

Modeling immigration from Mexico to the United States – A structural examination of available information and options for analysis

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Introduction

The debate over federal immigration policy rose to the forefront of the most recent national election in the United States. This attention follows multiple failed attempts at reforming undocumented migration from Mexico to the United States, one of the largest migration corridors in the world (Martin 2006). At first blush, the primacy attached to reforming undocumented migration doesn't seem to stem from economic stressors. Recent trends show a declining undocumented population in the U.S. and approximately zero net inflow of undocumented migrants (Passel et al. 2012). Economic analysis of labor markets tends to find minimal wage impacts of undocumented employment and positive effects of equilibrating thin labor markets (Cadena and Kovak 2016; Edwards and Ortega 2016; Dustmann et al. 2016).

Even as employers and industry leaders express concern for economic sectors that have made significant use of undocumented labor (see e.g. McPhate in the *New York Times* April 7, 2017), the current U.S. administration and Office of the Attorney General was issuing a new memo to federal law enforcement directing an increase in the scope of deportations (DOJ-OPA 2017; DOJ-OAG 2017). This trend toward increased internal enforcement (as opposed enforcement at border crossing and waypoints) may not be active economic policy, but will have considered impacts on the numerous regions where the undocumented workforce has settled (Massey et al. 2015).

Labor and international economics disciplines have long considered the role of migration and its varied economic impact. U.S. based studies have played special attention to Mexican migration and U.S. policy approaches (Hanson 2006). In this paper, we review past approaches and analyses of migration as and discuss the development a modeling framework for economic analysis of Mexico to U.S. undocumented migration. Model development is driven by several objectives detailed in latter sections. Foremost among these is a tractable mathematical model that 1) provides a frame of reference for comparing literature assumptions and 2) evaluating the recent history of growth and decline in undocumented migration. As we will see in the next section, the literature on undocumented migration is marked by a diversity of approaches – owing to a policy problem that spans multiple disciplines. We proceed to discussion of that literature, highlighting the both estimated impacts of changes in migration policy as well as the set economic and extra-disciplinary assumptions that support those findings.

Background

The literature covering undocumented Mexico to U.S. migration spans multiple spans many disciplines. Sociology (rural sociology), political science, demography, and economics and multi-disciplinary iterations of these have all made use of the increasingly rich data (and imputations of data) available to track and explain changes in undocumented migration. The growth in available data for analysis is discussed elsewhere (see e.g. PRC 2016; Passel and Suro 2005) and has allowed researchers to observe trends such as those in figure 1, sourced from the Pew Foundation's Hispanic Research Center (www.pewhispanic.org). Figure 1 highlights several interesting changes in the undocumented population of the U.S. From 1990 to 2000 we see Mexican and non-Mexican growth in the undocumented population track closely. After 2000, the undocumented population of Mexicans continues to grow on trend even as we see a flattening of other nationalities' population. From 2007 to 2014, the population of other undocumented nationalities flattens out while that of the Mexican undocumented begins its decline to 2014. Notably, the proportion of U.S. undocumented population in 2014 from Mexico is quite like what it was in 2000, the year when the two populations saw their growth diverge.

Population change has long been the domain of demographers and they have tackled the undocumented Mexican U.S. population extensively. Hanson and Spilimbergo (1999) explain a 1980s surge in undocumented Mexican migration as being driven by a faster increase in the country's working age population than its economy could accommodate. A deepening economic crisis in Mexico created wage volatility which caused families to diversify income sources through both rural-urban migration and migration to the United States (Cerrutti and Massey 2004; Massey and Espinosa 1997; Massey et al. 2002). Following the 1986 Immigration Reform and Control Act (IRCA) provisions for legalization and amnesty of certain classes of undocumented migrants, there were increased expectations that subsequent reforms would include provisions for those with stable histories of labor force participation. This combined with increased enforcement at the border serving as a deterrent to circular migration (seasonal work followed by repatriation) played a significant role in changing the settled permanent population response to consistent economic drivers (Massey et al. 2015; Massey et al 2016).

