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IZA DP No. 14867

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ABSTRACT

Rethinking Border Enforcement, Permanent and Circular Migration*

Canonical models of migration feature border enforcement as a strategy to contain undocumented immigration by effectively exacting a mobility cost. This paper revisits the role of border enforcement policy in a task-based model of the labor market where employers simultaneously hire circular migrants to take temporary tasks at low wages, in addition to permanent and native workers who perform complementary tasks at the efficiency wage. We show that stricter border enforcement is effectively a tax on temporary employment, and as such it incentivizes the reallocation of work along the task spectrum. Employers' dependence on low-wage transient work force diminishes, while more migrants prefer permanent migration, with labor market tightness consequences that favor both native and migrant workers. We explore the empirical implication of this finding, by investigating the pattern of spousal reunion among Mexican agricultural workers in the United States subsequent to major border enforcement reforms in the 1990's.

JEL Classification: F22, J61, J68

Keywords: border enforcement, circular migration, family migration, labor shortages

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1 Introduction

To stem the tide of undocumented immigration, major destination countries worldwide have devoted ever rising sums of government funds and resources to enhance border enforcement. In 2021 alone, the U.S. Customs and Border Patrol has an annual budget of US$17.7 billion, and employs closed to 20,000 border patrol agents. The European Commission has plans to devote 34.9 billion euros in the 2021-2027 multiannual financial framework for migration and border management. Economists have singled out these policy-driven, and other naturally occurring barriers to migration as culprits for the huge differences in the price of labor world wide (Clemens et al. 2019).

Studies on the effectiveness of these border enforcements on native labor markets have produced a rich set of findings, depending in particular on the outcome metrics in question, including (i) the inflow of migrants (Espenshade 1994, Hanson and Spilimbergo 1999, Orrenius and Zavodny 2005, Gathmann 2008, Lessem 2018, Allen et al. 2019, Feigenberg 2020) (ii) the netflow of migrants (Angelucci 1999), (iii) the apprehension likelihood at the border (Borjas, Freeman and Lang 1991), (iv) the wages of natives and migrants (Hanson and Spilimbergo 2002, Bansak and Raphael 2001), and (v) the role of internal enforcement and amnesty as complementary measures (Chau 2001, Epstein and Weiss 2011).

More recent works have also begun investigating a number of unintended consequences that can run counter to the original intention of border enforcement, as migrants lengthens the duration of their stay (Carriòn-Flores 2005, Massey, Durand and Pren (2016), Amuedo-Dorantes and Bansak 2012), make more frequent use of smugglers (Gathmann 2008, Roberts et al. 2010), and embark on ever-more dangerous border crossing journeys to evade detection (Massey, Durand and Pren 2016, Chau, Garip and Ortiz-Bobea 2021).[1]

A typical conceptual frame that guides this large body of work envisages migrants as workers that perform homogeneous work once they arrive, at a competitive wage that clears the market for migrants and natives (e.g. Ethier 1986, Chiswick 1988, Borjas 1995, Angelucci 2012). In such a setup, border enforcement interferes by raising the cost of migration, which filters down to the wage that destination employers pay. Any deterrent impact of border enforcement will depend

[1]For excellent surveys, see Chiswick (1986), Borjas (1999), Orrenius (2001), and Hanson (2006).

on migrants' ability to afford alternatives to evade border enforcement effort (Orrenius 2001, Angelucci 2015). In practice, however, both documented and undocumented migrants may enter into a host country as temporary migrants, repeat (circular) migrants, or permanent migrants (Rosenblum et al., 2012), and the share of these forms of migration can shift over time (Massey, Durand and Pren 2016). In the absence of a theory of migration that simultaneously accounts for this diverse set of choices, predictions about the effectiveness of border enforcement can be off base.

In this paper, we develop a theory of circular and permanent migration as an alternative setup in which to assess the effects of border enforcement. The model is motivated by salient features of Mexican undocumented migration to the United States, as well as the evolution of the nature of migrant work and family reunification trends through multiple major border enforcement operations in the 1990's. We connect the issue of the effectiveness of border enforcement with the emerging literature on the economics of contract employment. Moretti and Perloff (2002) is a pioneering study in this regard, showing that workers hired directly by agricultural employers in the U.S. pay wages that are consistent with efficiency wages, and at a level higher than worker temporarily hired by agricultural contractors. High efficiency wages discourage worker turnover, while the prospect of losing a high wage job encourages worker discipline. This is in sharp contrast to workers hired by agricultural contractors who pay lower wages and hire workers on a temporary basis. This distinctive feature of a two-tiered labor market in U.S. agriculture is common in both developed (Saint Paul 1996, Cahuc and Postel-Vinay 2002, Bentolila et al. 2011 and Boeri 2011) and developing country labor markets (Basu, Chau and Soundararajan 2020, 2021, Saha, Sen and Maiti 2013).

Thus, the stage for our permanent and circular migration model is set in a labor market featuring contractual duality, where open-ended employment at higher wages for permanent migrants as well as native workers coexist with short term contract employment at lower wages. Circular migrants by definition undertake temporary tasks, while permanent migrants along with native workers have the time and the access to hold out for better, open-ended jobs. We propose an infinite horizon task-based model of the labor market (Acemoglu and Autor 2011), in which temporary workers engage in tasks requiring little supervision at an acceptable wage, while regular workers can engage in tasks that are costly to monitor at the efficiency wage. In this model,

the choice between circular and permanent migration is equivalent to a choice between short term contracts, and a chance to get a longer term, open ended job in the destination country.

In contrast to earlier work on contract employment where the overall supply of labor is fixed (e.g. Basu, Chau and Soundararajan 2021), we show an equilibrium with a temporary employment feedback loop – strong supply of circular migrants incentivizes employers to expand the range of tasks assigned to low wage temporary workers to minimize cost. This shift reduces the number of regular jobs available, lowers the likelihood that workers in search of a regular job will indeed find one, which in turn justifies the expansion in the supply of circular migrants at the start. By introducing contractual duality as a novel feature in this model of circular and permanent migration, our setup offers fresh perspectives on the pros and cons of border enforcement.

Our main findings are as follows. We show that border enforcement is tantamount to a discriminating employment tax targeting temporary employment. Since circular migrants by definition engage in frequent border crossings, border enforcement disproportionately penalizes circular migrants, requiring native employers who wish to continue to hire these workers to pay more. Employment incentives are then tilted in favor of hiring more permanent employees. Thus, while border enforcement continues to harbor the standard migration deterrence effect, a task reallocation effect also applies.

These changes have important distributional consequences so far underappreciated in discussions concerning border enforcement. In particular, by discouraging employers from hiring temporary workers, border enforcement raises the regular employment likelihood of native workers. In addition to the employment effect of border enforcement, a tighter labor market in turn raises the efficiency wage required to maintain worker discipline. Thus, border enforcement also raise wages for all workers, including native, foreign permanent, as well as foreign circular workers.

Furthermore, we show that by restricting temporary employment and circular migration, border enforcement, perhaps ironically, has a lasting steady-state expanionsary effect on the stock of permanent migrants. As more migrants choose permanent migration, a correspondingly larger share of migrant workers have planning horizons long enough to cast out inferior temporary jobs, in expectation of a better regular job in the future. Importantly, by shifting the mix of migrants, border enforcement raises the capability of the average migrant worker to expect better pay, all the

while without adversely affecting native workers' chances. This is consistent with the US-Mexican border enforcement experience (Carriòn-Flores 2005, Massey, Durand and Pren (2016), Amuedo-Dorantes and Bansak 2012). This also suggests that while prohibitive border enforcement is no doubt welfare worsening for the sending country, the right amount of border enforcement may well be mutually beneficial, as enforcement contributes to (i) changing the composition of migrants favoring permanent migration and thus the share of migrants who receive the high efficiency wage including migrant workers, (ii) inducing an increase in the market determined temporary wage and efficiency wage as labor supply shifts, and (iii) limiting the misallocation of labor that occurs when multiple border crossings increase the chances of capture and the subsequent losses in labor time.

This paper makes several contributions. First, we offer an analytical framework in which circular and permanent migrant co-exist in equilibrium. To the best of our knowledge, this paper is the first attempt at reconciling the migrant wage gap between temporary and permanent workers in a migrant labor market (International Labour Organization 2020), as an outcome of the endogenous allocation of migrant tasks (both temporary and permanent) and native tasks. In so doing, we are able to disentangle the effect of border enforcement on the equilibrium employment, the frequency of cross-border commute by different migrant types, and the wage difference between migrant types, and between migrants and native workers.

