + \\
\beta E \left( \max \left\{ V_{i,a+1}^N, V_{i,a+1}^S \right\} \mid \Omega_{i,a}^N \right)
\]

where \( \Omega_{i,a}^N = \{ l_{i,a} = 1, w_{i,a}^S, w_{i,a}^N, b_a, Z_i, \alpha_{0,i}, \psi_{0,i} \} \).
Value Functions (South)

- $V_{i,a}^S$: value of starting the period in the South
Value Functions (South)

- $V_{i,a}^S$: value of starting the period in the South
- Must choose
Value Functions (South)

- $V_{i,a}^S$: value of starting the period in the South
- Must choose
  - to stay in or go to the South
Value Functions (South)

- \( V_{i,a}^S \): value of starting the period in the South
- Must choose
  - to stay in or go to the South
- Expected value of \( l_{i,a} = 0 \)

\[
V_{i,a}^S = \frac{(c_{i,a})^\theta}{\theta} + \beta E \left( \max \left\{ \max_{c_{i,a+1}} V_{i,a+1}^N, V_{i,a+1}^S \right\} \mid \Omega_{i,a}^S \right)
\]

where \( \Omega_{i,a}^N = \{ l_{i,a} = 0, w_{i,a}^S, w_{i,a}^N, b_a, Z_i, \alpha_{0,i}, \psi_{0,i} \} \)
Agent $a$ locates in the North if and only if

$$\max_{c_{i,a}} V^N_{i,a} > V^S_{i,a}$$
Migrant Decisions

- Agent \( a \) locates in the North if and only if

\[
\max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S
\]

- Agents in the South have 3 choices
Agent $a$ locates in the North if and only if

$$\max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S$$

Agents in the South have 3 choices

- Stay
- Migrate
- Migrate w/ coyote
- Migrate w/o coyote
Migrant Decisions

- Agent $a$ locates in the North if and only if
  \[ \max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S \]

- Agents in the South have 3 choices
  - Stay
  - Migrate
Agent $a$ locates in the North if and only if

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  - w/ coyote
  - w/o coyote
Migrant Decisions

- Agent $a$ locates in the North if and only if
  \[ \max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S \]

- Agents in the South have 3 choices
  - Stay
  - Migrate
    - w/ coyote
    - w/o coyote

- Agents in the North have 2 choices
Migrant Decisions

- Agent \( a \) locates in the North if and only if

\[
\max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S
\]

- Agents in the South have 3 choices
  - Stay
  - Migrate
    - w/ coyote
    - w/o coyote

- Agents in the North have 2 choices
  - Stay
Agent $a$ locates in the North if and only if

$$\max_{c_{i,a}} V_{i,a}^N > V_{i,a}^S$$

Agents in the South have 3 choices
- Stay
- Migrate
  - w/ coyote
  - w/o coyote

Agents in the North have 2 choices
- Stay
- Migrate
Mexican Migration Project

- Surveys areas with high rates of migration
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 w/pilots in 1982 and 1983
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 w/pilots in 1982 and 1983
- Surveys take place during the holidays
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 with pilots in 1982 and 1983
- Surveys take place during the holidays
- Retrospective data
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 w/pilots in 1982 and 1983
- Surveys take place during the holidays
- Retrospective data
- Only use the first crossing
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 with pilots in 1982 and 1983
- Surveys take place during the holidays
- Retrospective data
- Only use the first crossing
  - Deportations not available for intermediate crossings
Mexican Migration Project

- Surveys areas with high rates of migration
- Began in 1987 w/pilots in 1982 and 1983
- Surveys take place during the holidays
- Retrospective data
- Only use the first crossing
  - Deportations not available for intermediate crossings
  - It is salient ⇒ better able to recall it
Sample Selection

- Heads of household
Sample Selection

- Heads of household
- Between ages 20 and 60

Only use undocumented migrants

Migration history started after 1966

Bracero Program (1964)
Immigration Reform Act (1965)

Individuals needed to be born after 1945
Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
- Migration history started after 1966
Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
- Migration history started after 1966
- Two policies ended around here

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Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
- Migration history started after 1966
- Two policies ended around here
  - Bracero Program (1964)
Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
- Migration history started after 1966
- Two policies ended around here
  - Bracero Program (1964)
  - Immigration Reform Act (1965)
Sample Selection