Political efforts to arrive at comprehensive immigration reform over the past decade have not been successful, partially due to disagreement over replication of the IRCA's partial amnesty approach. Pointedly, the 2016 national election put in place a hardline immigration administration looking to expand enforcement and deterrence at the border while increasing effort to execute deportations (DOJ-OPA 2017). As the national debate sputtered in the past decade, states and localities have adopted numerous initiatives aimed at criminalization or reducing access to basic services for undocumented migrants (Ybarra et al. 2012). Amuedo-Dorantes et al. (2013) describe the primary impact of these measures as limiting the mobility, particularly interstate mobility, of undocumented migrants. This is of significant consequence because Cadena and Kovak (2016) highlight the relative mobility of the undocumented population as a stabilizing force for local economies traversing the Great Recession in the

United States. Ellis et al. (2014) similarly point to the relative mobility of the undocumented workers in the Great Recession as an expansionary force in the network of communities that is predominant in the undocumented population.

A diverse and growing labor force is typically viewed as net economic positive but considerable attention has been given to measuring negative impacts on native workers when migration is expanded. Borjas (2003) finds significant impacts for native unskilled workers of a degree that would support immigration reform as an active labor market policy. Subsequent research expanding on Borjas has found more muted impacts (Dustmann et al 2016) by examining the potential imperfect substitution that exists between native and foreign unskilled workers. A highly cited paper by Ottaviana and Peri (2012) estimates a nested constant elasticity of substitution production structure and finds significantly smaller native wage impacts due to the hiring of undocumented migrants. Follow on work by Edwards and Ortega (2016) re-examines approaches to education and experience measurement in wage impact studies lead to further reduction in the native wage impact of expanded undocumented labor supply.

The review paper by Dustmann et al. (2016) tracks developments in the economics literature through the lens of labor market assumptions, casting specific light on assumptions about substitution and labor mobility. These authors argue for broader scope that makes explicit assumptions about supply and demand response. Viewed in the larger economy, the labor mobility of natives relative to undocumented migrants will be a key determinant of economic impact. Undocumented migrants are in greatest use (relatively) where unskilled labor expense is significant in the sector cost structure. In figure 2 (reproduced from Passel and Cohn, 2015) we see that agriculture, construction, and hospitality services are sectors where changes to undocumented labor supply would be of highest impact.

Studies of agricultural sector impacts have been prominent in the literature, owing to the sector's long history of migrant labor use to meet seasonal variation in labor demands. Recent work by Kostandini et al. (2014) looks at recent state and local policies to deter undocumented hiring and finds the sector level impacts are consistent with lower performance due to labor shortages. There is also evidence that agricultural use of undocumented labor depends on new inflow of migrants as those jobs tend to be disfavored for a variety of reasons (including but not limited to seasonality of labor demand) and provide a gateway to employment in other sectors (Colson et al. 2015).

This would imply that cross-sector labor mobility (particularly of undocumented workers) is a key ingredient in understanding the economic impact of any policy affecting undocumented labor. This provides a point of entry for multi-sector models (particularly national and global computable general equilibrium CGE models) to enter the literature to shed light on the total effects (and their decomposition) of changes to undocumented labor supply. Dixon et al. (2011) provide a first CGE analysis of undocumented migration in the U.S. They focus on three stylized reduction mechanisms (border security, employment taxes, and criminal prosecution) and trace the impacts of reduced migrant labor force through the

intersectoral linkages and sources of welfare change for agents. They find that the native work force benefits from the occupation mix that prevails in the wake of undocumented worker reduction though this impact is lessened if public resources for prosecution or heightened border enforcement is the chosen policy approach. Only in the case of employment taxation where contributions are made to the public treasury would there be no negative spillover from the public finance activity of undocumented deterrence.