We also complement a related literature on the determinants of temporary migration (Da Vanzo 1983, Dustmann and Göerlach 2016), in which a list of rationale for return migration have been explored, including a preference for consuming goods in the origin country (Hill 1987, Djajič and Milbourne 1988, Dustmann 1995), asymmetric purchasing power in the two countries (Dustmann and Göerlach 2016), distance from origin communities (Carrión-Flores 2005) and skill acquisition in the destination country (Dustmann 2003, Co, Gang, and Yun 2000). These considerations are able to explain select observed migration behaviors such as income targeting prior to return, and income and occupational changes after return migration (e.g. Berninghaus and Seifert-Vogt 1988). Our paper contributes to this literature by introducing contractual duality between circular and permanent migrants as another driver of repeated return migration – simply put, few migrants stay on in the destination country if most jobs for migrants are temporary and at a wage too low to justify lengthy stays. In this context, border enforcement becomes an integral

part of the story in the balance between circular or permanent stay.

In addition, we contribute to the economics of fixed term / contract employment by allowing immigration to serve effectively as fuel that sustains employers' appetite for low wage workers in temporary contracts. Contrary to prior studies which focus on temporary employment as a precursor to long term employment (Cahuc and Postel-Vinay 2002), or as a deterrent to job search for regular work (Basu, Chau, and Soundararajan 2021) in models with essentially fixed populations that strictly prefer regular open-ended jobs, our story of temporary employment is driven by the endogeneity of temporary migration, in which migrants self-select to become circular migrants, even if at the cost of limited access to regular job opportunities.

Finally, as a case in point, we test our theory using as context permanent and circular migration between Mexico and the United States in agriculture – a sector which consistently employs a majority of workers from foreign sources, particularly from Mexico. We begin with an exploration of the major border enforcement operations that have taken place along the Mexico-US border, and the associated key dates. We then turn to a number of salient features of Mexico-US migration of agricultural workers in terms of basic demographics, and the trajectory of migrant income and employment over time that become building blocks for our model. We discuss a number of empirical studies in the area that present evidence on stricter border enforcement and the frequency of return migration, and note that no prior studies have explicitly demonstrated changes in permanent migration intentions subsequent to border enforcement reforms.

We use the restricted access data from the National Agricultural Workers Survey, and estimate the likelihood of family reunification in the U.S. among male migrants who are married to proxy for the intention to stay permanently. Our argument is that family reunification is a commitment to a destination country of migration, rendering much more costly any subsequent return migration attempts. Consistent with the predictions of the model, our empirical findings suggest that the likelihood of spousal reunification in the destination country (proxy for permanent migration) increases by 44% after the immigration reform operations of the mid 1990's.

2 Modeling Border Enforcement, Permanent and Circular Migration

Time is discrete, and each period is denoted $t = 1, ..., \infty$. There are two locations. In the source country of migration, henceforth the foreign country, there are M individuals who have within their choice sets the options of engaging either in circular migration, permanent migration, or remain in the foreign country. In the migration destination, henceforth the home country, N native workers along with an endogenous number migrant workers together form the labor pool from which employers draw labor inputs to complete tasks that in combination become marketable outputs. Workers in both countries are able to complete any production task, and in turn employers may hire circular migrants, permanent migrants, or both.

2.1 Duality in the Modes of Migration

A circular migrant travels to the destination location every period in search of work, and returns to the origin at the end of each period. The cycle begins again at the start of the next period. Naturally, the decision to shuttle back and forth minimizes separation from families and social networks. The tradeoff, however, is a perpetual cycle of apprehension risk at the border. From an employer's perspective, since footloose workers can only take temporary job offers, they may also be viewed as less reliable in performing tasks that cannot be readily monitored, particularly if they do not remain long enough for subpar effort levels to be discovered.

Permanent migration, by contrast, requires migrants to incur a relatively high cost of migration due to lengthy separation from source country communities and contacts. The tradeoff is that they no longer face a regular risk of border apprehension. Their continued presence in the migrant destination also means that they are more able to cast out low-wage, temporary job offers except when other employment options are unavailable, and set their sight instead on open-ended jobs that pay a regular salary.[2] For employers, permanent workers may also be viewed as more

[2]For example, Chen, Kosec and Mueller (2021) introduces a model of temporary and permanent migration among hetergeneously skilled workers. Their model shows positive selection for longer term migrants, as longer duration allows for better matching opportunities with employers. This result is tested using data from the Pakistan Panel Tracking Survey from 1991-2013. Their model assumes an exogenously given distribution of wages for temporary and permanent workers. The key distinction with our setup is that the equilibrium wage distribution is endogenously determined here. This endogeneity is key to our predictions regarding the effectiveness of border enforcement as we will show in the sequel.

reliable in certain tasks that are costly to monitor as they are in a position to internalize any punishments that employers carry out ex post.

We model native workers as having the same options as permanent migrants, in the sense they can work in both regular and temporary jobs. They work as temporary laborers when laid off from regular work, and engage in on-the-job search for regular work while temporarily employed. We assume that in the event of unemployment, if the native worker so chooses, unemployment benefit, available at w_o per time period, is lower than wage income from temporary work.[3]

2.2 Employers and Production Tasks

We model foreign country production capabilities simply, and let $w^* > 0$ denote the constant marginal product and the market wage of every potential migrant worker at source with competitive labor market condition. In the home country, Q units of an exogenously given input (e.g. land) produces Q units of output via a Leontief technology when combined with a composite labor input at a labor-land ratio of a_μ to 1. The production of the composite labor input in turn requires the completion of one unit each of a continuum of tasks $i \in [0, 1]$. The production function $y(i)$ of each task $i \in [0, 1]$ is given by:

$$y(i) = \mu_p + a(i)\mu_c$$

where the number of permanent workers who exert effort – unobservable without a time lag, and detection comes with type I error – at the job is μ_p. μ_c is the number of workers employed in task i without an open-ended and incentive compatible contract. Henceforth, we refer to μ_p and μ_c respectively as regular and temporary jobs. The labor requirement $a(i)$ is strictly decreasing in i, with $a(0) = \infty$ and $a(1) = 1$, to reflect the notions that (i) efforts on the part of workers is labor saving, and furthermore, that (ii) higher index tasks are less demanding of unobservable worker effort, and finally, that (iii) there are some jobs that cannot be accomplished by temporary workers.

Let w_p and w_c be the wage cost associated with employing a regular and a temporary worker respectively. Cost minimization implies that as long as the wage gap is large enough

[3]We make this assumption so as to consider situations where in equilibrium, native workers directly compete for jobs with migrant workers.

$(w_p/w_c > a(1))$, there exists a threshold task I, such that

$$w_p = w_c a(I), \quad a(I) = \frac{w_p}{w_c} \tag{1}$$

such that for all tasks $i \geq I$, the employer only makes temporary job offers, and regular open-ended job offers otherwise. Aggregate labor demand for temporary and regular work, henceforth respectively

$$L_c(I) = a_\mu Q \int_I^1 a(i)di, \quad L_p(I) = a_\mu QI \tag{2}$$

depend on I, reflecting how changes in the relative wage cost w_c/w_p is negatively correlated with the relative demand for temporary versus permanent workers.

2.3 Task Assignment

Given this basic labor market setup, we now explore the question of how migrants' preference for circular relative to permanent migration influences what types of tasks employers assign to temporary and regular workers respectively. Consider first a permanent migrant. Permanent migrants can access two types of jobs. Regular jobs are rationed as they pay incentive-compatible effort-eliciting efficiency wages, w_p. While these jobs are open-ended, an exogenous job turnover rate of $\delta \in (0, 1)$ applies. Laid off workers from regular employment can always resort to temporary jobs while they seek out regular job opportunities in subsequent periods. Let n_p denote the probability of regular job arrival.

A temporary job lasts only one period, and can employ native, permanent as well as circular migrants. At the end of each period, circular migrants return to the foreign country until the start of the period when they can choose to return and join native and permanent migrants to make up the total supply of temporary workers.

The full time-line of a migrant's journey is summarized in Figure 1. At decision node M, a foreign worker first chooses between migrating or not. The decision to migrate offers an income gamble in which with border apprehension probability b the attempt to cross the border fails delivering zero income for the period, and with probability $1 - b$, the worker finds a temporary job for at least one period.

The holder of a temporary job earns w_c, and faces the options of engaging in circular migration or stay behind in the home country for at least one more period at decision node P.

A circular migrant return migrates to the foreign country at the end of the period, where the cycle begins again at the beginning of the next period when the worker must once again decide between migrating or not (at M).

The holder of a temporary job who chooses to stay behind begins looking for a regular job while on the temporary job. A regular job opportunity arrives with probability $n_p \in [0, 1]$, paying w_p. A worker in search of a permanent job that fails to find one will stay on in temporary work for one more period earning w_c, and once again confronts the question of whether or not to engage in circular or permanent migration (at P).

At decision node E, the holder of a regular job who exerts effort at work earns w_p at effort cost e. With probability δ, employment turnover occurs. The worker takes a temporary job as last resort earning w_c, and confronts the question of whether or not to engage in circular (i.e. return to the foreign country) or permanent migration (i.e. continue to stay in the home country) at decision node P. With complementary probability $1 - \delta$, the worker stays regularly employed for one more period earning w_p, knowing that there is a probability δ of employment turnover in the next period, where the worker makes a decision about effort at E again.