- Heads of household
- Between ages 20 and 60
- Only use undocumented migrants
- Migration history started after 1966
- Two policies ended around here
  - Bracero Program (1964)
  - Immigration Reform Act (1965)
- Individuals needed to be born after 1945
## Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
</tr>
<tr>
<td>Married</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
</tr>
<tr>
<td>Ed</td>
<td>7.34</td>
</tr>
<tr>
<td></td>
<td>4.52</td>
</tr>
<tr>
<td>Survey Age</td>
<td>37.86</td>
</tr>
<tr>
<td></td>
<td>(8.62)</td>
</tr>
<tr>
<td>N</td>
<td>8366</td>
</tr>
</tbody>
</table>
## Outcome Data

<table>
<thead>
<tr>
<th>Crossing Year</th>
<th>Migrant</th>
<th>Coyote</th>
<th>Coyote Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986.81</td>
<td>0.20</td>
<td>0.77</td>
<td>1039.74</td>
</tr>
<tr>
<td>(8.63)</td>
<td>(0.40)</td>
<td>(0.42)</td>
<td>(1090.65)</td>
</tr>
</tbody>
</table>

Áureo de Paula and Timothy Halliday

March 2011
## Outcome Data

<table>
<thead>
<tr>
<th>Deported</th>
<th>Wage MEX</th>
<th>Wage US</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.26</td>
<td>2.19</td>
<td>9.89</td>
<td>3.11</td>
</tr>
<tr>
<td>(0.44)</td>
<td>(3.11)</td>
<td>(7.15)</td>
<td>(3.77)</td>
</tr>
</tbody>
</table>
Come from Department of Homeland Security (DHS)
Line Hour Data

- Come from Department of Homeland Security (DHS)
- Number of man hours used to patrol the border
Line Hour Data

- Come from Department of Homeland Security (DHS)
- Number of man hours used to patrol the border
- We do not consider crossing location
Coyote Usage, 1966-2004
Coyote Prices, 1966-2004
Deportations, 1966-2004
Estimation Sample

- Estimate model on a subset of the data

Major policy shift occurred in 1996

Illegal Imm. Reform and Imm. Responsibility Act (IRCA)

Dramatically increased resources for enforcement

We will simulate from 1966-2004

The years 1996-2004 are our validation sample
Estimation Sample

- Estimate model on a subset of the data
  - 1966-1996
Estimation Sample

- Estimate model on a subset of the data
  - 1966-1996
  - Major policy shift occurred in 1996
Estimation Sample

- Estimate model on a subset of the data
  - 1966-1996
  - Major policy shift occurred in 1996
  - Illegal Imm. Reform and Imm. Responsibility Act
Estimation Sample

- Estimate model on a subset of the data
  - 1966-1996
  - Major policy shift occurred in 1996
  - Illegal Imm. Reform and Imm. Responsibility Act
  - IRCA
Estimation Sample

- Estimate model on a subset of the data
  - 1966-1996
  - Major policy shift occurred in 1996
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- The years 1996-2004 are our validation sample
Likelihood Function

- History of migration $M_i$
Likelihood Function

- History of migration $M_i$
- Line hours $b_i(m_i) = \{b_{i,s}\}_{s=20}^{m_i}$
History of migration $M_i$

Line hours $b_i(m_i) = \{b_{i,s}\}_{s=20}^{m_i}$

For people who do not use a coyote,

$$
\hat{f}(M_i, (w_{i,s}^{OBS})_{s=20}^{m_i} | Z_i, b_i(m_i), \zeta_i) = \\
= \Pi_{s=20}^{m_i} \left[ h(d_{i,s} | l_{i,s-1}, c_{i,s-1}, Z_i, b(m_i), \zeta_i, w_{i,s}^{l_i,s, OBS}) \times \\
\times \hat{P}(l_{i,s}, c_{i,s} | l_{i,s-1}, c_{i,s-1}, Z_i, b(m_i), \zeta_i, w_{i,s}^{l_i,s, OBS}) \times \\
\times \phi(w_{i,s}^{l_i,s, OBS} | l_{i,s-1}, c_{i,s-1}, Z_i, b(m_i), \zeta_i) \right]
$$
For people who do use a coyote,

\[
\hat{P} \left( p_{i,s}, l_{i,s}, c_{i,s} \mid l_{i,s-1}, c_{i,s-1}, Z_i, b(m_i), \zeta_i, w^{i,s,\text{OBS}} \right) =
\frac{1}{R \times 2d_i(p_{i,s})} \sum_{r=1}^{R} \mathcal{K} \left( \frac{p_{i,s} - p_r}{2d_k(p_{i,s})} \right) 1 \left( l_{i,s}, c_{i,s}, l_{i,s-1}, c_{r,s-1} \right)
\]