Zahniser et al. (2012) use the same CGE model as Dixon et al. (2011) to examine the agricultural labor market under two scenarios: 1) expanded temporary worker programs and 2) increased enforcement. Their two scenarios identify the stark tradeoff at play for a sector dependent on unskilled labor and that has made increasing use of undocumented workers. Specifically, they find expansion of temporary worker programs is pro-growth in the sector (1-2%) though native employment falls and earnings per job decrease commensurate to the expansion (~3%). This is contrasted with an immigration control scenario that sees output in the sector fall (2-4%) while native employee earnings increase (3%). Both CGE studies identify their results as sensitive to labor substitution and factor mobility assumptions in keeping with the prior econometric based work (Dustmann et al. 2016). This common thread will serve as the driver of our current study, as detailed in the next section.

Model

The previous section examined the bounds of studies on undocumented migration and economics – discussing the single equation econometric studies of relative wage impact and large scale economy-wide simulation of policy proposals. This is certainly not exhaustive. International economists have certainly contributed to theory developments and tests thereof (see. E.g. Todaro 1969; Todaro and Maruszko 1987 and the papers that cite those seminal entries). Our narrowed focus into the literature stems from the complementarity of the approaches to policy evaluation. Specifically, the econometric studies look to historical data to measure policy impact while simulation studies provide forward looking analysis. These simulation studies make use of parameters derived from econometric studies while most econometric studies derive forward looking policy recommendations based on the limited estimated model. Both approaches carry the limitations that are married to the method, but neither is explicit about those limitations in the model development. Our goal in model development is to provide a framework that is amenable to looking at the same historical data that would determine response in the economy to future policy options.

Such a model would need to be tractable to apply to the variability observed in historical information, a requirement for identifying response components. It should make explicit the key assumptions for labor markets with an eye toward validating the model against the historical record before simulating future counterfactuals. And finally, it should be extendable to either 1) link with larger systems of economic interaction that may provide important feedback components or 2) make use of additional data or theory findings that are proven relevant.

We lay out such a model in equation (1) through (5) below, which describes a fixed output sector and the labor market that supplies inputs to that sector. The driving factor is a minimal representation that provides a structural proxy for existing simulation studies of Mexico to U.S. migration while also covering the required assumptions of econometric findings. Equations (1) through (5) describe a partial equilibrium structure in log-linear form (all lower-case variables indicate percentage change). Equation (1) establishes the output variable (q_{output}) as exogenous to the system, i.e. all expansion and contraction effects will be set from outside the model. Equation (2) and (3) describe factor demands and zero profits for the representative producer operating under locally constant returns to scale. In (2), the percentage change in input i 's demand (q_i) will respond to the total output level (q_{output}) and to changes to prices for the j inputs (p_j). The response of factor demands to prices is governed by the demand elasticity written as ($\sigma_{ij}s_j$), the Allen partial elasticity of substitution multiplied by the cost share.

Factor supplies and factor market clearing are given in (3) and (4) for only the input described as *mul* (Mexican undocumented unskilled labor). Here (x_{mul}) is the percentage change in input supplied to the production sector. Changes in the supply are determined by ($\eta_{\text{mul}} \times r_{\text{mul}}$), the supply side price multiplied by a factor supply elasticity. The final equation (5) describes price linkage between supply and demand prices for the input of initial incidence, undocumented labor from Mexico. The policy variable δ is an ad valorem wedge between the price paid and received for inputs in the model. This is an abstraction of convenience whereby we assume any of the myriad of policies to impact undocumented labor use can be recast as an ad valorem equivalent.

$$q_i = q_{\text{output}} - \sum_j \sigma_{ij} s_j p_j \quad (1)$$

$$p_{\text{output}} = \sum_i s_i p_i \quad (2)$$

$$x_{\text{mul}} = \eta_{\text{mul}} \times r_{\text{mul}} \quad (3)$$

$$x_{\text{mul}} = q_{\text{mul}} \quad (4)$$

$$r_{\text{mul}} = p_{\text{mul}} - \delta \quad (5)$$

The system in (1) through (5) is commonly called “equilibrium displacement” and is frequently used in partial equilibrium studies to emphasize the importance of factor supply and substitution (see. E.g. Hertel 1989; Salhofer and Sinabell 1999) in evaluating response to policies. A typical solution of the model identifies the incidence of a change in the price wedge (δ) as $(1/\eta_{\text{mul}})(\eta_{\text{mul}} - s_{\text{mul}}\sigma_{\text{mul,mul}})$ for the firm price (p_{mul}) when all other inputs are perfectly elastic in supply. Our goal in implementing this model is to eventually apply the structure to an historical era that saw dramatic change in undocumented migration into the United States such as can be seen in figure 1 for the period 2000 to 2014. In the current version we provide an assessment of the structure for examining factor supply and substitution, looking to the different cases of status quo versus removal of undocumented workers.