The holder of a regular job who shirks earns w_p at no effort cost. With probability $\delta + \sigma > \delta$, employment turnover / termination occurs where $\sigma > 0$ denotes the incremental to the probability of turnover due to shirking. The worker takes a temporary job as last resort earning w_c, and confronts the question of whether or not to engage in circular or permanent migration (at P). With complementary probability $1 - \delta - \sigma$, the worker stays regularly employed for one more period earning w_p at zero effort cost, knowing that there is a probability $\delta + \sigma$ of employment turnover in the next period, where the worker makes a decision about effort at E.

We solve the problem facing migrants backwards, by first considering the decision-making problem of migrants in possession of a regular job, and whose decision concerns whether not to shirk at work at E in Figure 1. Thus, we denote $V_p(w_p)$ and $V_{c_p}(w_c, w_p)$ as the value functions of a permanent migrant who exert effort at a regular job at wage w_p, $V_s(w_p)$ as the value function of a regular worker who shirks, and $V_{c_p}(w_c, w_p)$ as the value function of a temporary worker in

search of a regular job. Evaluated at time discount factor $\beta \in (0,1)$:

$$V_p(w_p) = w_p - e + \beta\left[(1-\delta)V_p(w_p) + \delta V_{c_p}(w_c)\right] - T, \quad (3)$$

$$V_{c_p}(w_c, w_p) = w_c + \beta\left[n_p V_p(w_p) + (1-n_p)V_{c_p}(w_c)\right] - T, \quad (4)$$

where e denotes the income equivalent of high effort. A relocation cost T is applied here, to reflect the fact that all else equal including income and work effort, absence from migrant's origin communities for a full time period is costly to the migrant. Equation (3) shows that the holder of a regular job earns w_p at the effort cost of e in the current period. Subsequent periods come with turnover risk at probability δ, when a permanent migrant must at least for one period resort to temporary employment at w_c.

By contrast, the holder of temporary job earns w_c, and faces the prospect of transitioning into regular employment, or staying put as temporary worker with probability n_p and $1-n_p$ respectively. The solutions to (3) and (4) are a pair of expected utilities that are linear combination of w_p and w_c:

$$V_p(w_p) = \frac{1}{1-\beta}\left[\theta_p(w_p - e) + (1-\theta_p)w_c - T\right], \quad (5)$$

$$V_{c_p}(w_c) = \frac{1}{1-\beta}\left[\theta_{c_p}(w_p - e) + (1-\theta_{c_p})w_c - T\right]. \quad (6)$$

where $\theta_p = 1 - \beta(1-n_p)/(1-\beta(1-n_p-\delta))$ and $\theta_{c_p} = \beta n_p/(1-\beta(1-n_p-\delta))$. Clearly, the tighter the labor market, via an increase in n_p, the higher the regular salary w_p, or the higher the wage of a temporary job w_c, the higher V_p and V_{c_p}

Equations (3) and (4) implicitly assume that workers provide high effort. But since high effort is costly to the worker, its application cannot be taken for granted. The value function of a permanent migrant with a regular job offer at hand at w_p but chooses to deviate from delivering higher effort for one period, $V_s(w_p)$, is:

$$V_s(w_p) = w_p + \beta\left[(1-\delta)V_s(w_p) + \delta V_{c_s}(w_c)\right] + \beta\sigma\left[V_{c_s}(w_c) - V_s(w_p)\right] - T. \quad (7)$$

where V_{c_s} denotes the value function of worker in search of a regular job in which he / she will deliver no effort:

$$V_{c_s}(w_c) = w_c + \beta\left[n_p V_s(w_p) + (1-n_p)V_{c_s}(w_c)\right] - T,$$

and σ is denotes the probability of discovery. Define an incentive compatible efficiency wage $\bar{w}_p$ as

$$\begin{aligned} \bar{w}_p &= \min\{w_p | V_s(w_p) \leq V_p(w_p)\} \\ &= w_c + e + e(1-\beta(1-\delta-n_p))/(\beta\sigma). \end{aligned} \tag{8}$$

Note that the wage associated with a regular job must be strictly higher than the wage from a temporary job, w_c, to be incentive compatible. Importantly, the efficiency wage changes with labor market conditions. The tighter the market for permanent jobs through an increase in the likelihood n_p, the highest must be the efficiency wage.[4]

While an efficiency wage w_p applies to regular jobs, employers of temporary workers need only pay a wage w_c that provides just enough incentives for workers to show up at work for at least one period. Define

$$\bar{w}_c = \min\{w_c | (1-b)w_c \geq w^*\} = \frac{w^*}{1-b}. \tag{9}$$

Equation (9) shows in stark terms how border enforcement is in effect a tax on employers of circular migrants. At this wage, a worker who engages only in circular migration is indifferent between staying in the foreign country or migrating, since

$$V^*(w^*) \equiv \frac{w^*}{1-\beta} = \frac{\bar{w}_c(1-b)}{1-\beta} \equiv V_m(\bar{w}_c). \tag{10}$$

With the efficiency wage $\bar{w}_p$ and the acceptable wage $\bar{w}_c$ as in (8) and (9) respectively, the wage ratio $\bar{w}_p/\bar{w}_c$, in turn dictates how employers allocate tasks between permanent workers and circular migrants:

$$a(I) = \frac{\bar{w}_p}{\bar{w}_c} = 1 + (1-b)\left(1 + \frac{1-\beta(1-\delta-n_p)}{\beta\sigma}\right)\frac{e}{w^*}. \tag{11}$$

[4]Regular jobs are open to both permanent migrants and native workers, as neither engage in circular migration. The value functions of a native worker, denoted with superscript "o", can be similarly stated as in (3) and (4), assuming that permanent and native workers share the same preference,

$$\begin{aligned} V_p^o(w_p) &= [\theta_p(w_p - e) + (1-\theta_p)w_c - T]/(1-\beta), \\ V_{c_p}^o(w_c) &= \left[\theta_{c_p}(w_p - e) + (1-\theta_{c_p})w_c - T\right]/(1-\beta) \\ V_s^o(w_p) &= w_p + \beta\left[(1-\delta)V_p^o(w_p) + \delta V_{c_p}^o(w_c)\right] + \beta\sigma\left[V_{c_p}^o(w_c) - V_p^o(w_p) - T\right]/(1-\beta) \end{aligned}$$

where the cost of migration of course does not apply to native workers. It can be readily confirmed that the incentive compatible efficiency wage is the same as equation (8) at $\bar{w}_p^o = w_c + \left(1 + \frac{1-\beta(1-\delta-n_p)}{\beta\sigma}\right)e = \bar{w}_p$.

Since $\lim_{I\to 0} a(I) = \infty$ and $a(1) = 1$, a threshold task I in the interior of $[0, 1]$ always exists. We have thus:

Proposition 1. *A tighter labor market for regular workers (higher n_p) decreases the share of tasks performed by regular workers (I), while stricter border enforcement has the opposite effect, at constant n_p.*

Proposition (1) shows that as an effective tax on the hiring of temporary workers, border enforcement decreases the share of tasks that employers allocate as temporary tasks. Meanwhile, if the labor market for regular work tightens through an increase in n_p, the efficiency wage rises, which then has the opposite effect of increasing the share of tasks allocated as temporary. The relationship between task assignment and the likelihood of employment n_p is plotted as the downward sloping AA schedule in Figure 2. In particular, an increase in b shifts the AA to the right, implying a higher share of regular tasks at constant labor market tightness, n_p.

Of course, labor market tightness is itself endogenously determined depending on the supply of permanent and temporary migrants, in response to border enforcement to begin with. We turn to this next.

2.4 Circular or Permanent Migration?

We endogenize labor market tightness, n_p, by investigating the choice problem among the M number of foreign workers into permanent migrants M_p, circular migrants M_c, and non-migrants $M - M_p - M_c$, at decision node P in Figure 1. To determine M_p, we compare the expected utilities of a migrant in a temporary job, and examine the factors that trigger a migrant to stay on, but another to return home. For M_c, we evaluate the residual demand for temporary workers accounting for foreign permanent migrants and native workers in the home country.

Starting therefore with M_p, we assume that workers are heterogeneous in terms of their individual costs of migration, due for example to differential access to relevant social and ethnic networks in the home country. Thus, let $\nu(T)$ be the cumulative distribution function of $T \in [0, \infty)$ among all potential foreign workers. Also let $\epsilon_m \equiv d\log\nu(T)/d\log T$ denote the elasticity of migrant labor supply.