= \frac{1}{R} \sum_{r=1}^{R} 1 \left( l_{i,s-1}, c_{i,s-1} \right)
Note that wages in the north are drawn conditional on observed waged

$$\log W^N | \log W^{N,OBS} \sim \mathcal{N} \left( \frac{\sigma_\eta^2}{\sigma_N^2 + \sigma_\eta^2} \mu^N + \frac{\sigma_N^2}{\sigma_N^2 + \sigma_\eta^2} W^{N,OBS}, \left[ \frac{1}{\sigma_N^2} + \frac{1}{\sigma_\eta^2} \right]^{-1} \right)$$
The Likelihood function is

\[
\mathcal{L}(\theta) = \sum_{i \in A} \log \left( \sum_{a=1}^{2} \hat{f}(p_i, M_i, w_i^{OBS}, d_i | Z_i, b_i, \zeta_a) \pi_a \right) + \sum_{i \in B} \log \left( \sum_{a=1}^{2} \hat{f}(M_i, w_i^{OBS}, d_i | Z_i, b_i, \zeta_a) \pi_a \right).
\]
Asymptotics (sketch)

- Follow Laroque and Salanie (1989)
Asymptotics (sketch)

- Follow Laroque and Salanie (1989)
  - Send $S$ to infinity
Asymptotics (sketch)

- Follow Laroque and Salanie (1989)
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  - Estimated density becomes arbitrarily close to the real density
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- Problem reduces to MLE
Asymptotics (sketch)

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- Technicality
Asymptotics (sketch)

- Follow Laroque and Salanie (1989)
  - Send $S$ to infinity
  - Estimated density becomes arbitrarily close to the real density
  - Problem reduces to MLE

- Technicality
  - Simulated objective function must converge uniformly over parameter space
Asymptotics (sketch)

- Follow Laroque and Salanie (1989)
  - Send $S$ to infinity
  - Estimated density becomes arbitrarily close to the real density
  - Problem reduces to MLE

- Technicality
  - Simulated objective function must converge uniformly over parameter space
  - Appeal to Theorem 3 of Andrews (1995) to verify
African Cities and The Structural Transformation: Evidence from Ghana and Ivory Coast

Remi Jedwab

Paris School of Economics & LSE

Work in progress

PACDEV Conference, 12 March 2011.
Research Question

Sub-Saharan Africa:

- Larger urban population than Northern America / Western Europe
- Very few cities one century ago
- Dramatic urban growth after independencies
  - Similar to Industrial Revolution in developed countries
  - Amongst the highest rates of urban change ever registered
- High urbanization rates
  - More urbanized than India, slightly less than China
  - If lagging in economic development, not in urbanization
Motivation 1

Development associated with the structural transformation (ST): the decline of agriculture, the rise and fall of manufacturing, and the rise of services.

ST models for developing countries:
- closed economy: rising agricultural productivity releases labor for the modern sector (Michaels, Rauch and Redding 2008, Gollin 2010)
- open economy: high productivity in manufacturing/tradable services → exports (Matsuyama 2008, Yi and Zhang 2010).

These stories fit well developed countries (Williamson 1990, Allen 2009), China and India today (Bosworth and Collins 2008, Deng et al. 2008).

Africa: low yields + uncompetitive manufacturing and service sectors, but dramatic urban change.
Figure: Manufacturing and Service Sectors and Urbanization in Developing Countries in 2000.
Figure: Primary Exports and Urbanization in Africa in 2000.
Figure: Primary Exports and Cities in West Africa in 2000.
Motivation 1 - This Paper’s Approach

1. A specific model of African urbanization?

Structural transformation model where exports of non-food primaries (cash crops and mineral resources) push urbanization, through imports and a rise of the non-tradable service sector.