The matrix of substitution elasticities σ_{ij} is operationalized in our empirical model via a nested-CES substitution framework for inputs, including the sources of unskilled labor. In figure 3 we show a production nest for a composite output that generates factor demands for two inputs, unskilled labor and the amalgam of other inputs. Unskilled labor is further divided into that that is sourced from Mexico and other sources. Finally, the Mexican unskilled labor is split between documented and undocumented types. The nested structure accommodates three CES substitution parameters labeled σ_A through σ_C working from top to bottom of the nested structure. The different nest level substitution parameters impose common elasticities of substitution on all members of a nest and for those members with inputs in other nests that are dependent on the values of the CES parameters and the cost structure of production.

We make a set of generic assumptions (nominally equivalent to output being a sector with higher than average use of Mexican unskilled labor) on the relative importance of inputs in production for carrying out our exploratory simulations of response to two scenarios of undocumented migration enforcement. We assume an 80-20 split in the top-level costs between the broad “other inputs” category and unskilled labor. Within unskilled labor we assume a 50-50 split between Mexican and other unskilled labor with 75% of that Mexican labor being documented. Thus, 2.5% of the total sectoral expenses are undocumented migrant wages. We do not offer a specific rationale for the cost breakdown because for present purposes the analysis is geared toward understanding how changes to factor supply and substitution assumptions influence model outcomes of interest under differing scenarios of undocumented labor regulation. This will become clear as we review the results of our two experiments in the next section.

Results

We posit a medium term economic expansion in the representative sector whereby output grows by 10% and prices for exogenous inputs (everything but the *mul* input) increase by 5%. The notion is to try and match a 5-year medium run adjustment that might correspond to our target historical experiment multi-year intervals pre- and post- to the Great Recession as experienced in the U.S. economy (detailed in the final section’s directions for future work). Our two simulations differ in the treatment of the exogenous policy variable δ , which places a wedge between the firm and laborer’s price for undocumented employment. In the “normal enforcement” case we set the percentage change in this variable to 2, consistent with findings that stronger economic growth and new hiring typically brings some increase in scrutiny of undocumented employment (see e.g. Villareal 2014; Ellis et al. 2014). We contrast this with results of an experiment where enforcement is ramped up to five times this level, leading to a 10 percent increase in the implicit tax on hiring undocumented workers.

Results from the two experiments are presented as three multi-part figures, with figure 4A-C representing the “normal” response of enforcement. All graphs show five curves representing different assumptions on substitutability between documented and undocumented workers with no other changes in the substitution structure ($\sigma_A = 0$; $\sigma_B = 4$). These values range from 0 to 10. On the horizontal axis of all the graphs is the factor supply elasticity of undocumented migrant workers from Mexico. We range this elasticity between 0 and 5. The vertical axis in each graph represents a variable of interest (panel A = percentage change in undocumented labor use; panel B = percentage change in non-Mexican unskilled

hiring; and panel C = change in the output (average cost) price level). Results in 4A through C show the importance of the factor supply assumption in measuring the sector impact. As we increase labor supply response of undocumented migrants we see the disappearance of substitution impacts in general, but especially in the price level (average cost) impact at the industry level. To wit, results from studies such as Borjas (2003) that assume perfectly elastic supply of unskilled undocumented workers have a limited role for imperfect substitution across types such that increased enforcement (driving up the relative cost of hiring undocumented workers) will be a boon to domestic unskilled workers (Figure 4B) with the associated earnings impacts.