For a migrant with a temporary job in hand, the decision to stay on as permanent migrant rather than returning home depends on the balance between two value functions, respectively,

V_{c_p} for permanent migration stated in (6) as:

$$V_{c_p}(\bar{w}_c) = \frac{1}{\beta}\left(\theta_p(\bar{w}_p - e) + (1-\theta_p)\,\bar{w}_c\right) - T\right),$$

and V_{c_c} for circular migration, using (10):

$$V_{c_c} = \bar{w}_c + \beta V_m(\bar{w}_c) = \frac{(1-\beta b)\bar{w}_c}{(1-\beta)}.$$

The marginal migrant just indifferent between circular and permanent migration is characterized by a threshold $\bar{T}$:

$$\bar{T} = \theta_p \frac{\bar{w}_p - \bar{w}_c - e}{w^*} + \beta b \bar{w}_c. \tag{12}$$

The number of permanent migrants is in turn given by

$$M_p(n_p, b) = M\nu(\bar{T})$$

where the tighter the home country labor market through n_p, the higher the supply of permanent migrants. Similarly, stricter border enforcement raises permanent migrant's income floor, $\bar{w}_c$, and likewise increases total permanent migrant supply.

To close the model, we observe that in a steady state, exits from regular employment must equal the number of new regular workers. Since I is the share of tasks completed by permanent workers, we have:

$$\delta a_\mu IQ = n_p(N + M_p(n_p, b) - a_\mu IQ), \;\; \Leftrightarrow \;\; a_\mu IQ = \frac{n_p}{n_p + \delta}(N + M_p(n_p, b)). \tag{13}$$

where native labor supply and immigrant labor supply $N + M_p(n_p, b)$ net of permanent employment $a_\mu IQ$ gives the total number of job seekers. (8) and (9) together yields an upward sloping relationship between the marginal task I and the labor market tightness n_p. This positive relationship between n_p and I is plotted in Figure 2 as the NN schedule. Note that an increase in border enforcement increases permanent labor supply through $\bar{T}$, and as such an increase in border enforcement shifts the NN schedule downwards implying a reduction the likelihood of employment n_p at constant I.

We can also determine the steady-state employment of native and migrant workers in permanent tasks $L_N(n_p, I, b)$ and $L_M(n_p, I, b)$ respectively:[5]

$$L_N = \frac{n_p N}{n_p + \delta}, \;\; L_M = \frac{n_p M_p(n_p, b)}{n_p + \delta}.$$

[5]To see this, note that in a steady state: $\delta L_N = n_p(N - L_N)$, $\delta L_M = n_p(M_p - L_M)$.

Thus, $N - L_N$ and $M_p - L_M$ are the steady state number of permanent migrants that temporarily engage in fixed term work while searching for permanent jobs. Labor market clearance thus imply a level of circular migration equalling:

$$M_c(n_p, I, b) = a_\mu Q \int_I^1 a(i)di - \frac{\delta}{n_p + \delta} \left(N + M_p(n_p, b)\right).$$

3 Equilibrium

A steady state equilibrium in this labor market is a pair of wage cost $\bar{w}_p$, and $\bar{w}_c$, a threshold task index I, a threshold migration cost $\bar{T}$, an allocation of the M migrant workers into permanent M_p and circular migrants M_c, and an employment likelihood n_p such that employer maximizes profits by paying regular workers (both native and migrant) the efficiency wage

$$\bar{w}_p = \bar{w}_c + e + e(1 - \beta(1 - \delta - n_p))/(\beta\sigma)$$

and any workers doing temporary tasks (including native, permanent and circular migrant) receive the acceptable wage to circular workers:

$$\bar{w}_c = \frac{w^*}{1 - b}.$$

The cost minimizing threshold task is adopted, where

$$\frac{\bar{w}_p}{\bar{w}_c} = a(I).$$

Foreign workers maximize expected utility by choosing first between to migrate or not, and once a temporary job is at hand, between staying behind ($M_p(n_p, b)$) or practice circular migration ($M_c(n_p, b)$). Finally, inflows into and outflows from regular employment are balanced:

$$n_p = \frac{\delta a_\mu IQ}{N + M_p(n_p, b) - a_\mu IQ}.$$

Since $\lim_{I \to 0} a(I) = \infty$ and $\lim_{I \to 1} a(I) = 1$, it is straightforward to demonstrate that an equilibrium exists, and since AA and NN have slopes in the (I, n_p) space of opposite signs, such an equilibrium is also unique.

3.1 Predictions and Distributional Implications

In Figure 2, we demonstrate the labor market equilibrium of the model as the intersection of the task assignment schedule AA, and the labor market clearance schedule NN. Together, these pin down the equilibrium labor market tightness n_p and the share of tasks allocated to regularly employed workers at the efficiency wage.

Border enforcement directly raises the cost of hiring circular migrants. This shifts the AA schedule to the right, implying a higher share of tasks completed by regularly employed workers, and accordingly a tighter labor market n_p for such workers. As discussed, border enforcement impacts the supply side of the labor market as well. Indeed from (13), the NN schedule pivots clockwise subsequent to an increase in b to reflect the increase in permanent labor supply $M(n_p, b)$ since stricter enforcement increases the base earning $\bar{w}_c$ of a temporary worker (Figure 2):[6]

Proposition 2. *An increase in border enforcement increases the fraction of regular tasks (I). If migrant supply elasticity ϵ_m is sufficiently small, the likelihood of regular employment n_p, and thus the efficiency wage markup over the wage of temporary work:*

$$\bar{w}_p - \bar{w}_c = e(1 - \beta(1 - \delta)) + en_p/\sigma$$

rise with stricter border enforcement. Under the same condition, the number of permanent migrants L_M rises with border enforcement.

[6]To see this, note that (11) and (13) are two equations in two unknowns I and n_p. In addition, the function $M_p(n_p, b)$ is implicitly defined in (12). Totally differentiating (11) and (13), making use of (12), we find that I is strictly increasing in b, since the comparative statics response is:

$$\frac{\partial I}{\partial b} = \left(\left(\frac{\bar{w}_p}{\bar{w}_c} - 1 \right) \frac{1}{1-b} \left[(N + M_p - a_\mu IQ) + n_p M_{p_{n_p}(n_p,b)} \right] + n_p M_{p_b} (1-b) e/(\sigma w^*) \right) / \Omega > 0$$

where $M_{p_{n_p}}(n_p, b) > 0$ from (12), and $\Omega > 0$ is given by the following:

$$-a'(I) \left[(N + M_p - a_\mu IQ) + n_p M_{p_{n_p}(n_p,b)} \right] + a_\mu (\delta + n_p) Q (1-b) e/(\sigma w^*) > 0.$$

In addition, n_p is increasing in b as well if and only if

$$\frac{\partial n_p}{\partial b} = \left[\left(\frac{\bar{w}_p}{\bar{w}_c} - 1 \right) a_\mu (\delta + n_p) Q/(1-b) + a' n_p M_{p_b} \right] / \Omega > 0$$

which may take on a negative sign since a' is negative by assumption. From (12), $M_{p_b} = M_p \epsilon_m \beta \bar{w}_c \theta_p / ((1-b)T) > 0$. Setting $\epsilon_m \to 0$, $\frac{\partial n_p}{\partial b} > 0$ unambiguously, and thus there exists a sufficiently small ϵ_m such that M_p is strictly increasing in b. In addition, since the number of permanent migrants $M_p(n_p, b)$ is strictly increasing in n_p as well as b, under the same sufficient condition that guarantees that n_p rises with border enforcement, permanent migration rises with border enforcement as well.

Thus, border enforcement serves multiple purposes. In this setting where low wages abroad w^* translates to low temporary wages $\bar{w}_c = w^*/(1-b)$, employers are able to discipline regular workers at a strictly lower wage, as the efficiency wage is a markup over the base at $\bar{w}_c$. Border enforcement counters these tendencies. As effectively a tax on temporary employment, border enforcement can (i) shift task allocation away from the temporary work, and (ii) raise the earnings of all migrant as well as native workers. In this way, border enforcement becomes an effective way of raising labor standards, both from a quantity (fraction of temporary work), as well as a quality (earnings) point of view, benefitting **both** the average native and the average foreign workers employed in the country.

In addition to these income distributional consequences, we note here an additional consideration that should be accounted for in rethinking border enforcement reforms. In particular,[7]

Proposition 3. *For every level of border enforcement, b, there exists a temporary wage tax $\tau = [1/(1-b)] - 1$, that replicates the home country wage and the employment effects of stricter border enforcement, but does not give rise to forgone labor inputs due to border apprehensions.*

Proposition 3 makes the case that if border enforcement is deemed desirable simply for its ability to shift the mix of employment contracts from temporary to regular, it would be more efficient to do so directly by imposing an equivalent employment tax from (3). In particular, a tax has the effect of shifting the employment mix, without wasteful labor inputs forgone for sending as a result of border apprehensions, although of course the political economy of such a tax is a different question altogether.[8]

[7]To see how border enforcement leads to welfare changes associated with labor time forgone, define world gross domestic product as $W = Y + Y^*$, where

$$\begin{aligned} W &= Q + w^*(M - \frac{M_c(n_p,b)}{1-b} - M_p(n_p,b)) \\ &= Q + w^*M - w^*\left[Q(\int_I^0 a(i)di) + QI - N\right] + \frac{b}{1-b}M_c(n_p,b) \end{aligned}$$

where world GDP is the sum of home country output Q and the foreign country output $w^*M - w^*\left[Q(\int_I^0 a(i)di) + QI - N\right]$. With border enforcement, discovery of undocumented migrants happens at rate b. Captured workers effectively forgo one period of labor earnings. The number of such workers is equal to $[b/(1-b)]M_c(n_p,b)$, since $M_c(n_p,b)$ is the total number of circular migrants per period that made it to the destination country, and $M_c(n_p,b)/(1-b)$ is the number of workers that attempted migration. The number of workers who loses one period of labor time is thus $bM_c(n_p,b)/(1-b)$.