Case study on cocoa-coffee production and cities at the district level in 20th century Ghana and Ivory Coast. Cocoa-coffee: 60% exports, 15-20% GDP. High urbanization rates: 51.5% and 50.6% in 2010.

Identification strategy: for agronomic reasons, cocoa is a ”migrant” culture. Regional cycles as the cocoa frontier moves. Urbanization in new and old producing regions.
Motivation 2, 3 & 4

2. **Urbanization and growth in developing countries:**

3. **Cash crop windfalls and resource curse:**

4. **Geography vs. history in development:**

**This paper:** growth → urbanization in producing regions. But *resource movement effect* of a Dutch Disease (↑ non-tradable sector). If learning-by-doing is lower in the non-tradable service sector than in the tradable sectors, lower growth in the long run (Africa vs. Asia).
This Paper’s Approach

- We develop a new structural transformation model.

- We assemble a historical data set on cities in Ivory Coast/Ghana. We combine this with a district panel data set on cocoa-coffee production. Ghana 1900-2000: $N = 79 \times 9$, Ivory Coast 1948-98: $N = 46 \times 6$.

- We show that cash crop production drives urbanization. Identification strategy: cocoa is produced by replacing forest trees. When forest trees are too old (25 years), no choice but to deforest a new region. Regional cycles as the cocoa frontier moves.

- Specifications: long-differences and fixed effects OLS & IV models. Instrument: suitable x distance to cocoa frontier. Cash crop production explains around half of non-primate urbanization in both countries.
Figure: Value of Cash Crop Production (1900-2000) and Cities (2000).
Figure: District Density of Cocoa Production and Cities in 1948.

1948 in Ghana, 1948 in Ivory Coast.
**Figure:** District Density of Cocoa Production and Cities in 1960-1965.

1960 in Ghana, 1965 in Ivory Coast.
Figure: District Density of Cocoa Production and Cities in 1970-1975.

1970 in Ghana, 1975 in Ivory Coast.
Figure: District Density of Cocoa Production and Cities in 1984-1988.

1984 in Ghana, 1988 in Ivory Coast.
Main Results

Fixed effects OLS & IV model

Figure: District Density of Cocoa Production and Cities in 1998-2000.

Figure: District Density of Cocoa Production and Cities in 2009.

2009 in Ghana, 2009 in Ivory Coast.
I also use household survey and census data to identify the channels behind the results.

1. No effect of cocoa production on rural growth = pure urbanizing effect. Cocoa farmers spend their rising income in city.
2. The urban growth effect can be equally decomposed between existing cities growing further and new cities.
3. "Cocoa” tax around 50%. Diversion of urbanization effects towards the capital and Northern regions.
Summary

- **The past**: cash crop exports explain more than half of local urbanization in both countries. This does not include the effect of cash crops on the growth of national cities (capital, regional centers).

- **The present**: settlement $(1/3) + \text{urban non-tradables (50\%)} \rightarrow \text{“consumption” cities of farmers, traders and service employees.}$

- **The future**?
  - long-run impact of ”consumption” cities vs. ”production” cities (manufacturing exports, tradable services) = supposedly larger learning-by-doing effects. Economic growth but Dutch Disease.
  - urban resilience in old cocoa-producing regions. But scenario of demographic growth + resource exhaustion.
Birth Rates and Border Crossings: Latin American Migration to the US, Canada, Spain, and UK

Gordon Hanson, UCSD and NBER

Craig McIntosh, UCSD
Introduction

Latin America has among the highest emigration rates of any region in the world

Overall emigration rate is 4.7%, with 3.8% of population having moved to a high-income country (as of 2000)

It is much more than just Mexican migration to the US

Other sizable flows:

- Dominican Republic, El Salvador, Haiti to the US
- Bolivia, Ecuador, Colombia to Spain
- Barbados, Jamaica, Trinidad to Canada and the UK
Introduction

Distinguishing features of Latin American emigration

Concentration of emigrant flows to a small number of high-income destinations: US, Canada, Spain and UK

- Geography (remoteness of Western Hemisphere, proximity to US) and colonial legacy (dominance of Spain, UK)
- Since we only need data on immigrant stocks in a few destinations, measurement is relatively easy

Magnitude and frequency of labor market shocks

- Recent demographic bulge contributing to labor supply growth
- Repeated balance of payments crises, natural disasters (Ring of Fire, hurricanes), civil and military conflict (coup, insurgencies)
Introduction