The increased enforcement scenario of the figure 5 series (particularly Figure 5C) shows that with mobile undocumented labor and limited substitution the enforcement impact is larger, with higher factor price levels (average cost of output) that must be paid to replace the disappearing undocumented work force (Figure 5A). If there is imperfect substitution, more undocumented disappearance in employment is muted, while industry average costs are increased. This highlights the impact described by Dixon et al. (2011) where securing the increased industry cost as treasury receipts as opposed to other costly enforcement options may be a determinant of the best approach for achieving an effective policy adjustment of $\delta = 10$.

Existing literature estimating substitution parameters tends toward rejection of perfect substitution of undocumented labor with other unskilled types but tending toward the higher end (and above) of the range we consider (see Appendix table 1A). Our results show that precision at these larger levels (at least in the aggregate) may not be a significant source of error in projecting future impacts. Substitution possibilities are also impacted by the other nests for which we have adopted low values which would further indicate that substitution possibilities with undocumented workers may be of limited concern relative to other parametric drivers of typically reported impacts of increased enforcement (excepting those specific to the welfare of the undocumented worker).

Our approach here uses a minimal setup to provide a contextual frame of reference for the extant literature studying the impact of undocumented migration and associate policy options. In the proceeding discussion we lay out extension of this framework to historical data for testing the structural and parametric robustness against the record and offer some insight on how counterfactual analysis may be improved thereby.

Discussion

Natural experiments, shocks that allow identification of key responsiveness measures, are idealized above all in econometric analysis aimed at policy evaluation and improvement. The recent Global Recession with its unexpected impact across the breadth of the economy has been the source of much analysis including estimations making use of this shock as an identification tool. Studies of migration have made use of improved data that tracked employment flows as North America traversed the economic downturn. Ellis et al. (2014), Villareal (2014), and Ybarra et al. (2016) all offer evidence of how labor markets work vis-à-vis undocumented workers by evaluating experiences through the decade surrounding the Great Recession. Prior to that, shocks such as the Mexican peso crisis and sudden termination

of the U.S. Mexican bracero (temporary worker) programs provided “experimental” evidence for statisticians to identify economic responsiveness (Monras 2015; Clemens et al. 2017).

For calibrated simulation environments, the loose equivalent of econometric identification is validation (see. E.g. Valenzuela et al. 2007), the measure of an economic simulation tools outputs against historical record. As we look ahead in model development analysis with the current framework and debate over undocumented migration, data collected during the Great Recession offers a unique opportunity to examine an economic policy structure’s ability to replicate historical record. Our development here of a simple, readily extendable framework is in fact driven by the desire to frame this historical period for simulation analysis. Validation studies of simulation environments are as much about identifying failure points and limitations as any measure of accuracy that might be afforded. In the current case, we have a simple structure that is amenable to direct use of econometric studies’ parameter estimates (i.e. the studies that derive wage impacts employ nested CES output functions) with exogenous variables that can be pegged to historical observation for the relevant period of study.

Recalling our previous discussion of figure 1, two points of significant divergence in the undocumented population were identified. First when the growth in undocumented Mexicans continued to grow as other nationalities fell off and then when Mexican undocumented population began to decline. Taking the economic drivers (prices and policies) over the first period from 2000 to 2007 we can replicate that growth in undocumented population using our model and find the necessary parametric structure required. The second period, which is distinguished by declining population then stands as an out of sample test to a model set to replicate the first historical period. We are in the process of gathering the requisite data to continue down this path and begin the two-part historical simulation analysis. We close this initial draft with some thoughts on expectations for that work.

If validation tests are about identifying failure points and extra-model influences that lead to error then this will obviously apply to our period 1 historical simulation analysis. Ample evidence exists in the literature to show us that economic drivers are only part of the story determining migration. Sociology studies highlight the existence of non-price (or implicit price) factors that exist within the network of communities supporting Mexico to U.S. immigration as key to understanding periods of sustained growth even as enforcement is increased (Massey et al. 2016). Similarly, demographic studies (and demographic controls in econometric studies) point to a necessary reduction in migration from Mexico based solely on previous declines in fertility levels. These are all important pieces that must be considered in our historical simulation. Some may require a structural expansion (e.g. a detailed labor supply choice for Mexican workers). An alternative may be to adjust the policy parameter to serve as a reduced form measure of known factors (e.g. non-pecuniary benefits of migrant community support) or difficult to measure factors (the relationship between enforcement and probability of being deported).