[8]In practice, there is labor inputs forgone in the destination country as well as border enforcement is labor intensive, as our discussion in the next section will show.

The welfare consequences of stricter border enforcement must also account for spill-over consequences, as well as implications that static models and one shot considerations need not take into account. These include altered incentives for human capital accumulation, as well as savings and remittances, for example. In the next section, we turn to the case of Mexico-U.S. migration of agricultural workers. We discuss the distinctive phases of border enforcement in recent decades, and subsequent changes in employment and migration patterns, notably the type of tasks that hired workers are responsible for, as well as the share of regular and temporary workers. We then turn to an important spill-over consequence of stricter border enforcement so far understudied in the literature, that of family reunification rates subsequent to border enforcement reforms.

4 U.S. Border Enforcement and Mexican Agricultural Workers

Figure 3 displays the apprehension trend of undocumented immigrants at the Mexico-US border from 1960 to 2013 based on data from the US Customs and Border Protection. The number of border patrol agents reported to be in use during this time period is also displayed. As shown, in the early years,[9] border apprehension as well as manpower devoted to enforcement numbers were both quite low. At its peak in both the late 1980's and early 2000, over 1.5 million migrants were apprehended at the border annually. More recently, a decade-long decline in border apprehension became a central feature of the trajectory of border apprehension since around 2005 and the trend had continued through 2016.

To put these figures in context, in 1986, the Immigration Reform and Control Act (IRCA) became the first major legislation aimed at mitigating undocumented migrant inflows into the United States. In addition to strengthened border and internal enforcement, the IRCA offered select immigrants a path to citizenship. The sharp drop in the number of apprehended migrants at the border immediately after 1986 may have reflected a change in status by many circular migrants who gained legal status under the amnesty clause of the IRCA (Massey, Durand and Pren 2016).

In 1993, and in 1994 the United States launched two major border operations to stem

[9]The exception is the early 1950's when Operation Wetback led to the apprehension and deportation of large number of undocumented Mexican workers in the United States.

the tide of undocumented immigration: Operation Hold the Line and Operation Gatekeeper respectively. These operations focused on border enforcement, via investments in new detection technologies, and the building of border walls. The support for and the number of border patrol personnel also increased, while total border patrol funding tripled within a decade to US$1.5 billion by 2005, and then again to US$3.5 billion by 2010. In 2005, the Secure Fence Act further reinforced border apprehension effort in the Tucson Arizona border with Mexico (Cornelius 2001, Gathman 2008, Allen et al. 2019, Feigenberg 2019).

Employment and Wage Effects in the United States

Studies on the effectiveness of immigration enforcement reforms have so far offered mixed results depending critically on policy details. For example, Hanson and Spilimbergo (2002) examines the wage impact of U.S. border patrol on wages in areas near the border including California, Texas and Mexico, using high frequency data on wages and person hours of border patrol personnel. The study finds border enforcement to have had limited impact on wages in border cities. By contrast, Bansak and Raphael (2001) finds that internal enforcement efforts aimed at making employers responsible for the hiring of undocumented workers had an a significant negative impact on the earnings of non-agricultural Latino workers relative to agricultural Latino workers.

Nevertheless, if agricultural labor markets are indeed two-tiered, employing both permanent and circular migrants, we should expect to see notable composition effects subsequent to border enforcement that were not a focus in these earlier studies. In what follows, we assess these effects both before and after the major border enforcement reforms discussed above. To complement national level statistics, we will also use restricted access data from the National Agricultural Workers Survey to more formally estimate the likelihood of spousal reunion among agricultural workers in the United States subsequent to the implementation of stricter border enforcement in the United States since Operation Gatekeeper and Operation Hold the Line in the mid 1990's.

Sharply contrasting the major fluctuations in apprehension rates during the same time period in Figure 3, the first thing to note about Figure 4A is that aggregate agricultural employment in terms of hired farm workers, hired crop workers and agricultural service workers have all remained quite stable during this period (1990 - 2008), with a small downward trend in most cases illustrated by the linear trend lines in the figure. This trend in agriculture contrasts sharply with

employment trends for non-farm employment in Figure 4B, where the linear trend line illustrates a consistent increase. Evidently, both agricultural and non-farm employment fail to mirror the wide swings in enforcement efforts at the border. In addition, labor markets have been tighter consistently over time, and Figure 4C plots the average hourly wage of agricultural field workers in the United States, the average hourly wage of production or nonsupervisory workers in the private non-farm sector, as well as the ratio of the two during the same period (1990 - 2008). Both nominal wages have been steadily on the rise, and the ratio of the two has remained virtually constant at around 54%.

These aggregate labor market outcomes mask additional interesting details and marked changes in the nature of agricultural employment in the United States during this period. Table 1 displays summary statistics from six rounds of National Agricultural Worker Survey between 1989 - 2016. We have included data up until the most recent round to illustrate the full trajectory of these trends. As shown, despite significant resources devoted to border enforcement, the share of foreign born and undocumented workers have both increased quite sharply since 1989 from 60% and 14% to 77% and 51% respectively by 2012. The share of migrants who are settled (i.e. employed at locations within 75 miles of each other) and those who are shuttlers (i.e. have a home base where they do not engage in farm work, and have one farm work location more than 75 miles from the home base) have gone in opposite directions. A predominant and rising share of migrants ($> 50\%$) are settled, while the share of shuttlers was in persistent decline. The share of newcomers (i.e. first entry to the U.S. less than 12 months prior to the interview) has always been quite low ($< 5\%$), with the exception of the 1998-2000 survey round (22%) and the 2007-2009 survey round (9%).

To complement these demographic characteristics, Table 3 shows the employment characteristics of these workers. A majority of workers are directly hired by employers ($> 80\%$) rather than by labor contractors. These workers identify themselves as agricultural workers, with over 75% expressing intention to remain in agriculture, as demonstrated also by increases in the number of years of experiencing in farming over time (from 10 years to 14 years by 2016). Interestingly, the fraction of workers hired purely to conduct harvest tasks has also sharply declined from 41% in 1998 to 17% in 2015-2016, while the share of workers engaged in semi-skilled tasks, or pre-harvest have increased.

The above paint a picture of a shift in the composition of the agricultural work force that increasingly depends on the employment of undocumented migrants despite border enforcement measures. While the dependence on foreign workers have continued, the trends also indicate the employment of more settled rather than transient workers, and the allocation of tasks to more workers in pre-harvest and other semi-skilled tasks. These are consistent with our model predictions on the role of stricter border enforcement on the allocation of tasks.

Border Enforcement and Family Reunification

A hallmark of permanent resettlement in a destination is family reunification (Costa and Martin 2018). Whereas prior studies on the effectiveness of border enforcement have shown that migrants increase the duration of employment prior to return (e.g. Carriòn-Flores 2005, Massey, Durand and Pren 2016, Amuedo-Dorantes and Bansak 2012), studies have not directly addressed whether permanent migration followed stricter border enforcement. To test a finding of our model in Proposition 2 – whether border enforcement can impact a migrant's decision to permanently migrate – we use the restricted access data files of the National Agricultural Workers Survey (NAWS), running from 1998 - 2016, to demonstrate how the likelihood of family reunification in the United States may have changed subsequent to border enforcement reforms.

Specifically, the NAWS dataset is an employment-based, random-sample survey of crop workers in the United States. The survey conducts face-to-face interviews in the United States to collect demographic, employment, and health related data. We are able to retrieve data on 23,858 Mexican married males among all survey respondents. For each individual migrant, we have data on their first year of entry into the United States, the year of the spouse's entry into the United States. We also have information on the destination state in the United States where the interview was conducted, and the state of residence before entry into the United States.

We estimate a proportional hazards model (Cox 1972), which ascertains the determinants of the likelihood of family reunification in a given year after the migrant's first entry conditional on not having done so in prior years. In order to control for the role of border enforcement, we generate a dummy variable `Post_95` to mark the date of the major change in border enforcement intensities discussed earlier. In addition, to focus on its impact on states in Mexico that are historically popular migration origins, we interact the `Post_95` dummy with a categorical variable

we call `Historical` – the collection of historically migrant sending states of Aguascalientes, Colima, Durango, Guanajuato, Jalisco, Michoacán, Nayarit, and San Liu Potosi (Massey, Durand and Pren 2016). This specification is guided by our theory. In particular, our theory shows that only individuals with sufficiently low fixed cost of migration will choose to migrate, or be subject to the influence of border enforcement intensities. Historically popular migration origins fit this characterization, for historical ties with the United States can facilitate job search, and assist in making acclimation to destination conditions easier (Chau 1997, McKenzie and Rapoport 2010).