We examine how labor supply and demand shocks affect migration from Latin America to US, Canada, Spain, UK

- We examine how conditions at labor market entry and subsequent shocks affect migration for cohorts at peak migration ages (16-40)

Given variation in immigration policies, we allow sensitivity of migration to shocks to differ by destination

- US permits illegal immigration (30% of total), relatives of citizens
- Canada favors skilled workers, asylees (few illegals)
- UK favors EU citizens, skilled workers, asylees
- Spain favors EU citizens (was open to illegals, now less so)
### Immigration by type of admission

<table>
<thead>
<tr>
<th>Immigrants</th>
<th>US&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Canada&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Spain&lt;sup&gt;c&lt;/sup&gt;</th>
<th>UK&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illegal</td>
<td>30%</td>
<td>~0%</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Legal</td>
<td>70%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Family sponsored</td>
<td>42%</td>
<td>36%</td>
<td>--</td>
<td>27%</td>
</tr>
<tr>
<td>Employment based</td>
<td>11%</td>
<td>47%</td>
<td>--</td>
<td>29%</td>
</tr>
<tr>
<td>Refugees</td>
<td>7%</td>
<td>17%</td>
<td>2%</td>
<td>14%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
<td>--</td>
<td>19%</td>
<td>6%</td>
</tr>
<tr>
<td>EU free movements</td>
<td>--</td>
<td>--</td>
<td>41%</td>
<td>24%</td>
</tr>
<tr>
<td>Temporary Legal</td>
<td>3%</td>
<td>--</td>
<td>38%</td>
<td>--</td>
</tr>
</tbody>
</table>

<sup>a</sup> Stock of legal and illegal immigrants in 2005 (DHS, Pew Hispanic Center); breakdown of legal entrants by visa category is based on legal inflows over 2002-06 (DHS).

<sup>b</sup> Inflows of permanent and temporary legal immigrants 2005-06 (OECD).

<sup>c</sup> Stock of foreigners with *certificado de registro* or *tarjeta de residencia* in 2007 (INE).

<sup>d</sup> Inflows of permanent and temporary legal immigrants 2005-06 (OECD).
Preview of results: American exceptionalism

Migration to US
- Higher for cohorts that are larger (+ labor supply shock), exposed to sudden stops, disasters, conflict (- labor demand shock)
- These effects are attenuated by geographic distance from the US

Migration to Canada, Spain, UK
- Much less responsive to labor supply, labor demand shocks
- Flows are higher in response to civil and military conflict

Interpretation
- US porous border, permissiveness of illegal immigration makes labor inflows sensitive to labor market shocks in Latin America
- Other countries’ isolation, bias toward skilled workers & asylees partially insulates them from labor market shocks in the region
Data

Immigrant stocks
- US (80, 90, 00, 05), Canada (81, 91, 01), Spain (81, 01, 07), UK (81, 91, 01) – decennial censuses, census bureaus, ACS, INE

Labor supply in source countries
- Number of births by year from the WDI, which indicates size of cohort entering labor force 16 years hence

Economic and political shocks
- Initial economic conditions from WDI
- Deaths due to civil and military conflict from IPRI
- Natural disasters from EMDAT
- Sudden stops from Cavallo (2007)
Number of usable bilateral migration rates (based on five year birth cohorts)

<table>
<thead>
<tr>
<th>Origin Country</th>
<th>Canada</th>
<th>Spain</th>
<th>UK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigua-Barbuda</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Bahamas</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Belize</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Bolivia</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Barbados</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Chile</td>
<td>10</td>
<td>9</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Colombia</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Ecuador</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Grenada</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Guatemala</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Guyana</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Honduras</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Haiti</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Jamaica</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Mexico</td>
<td>10</td>
<td>9</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Panama</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Peru</td>
<td>10</td>
<td>9</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Paraguay</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>El Salvador</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>10</td>
<td>0</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Uruguay</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Venezuela</td>
<td>10</td>
<td>9</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>252</strong></td>
<td><strong>96</strong></td>
<td><strong>40</strong></td>
<td><strong>444</strong></td>
</tr>
</tbody>
</table>
Number of changes based on five year cohorts