Regardless of the complications, our review of existing literature and the presentation of a simplified model here point to the need for an extended framework for counter-factual policy analysis. Simulations built off of econometrically identified equations, even those using suitable identification precautions, will still tend to be the net effect of supply and demand

responses in equilibrium overcome by making some assumption of an extreme supply response that truly signals length of run. Large simulation approaches to date have been insertions into existing multi-sector models, too large and complex to be subjected to validation tests of the labor market and migration components. As we continue the work presented here it is this gap we believe needs to be filled.

Increased attention and action toward deterrence and removal of undocumented migrants is emerging as a key economic policy issue. Whether the impetus is active economic policy (i.e. raising citizen and authorized wages) or not, the impacts will be mediated through labor markets that face heterogeneous industries with differing technology. A tool for forward looking policy analysis with identifiable metrics against historical changes in the undocumented population will allow counterfactual analysis that 1) allows for differing policy objectives (e.g. minimizing relative sector impacts) to be weighed and 2) better accounting for the range of uncertain outcomes that may follow any policy action.

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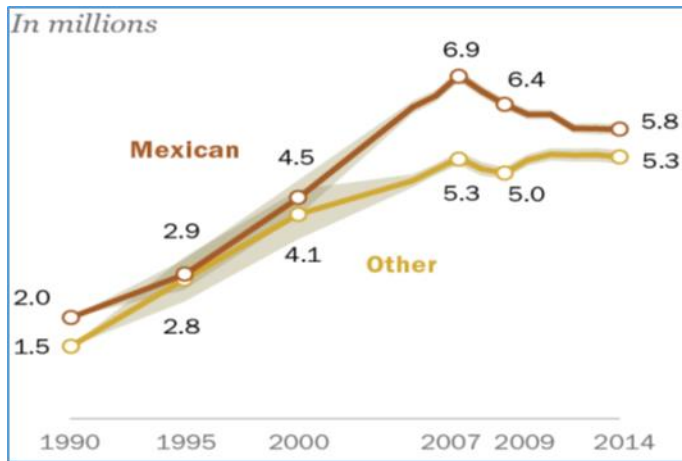
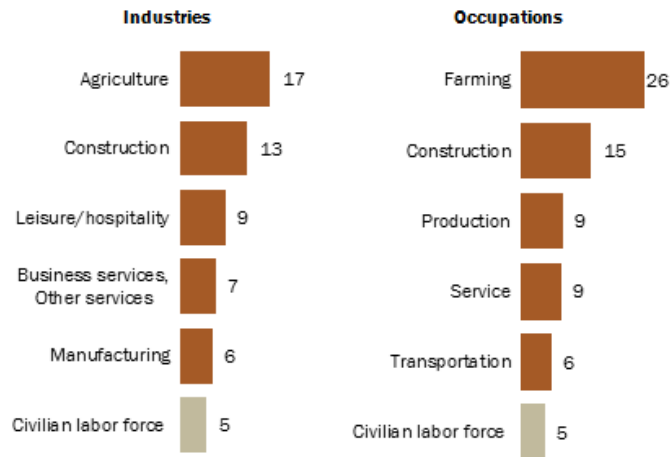


Figure 1. Undocumented U.S. population (Mexican and other nationalities), 1990 – 2014
Source: Pew Research Center 2016, <http://www.pewhispanic.org/interactives/unauthorized-immigrants/>

Some U.S. industries and occupations have high shares of unauthorized immigrant workers

% of workers in ____ industry/occupation who are unauthorized immigrants, 2014



Note: Percentages calculated from unrounded numbers. Rankings based on unrounded percentages. The industry/occupation groups shown correspond to the Census Bureau classifications for major industry/occupation groups. The names have been shortened for display purposes. See Methodology for full Census Bureau classifications.
Source: Pew Research Center estimates from augmented 2014 American Community Survey (IPUMS).