We control for a host of push and pull factors of migration, including the share of adults reporting to have received no formal education measured at the time of entry, the share of the agricultural sector's employment in the origin state's total employed individuals, and the share of population in the origin state younger than (inclusive of) the age of 25 (Mexican Census). We also control for the annual precipitation in the origin state in Mexico using data from the Environmental Supplement of the Mexican Migration Project. As pull factors, we control for the share of agriculture in the destination states' total value-added (US Farm Income and Wealth Statistics), as well as the share of population self-reporting as Hispanic in the destination state (US Census). In addition to these push and pull forces at the local level, we also control for the age of the individual at the time of migration. A summary statistics table is presented in Table 3.

Table 4 presents regression results. A hazard ratio less than unity indicates that the variable in question is negatively associated with the likelihood of spousal reunification. From Table 4, variables that tend to delay family reunification are thus age of the migrant at entry, higher annual precipitation in the origin state in Mexico, while factors that tend to hasten family reunification include the importance of agriculture in the origin Mexican state, higher share of workers with no education in the origin, as well as higher importance of agriculture in the destination state within the United States. These findings tell a story of permanent migration driven by economic conditions at home and aboard (e.g. the agricultural share), as well as a concern for the education prospects of the next generation (e.g. share of educated workers at source).

To this list of individual-level determinants, the main finding displayed in Table 4 is that subsequent to the build up in border enforcement in the mid 1990's the likelihood of spousal reunification from historically migrant-sending states in Mexico has increased by 44%. This

result is statistically significant at the 1% level.

These suggest a potential link between border enforcement and migrants' relative preference between circular and permanent migration, complementing the two salient facts presented earlier, respectively in Tables 1 on the rising number of more settled migrants, and in Table 2 on the persistent decline in the fraction of migrants hired to only perform harvest tasks. A potential threat to our interpretation is that concurrent to the rise in enforcement, the mid 1990's spelled a number of important events in Mexico as well as in the U.S. The signing of the North American Free Trade Agreement, and the Peso Crisis are two examples. These events are clearly important shifters of migration intentions, but it is not clear why trade shocks and currency crisis will shift the mix of regular and temporary workers in agriculture favoring regular work (Table 2), or the number of settled migrants (Table 1). Spousal reunification is a costly commitment that entails giving up risk diversification when all members of a household are in one single country. It is unlikely that a one-time economic shocks (e.g. peso crisis) will trigger such a commitment away from a diverse income portfolio. The NAWS data does not include sufficient information on the number of children in the family, and spousal occupation before and after reunification, however. We are thus unable to investigate further the underlying reasons for family reunification. Acknowledging these limitations, we do not claim that we have eliminated alternative mechanisms. Rather, we will simply note that the family reunification pattern we observe is consistent with the findings of our model.

An additional message from Table 4 is that the relative benefits and costs of border enforcement should more broadly take into account long run consequences when entire families are uprooted and moved to the U.S. Some concrete possibilities include remittances, the incentives to acquire human capital, spill-over effects on public finance, for example.

5 Conclusions

In this paper, we revisit the economics of border enforcement in a model where circular and permanent migration co-exist. We show that border enforcement is a de facto tax on the hiring of circular migrants. By changing the cost-minimizing mix of temporary and regular workers, we show that while border enforcement in this setting has the standard effect of raising wages by making migration costlier, it can (i) increase the share of open-ended jobs at higher wages, and

(ii) increase the share of migrants in such jobs as optimal migration decision favor permanent migration.

These raise important questions and suggest a rich future research agenda. Our model of migration is essentially one-sector. Changes in the duration of migratory moves can give rise to interesting spillover effects on other sectors of the economy, both in terms of the flow of migrant laborers, as well as resulting entry / exit of employers. Future empirical work on family reunification likelihoods at the worker-level should take into account, whenever data availability allows, family level considerations such as the number of children, as well as a whole host of source country considerations such as trade, climate, and public safety.

The policy implications of this paper are nuanced. Whereas border enforcement can have a positive impact on immigrant wages, to what extent should border enforcement be seen as gains for the sending country if entire migrant families are uprooted and permanently leave their country of origin? In addition, border enforcement has short term as well as longer term consequences, through changes in savings / remittances, and changes in the incentives to acquire human capital, when migrants prefer a permanent move rather than repeated moves, for example. These are important open questions that warrant future research.

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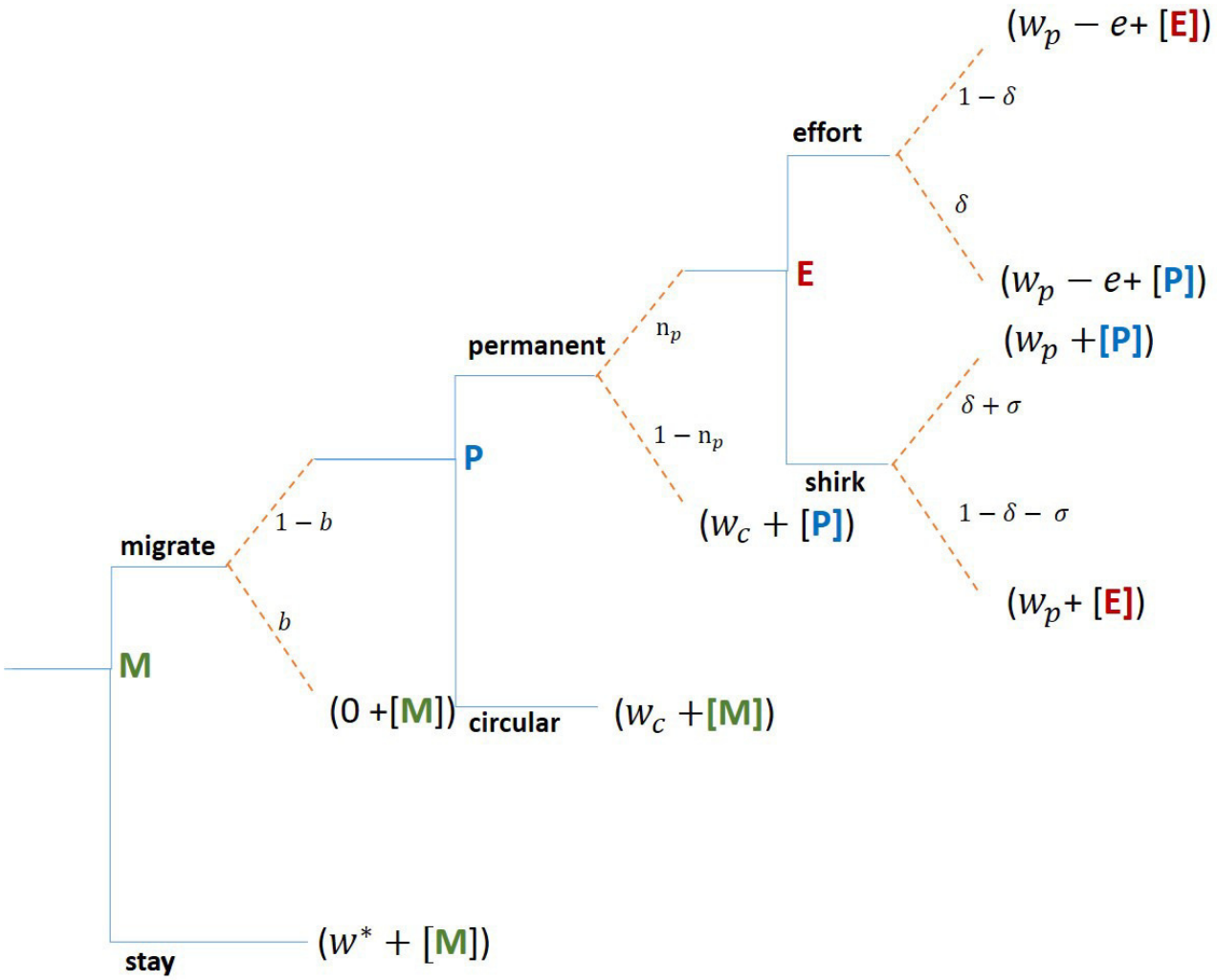
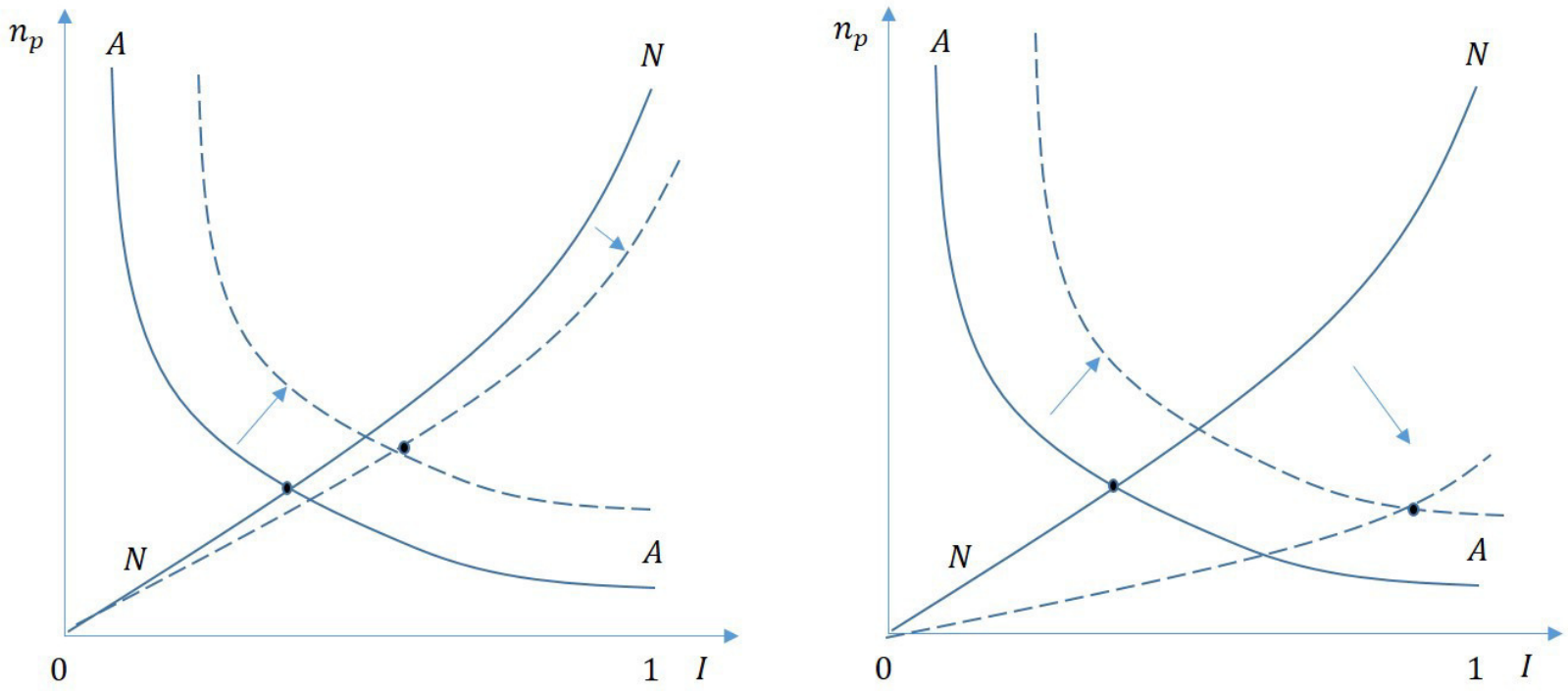
Figure 1: Model Timeline