Gohanson, 1/8/2010
## Basic results

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>USA</th>
<th>CAN</th>
<th>SPN</th>
<th>UK</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annualized migration rate over census interval, percent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Birth Cohort Size Ratio</td>
<td>0.355</td>
<td>0.015</td>
<td>-0.202</td>
<td>-0.450</td>
<td>0.120</td>
</tr>
<tr>
<td>(4.09)**</td>
<td>(1.15)</td>
<td>(1.10)</td>
<td>(3.68)*</td>
<td>(2.74)**</td>
<td></td>
</tr>
<tr>
<td>Log GDP pc Ratio at Age 16</td>
<td>0.148</td>
<td>0.014</td>
<td>-0.039</td>
<td>-0.009</td>
<td>0.059</td>
</tr>
<tr>
<td>(2.22)*</td>
<td>(1.74)</td>
<td>(0.82)</td>
<td>(0.18)</td>
<td>(1.27)</td>
<td></td>
</tr>
<tr>
<td>Log GDP pc in year of census</td>
<td>0.032</td>
<td>-0.019</td>
<td>1.532</td>
<td>-1.091</td>
<td>0.102</td>
</tr>
<tr>
<td>(0.42)</td>
<td>(1.11)</td>
<td>(4.66)**</td>
<td>(4.33)*</td>
<td>(1.15)</td>
<td></td>
</tr>
<tr>
<td>Young (16-22)</td>
<td>-0.079</td>
<td>-0.004</td>
<td>-0.036</td>
<td>0.022</td>
<td>-0.063</td>
</tr>
<tr>
<td>(2.58)*</td>
<td>(1.29)</td>
<td>(1.23)</td>
<td>(0.95)</td>
<td>(2.70)**</td>
<td></td>
</tr>
<tr>
<td>Older (35-40)</td>
<td>-0.129</td>
<td>0.001</td>
<td>-0.065</td>
<td>-0.098</td>
<td>-0.060</td>
</tr>
<tr>
<td>(1.84)</td>
<td>(0.28)</td>
<td>(2.02)</td>
<td>(2.56)</td>
<td>(1.15)</td>
<td></td>
</tr>
<tr>
<td>Dyadic Distance, (000 km)</td>
<td>-0.306</td>
<td>-0.023</td>
<td>-0.472</td>
<td>-0.805</td>
<td>-0.052</td>
</tr>
<tr>
<td>(5.47)**</td>
<td>(2.71)*</td>
<td>(4.65)**</td>
<td>(4.48)*</td>
<td>(1.09)</td>
<td></td>
</tr>
<tr>
<td>Log Birth Cohort Size Ratio * US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.085</td>
</tr>
<tr>
<td>(3.04)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance * US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.070</td>
</tr>
<tr>
<td>(5.05)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>426</td>
<td>242</td>
<td>96</td>
<td>40</td>
<td>804</td>
</tr>
</tbody>
</table>
Out-Migration Rates by Distance

Quadritic fit over distance to origin, by destination

% of origin cohort in destination

Distance (km)

US CAN SPN UK

% of origin cohort in destination

Distance (km)

US

CAN

SPN

UK
US births relative to Mexico and Central America

Ratio of Births per Year by Country

1960=1

Source: WDI
Economic and political shocks in sending countries

- **Number of serious natural disasters**
  Sum over census intervals of (a) earthquakes over 7.5 on Richter scale, (b) windstorms lasting a week or more, or (c) landslides or volcanic eruptions affecting more than 1000 people (normalized by land area of the country)

- **Number of sudden stops**
  Sum over census intervals of sudden stops from Cavallo, defined as a fall in current account surplus of at least 2 SD from sample mean (mean incidence across Cavallo’s four measures)

- **Civil or military conflict**
  From CSCW Monadic Armed Conflict data, calculated as number of years between census intervals in which a conflict exists (extra-state, intra-state, internal, internationalized internal) that kills > 1000 people
### Natural disasters, sudden stops, civil conflict

All regressions use Annualized migration rate over census interval, percent as the dependent variable.