"Size of U.S. Unauthorized Immigrant Workforce Stable After the Great Recession"

PEW RESEARCH CENTER

Source: Passel and Cohn (2015).

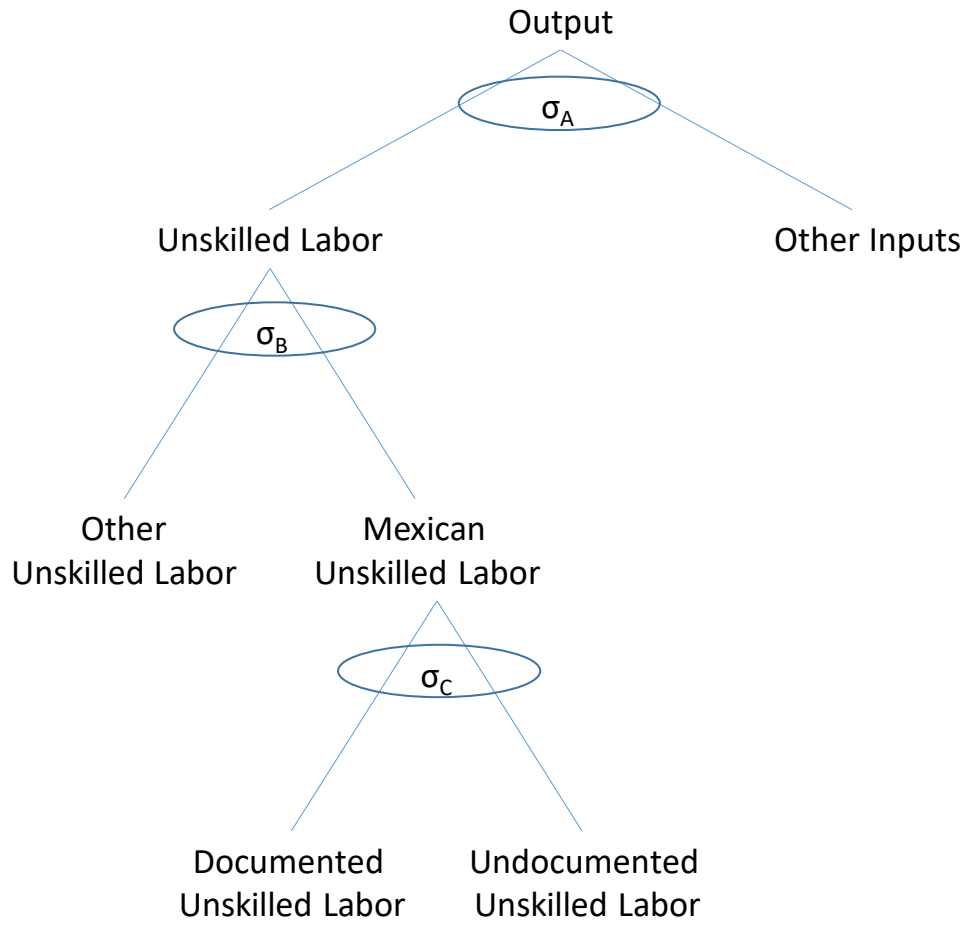


Figure 3. Production technology for U.S. output