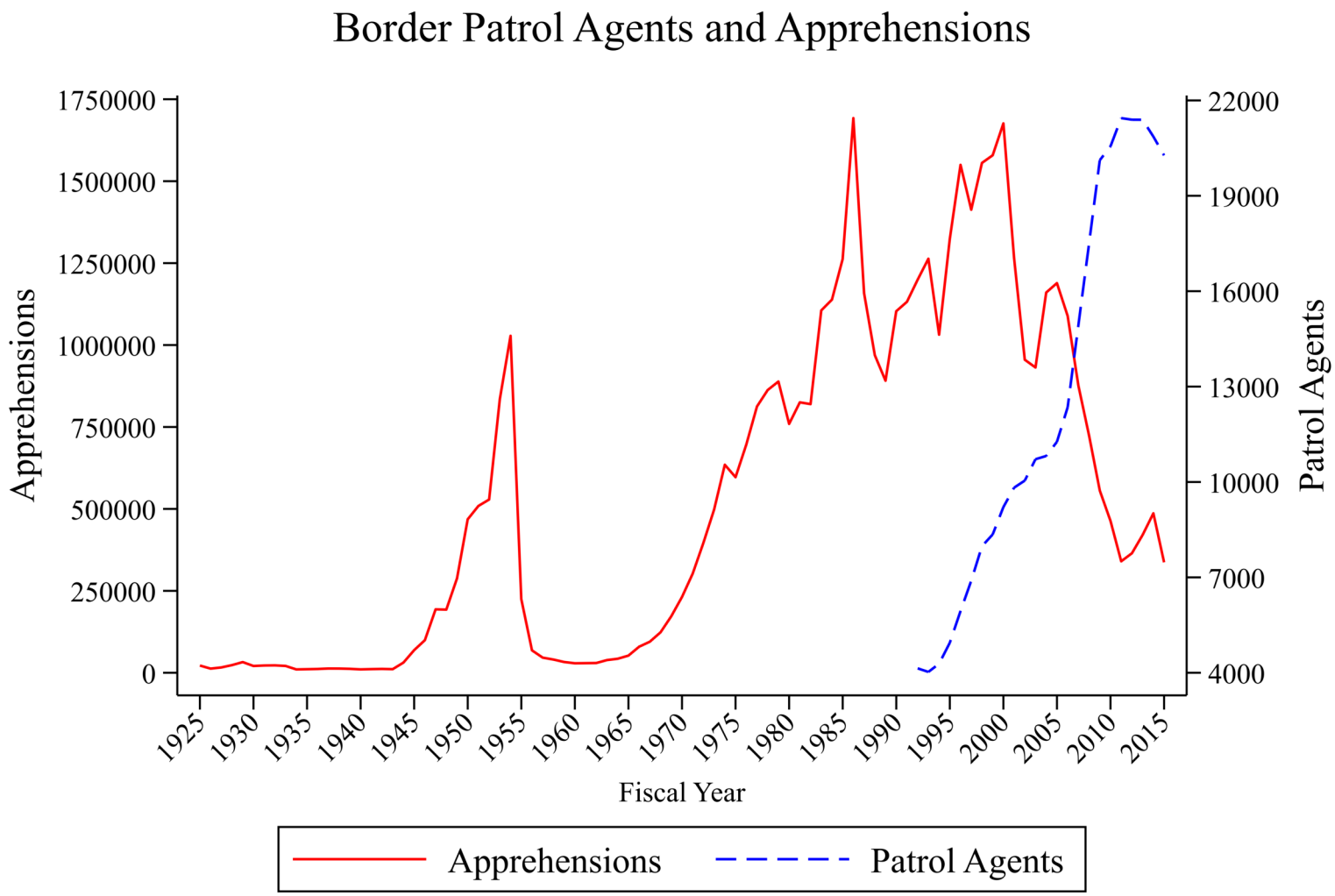
Note: The figure shows the full time-line of the migrant's decision problem. At decision note M, the migrate chooses between whether or note to migrate. At P, the migrant already at the destination country decides to stay one more period or not. At E, the holder of regular job decides whether or not to shirk. b is the probability of border apprehension. w_c denotes the wage of a temporary job. p is the probability of regular job turnover without shirking, and $\delta + \sigma$ is the corresponding probability for a worker who shirks. w_p is the regular wage, and e denotes the income equivalent of the cost of effort. Expressions in parenthesis denote discounted expected utility. We put the symbol of a decision node in square parenthesis to indicate the discounted expected utility starting from that decision node.