<table>
<thead>
<tr>
<th>Shocks</th>
<th>Annualized # of Serious Natural Disasters (per '000 square km.)</th>
<th>Annualized # of Sudden Stops</th>
<th>Annualized Civil Conflict</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Disasters * US</td>
<td>61.519</td>
<td></td>
<td></td>
<td>67.482</td>
</tr>
<tr>
<td></td>
<td>(2.79)**</td>
<td></td>
<td></td>
<td>(2.66)*</td>
</tr>
<tr>
<td>Sudden Stops * US</td>
<td>0.626</td>
<td>-0.334</td>
<td>-0.332</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.48)</td>
<td></td>
<td></td>
<td>(1.83)</td>
</tr>
<tr>
<td>Civil Conflict * US</td>
<td></td>
<td></td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.03)</td>
<td></td>
</tr>
<tr>
<td>Natural Disasters</td>
<td>-30.087</td>
<td>25.868</td>
<td>27.452</td>
<td>-36.489</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(3.29)**</td>
<td>(3.66)**</td>
<td>(1.39)</td>
</tr>
<tr>
<td>Sudden Stops</td>
<td>0.154</td>
<td>-0.207</td>
<td>0.171</td>
<td>-0.390</td>
</tr>
<tr>
<td></td>
<td>(0.94)</td>
<td>(0.93)</td>
<td>(1.00)</td>
<td>(1.49)</td>
</tr>
<tr>
<td>Civil Conflict</td>
<td>0.000</td>
<td>0.001</td>
<td>0.193</td>
<td>0.215</td>
</tr>
<tr>
<td></td>
<td>-0.01</td>
<td>(0.03)</td>
<td>(3.06)**</td>
<td>(3.06)**</td>
</tr>
<tr>
<td>Observations</td>
<td>642</td>
<td>642</td>
<td>642</td>
<td>642</td>
</tr>
<tr>
<td>p-value on F-Test that the shock is significant in U.S.:</td>
<td>0.00</td>
<td>0.10</td>
<td>0.09</td>
<td></td>
</tr>
</tbody>
</table>
Five year birth cohorts, with birth year, origin country, destination country, census wage fixed effects. All regs weighted by cohort size. SEs clustered by origin/destination dyad.

gohanson, 3/15/2010
**Cohort size enhances the effects of disasters:**

<table>
<thead>
<tr>
<th>All regressions use Annualized migration rate over census interval, percent as the dependent variable.</th>
<th>Annualized # of Serious Natural Disasters (per '000 square km.)</th>
<th>Annualized # of Sudden Stops</th>
<th>Annualized Civil Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort Ratio * Disasters * US</td>
<td>28.537</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.15)</td>
<td></td>
</tr>
<tr>
<td>Cohort Ratio * Sudden Stops * US</td>
<td></td>
<td>1.239</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.03)**</td>
<td></td>
</tr>
<tr>
<td>Cohort Ratio * Conflict * US</td>
<td></td>
<td></td>
<td>-0.408</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5.75)**</td>
</tr>
<tr>
<td>Cohort Ratio * Disasters</td>
<td></td>
<td>-5.208</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.31)</td>
<td></td>
</tr>
<tr>
<td>Cohort Ratio * Sudden Stops</td>
<td></td>
<td></td>
<td>-0.941</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.02)**</td>
</tr>
<tr>
<td>Cohort Ratio * Conflict</td>
<td></td>
<td></td>
<td>0.091</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.22)</td>
</tr>
</tbody>
</table>

p-value on F-Test that the interaction between the shock and the cohort size effect is significant in U.S.:

| 0.13 | 0.05 | 0.00 |
Five year birth cohorts, with birth year, origin country, destination country, census wage fixed effects. All regs weighted by cohort size. SEs clustered by origin/destination dyad.

gohanson, 3/15/2010
Extensions, robustness

Including US cohort sizes, GDP for other destinations

Lagged values of shocks

One, three, five year birth cohorts for US and Canada

Including adjacent (just older, younger) birth cohorts

Excluding Mexico
Discussion

Latin America has high emigration rates, with region sending most of its migrants to US, Canada, UK, Spain

- Labor supply helps drive outflows from Latin America, but falling fertility will reduce labor supply pressures in coming years

The impact of push factors on bilateral migration flows varies sharply across the major destination countries

- Flows to US, whose physical proximity to region results in high levels of illegal entry, are responsive to labor supply and economic shocks, with effects mediated by geography

- Flows to Canada (and UK and Spain) are less responsive to labor supply or economic shocks but more response to political shocks, reflecting relative openness to refugees/asylees