Figure 2: Steady State Equilibrium and the Role of Border Enforcement



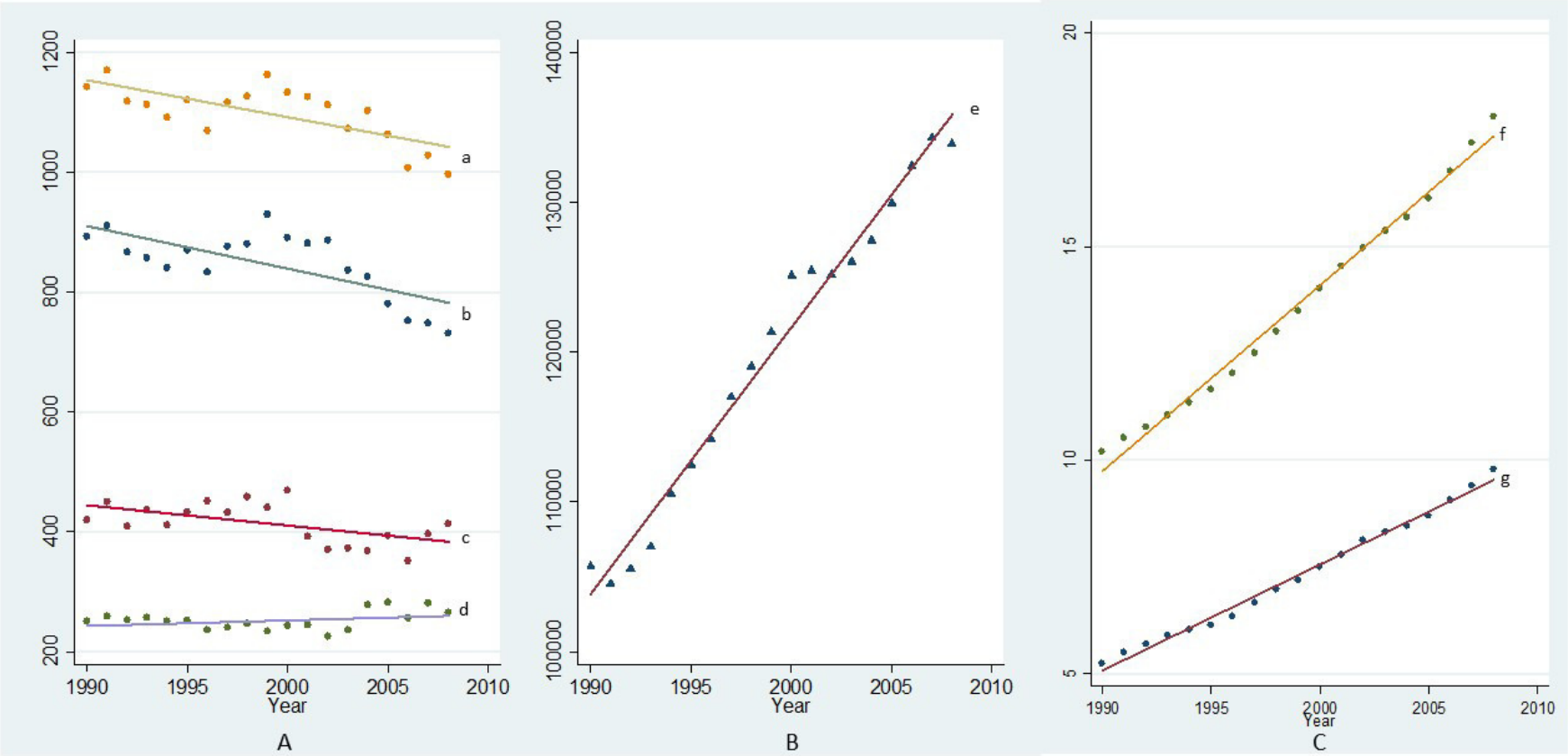
Note: The AA schedule plots the input cost minimizing relationship between task assignment and the likelihood of employment n_p through the efficiency wage. The NN schedule plots the steady state labor market equilibrium condition relating the share of task assigned to regular workers and likelihood of finding a regular job n_p.

Figure 3: Border Apprehension along the Mexico-US Border and Border Patrol Personnel



Source: US Customs and Border Patrol.

Figure 4: Comparing Employment and Wages in Farm and Non-farm Sectors in the U.S.



Notes: a. Total hired farm employment. b. Hired farm workers. c. Hired crop workers. d. Agricultural service workers. e. Total non-farm wage and salaried employment. f. Average wage hourly wages of production or non-supervisory workers in non-farm sectors. g. Average hourly wage of field workers. Linear time trends are also displayed

Source: Farm Labor Survey, USDA National Agricultural Statistics Service (a-e in thousands, f in US$), Bureau of Labor Statistics employer survey.

Table 1: Hired Crop Workers Demographic Characteristics

Characteristic	1989-1991	1998-2000	2007-2009	2010-2012	2013-2014	2015-2016
Foreign-born	0.6	0.83	0.71	0.74	0.73	0.75
Unauthorized	0.14	0.54	0.48	0.5	0.47	0.49
Place of Birth: US	0.4	0.17	0.29	0.26	0.27	0.25
Place of Birth: MX	0.54	0.79	0.68	0.67	0.68	0.69
Settled Migrant	0.59	0.45	0.74	0.79	0.84	0.81
Shuttle Migrant	0.23	0.22	0.12	0.14	0.1	0.1
Follow-the-crop Migrant	0.14	0.1	0.05	0.06	0.04	0.06
Foreign-born Newcomer	0.04	0.22	0.09	0.02	0.02	0.04
Male	0.73	0.8	0.78	0.73	0.72	0.68
Married Parent	0.44	0.42	0.45	0.47	0.48	0.41
Accompanied Parent	0.74	0.59	0.72	0.82	0.83	0.85
Share of Families Below Poverty Level		0.55	0.33	0.31	0.3	0.33
Share of Families that Received Benefits from Need-based Programs	0.2	0.22	0.31	0.46	0.5	0.55

Source: National Agricultural Workers Survey, Public Access Data, Fiscal Years 1989 - 2016. Notes: Settled crop workers are employed at locations that are within 75 miles of each other. Shuttle migrants have a home base where they do not engage in farm work and have one farm work location that is more than 75 miles from the home base. Follow-the-crop migrants have at least two farm jobs that are separated by more than 75 miles. Newcomers are foreign-born crop workers whose first arrival to the United States occurred within the year preceding the interview and whose migration patterns have not yet been established. Need-based benefits include financial assistance through programs such as Temporary Assistance for Needy Families (TANF), general assistance or welfare, and publicly provided housing or medical and nutritional assistance such as Medicaid, Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and Supplemental Nutrition Assistance Program (SNAP).

Table 2: Hired Crop Worker Employment Characteristics

Characteristic	**1989-1991**	**1998-2000**	**2007-2009**	**2010-2012**	**2013-2014**	**2015-2016**
Share of Directly Hired	0.84	0.73	0.88	0.88	0.85	0.8
Years in US Farmwork	10	8	13	12	14	14
Hourly Earnings	5.25	6.52	9.14	9.38	10.2	10.6
Number of Farm Employers (Last 12 Months)	2.14	1.57	1.29	1.29	1.34	1.32
Primary Task: Pre-Harvest Task	0.2	0.2	0.27	0.34	0.26	0.3
Primary Task: Harvest	0.41	0.29	0.27	0.22	0.23	0.17
Primary Task: Post-Harvest	0.13	0.1	0.18	0.17	0.18	0.25
Primary Task: Semi-Skilled (e.g., Equipment Operator)	0.18	0.23	0.25	0.27	0.33	0.29
Current Farm Employer Provides Health Insurance or Pays for Health Care for Work-related causes	0.46	0.64	0.74	0.69	0.7	0.76
Plans to Continue Working in Agriculture: Over Five Years and as Long as able to do the Work	0.65	0.56	0.64	0.76	0.76	0.74

Source: National Agricultural Workers Survey, Public Access Data, Fiscal Years 1989 - 2016.

Table 3: Hired Crop Worker Employment Characteristics

	Pre-1995		Post 1995	
Variable	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**
Historical States: MX	0.611	0.487	0.412	0.492
Age at Entry	21.13	7.43	25.44	9.31
Share of Ag. In VA: US	0.064	0.041	0.065	0.046
Share of Hispanic Population: US	0.14	0.098	0.142	0.111
Share Missing Formal Education: MX	0.179	0.068	0.146	0.056
Mean Annual Precipitation: MX	763.12	253.06	969.57	421.9
Share of Ag. Employment: MX	0.274	0.12	0.253	0.128
Share of Young Population: MX	0.623	0.029	0.584	0.037
Observations	16,868		6,979	

Source: National Agricultural Workers Survey, Restricted Access Data, Fiscal Years 1989-2016.

Table 4: Proportional Hazard Regression: Spousal Reunification Determinants

	Location	Baseline (1)	Push (2)	Pull (3)	Push+Pull (4)
Post 1995	US	0.465	0.443	0.817	0.800
		(0.014)	(0.014)	(0.027)	(0.027)
Historical States	MX	1.073	1.001	0.664	0.639
		(0.022)	(0.021)	(0.015)	(0.015)
Post 1995 × Historical States	N/A	0.979	1.012	1.423	1.444
		(0.042)	(0.044)	(0.064)	(0.064)
Age at the time of Entry	N/A	0.992	0.992	0.949	0.950
		(0.001)	(0.001)	(0.001)	(0.001)
Share of Ag. in Value Added	US		228.047		10.317
			(86.578)		(3.626)
Share of Hispanic Pop.	US		0.172		1.285
			(0.028)		(0.196)
Share Missing Formal Education	MX			1,721.4	1,927.6
				(260.66)	(294.08)
Share of Ag. Employment	MX			3.607	3.185
				(0.421)	(0.373)
Share of Young Pop.	MX			1.189	1.195
				(0.007)	(0.007)
Mean Annual Precipitation	MX			0.999	0.999
				(0.0001)	(0.0001)

Notes: Results from a proportional hazard regression (Cox 1972) based on observations of year of arrival in the U.S. of the primary migrant. Hazard ratios are displayed. Standard error is in parentheses. A "failure" event is recorded as the year of spousal arrival. The regression ascertains the likelihood of spousal reunification at a given year conditional on no reunification in prior years based on determinants recorded during year of arrival of the primary migrant.