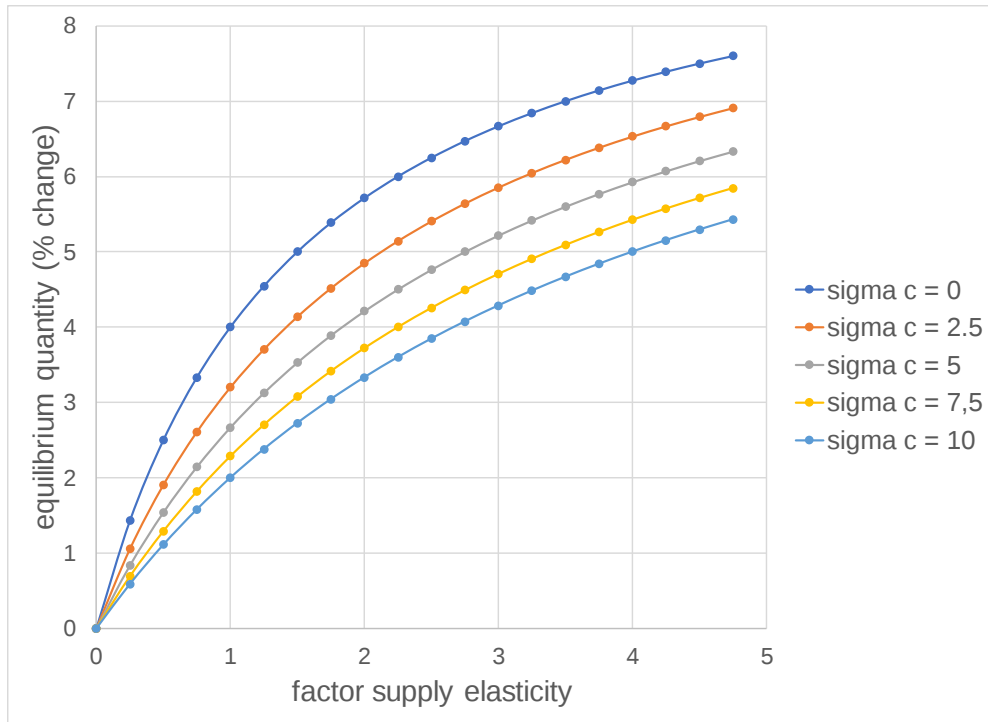


Figure 4A. Change in undocumented labor market under varying supply & demand response

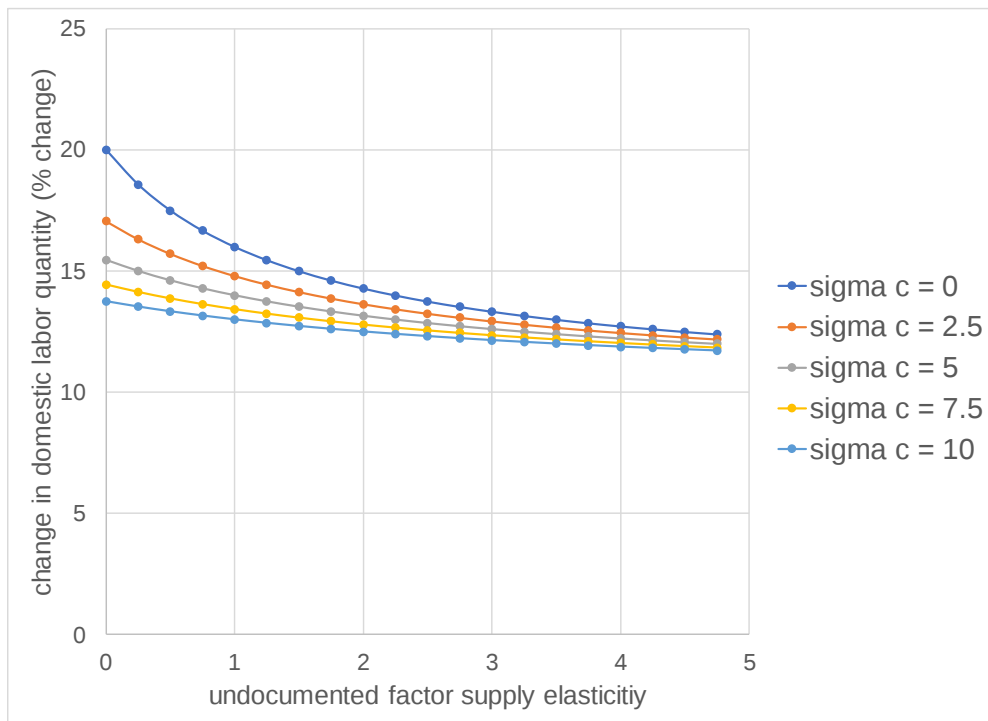


Figure 4B. Change in domestic labor under varying undocumented supply & demand response

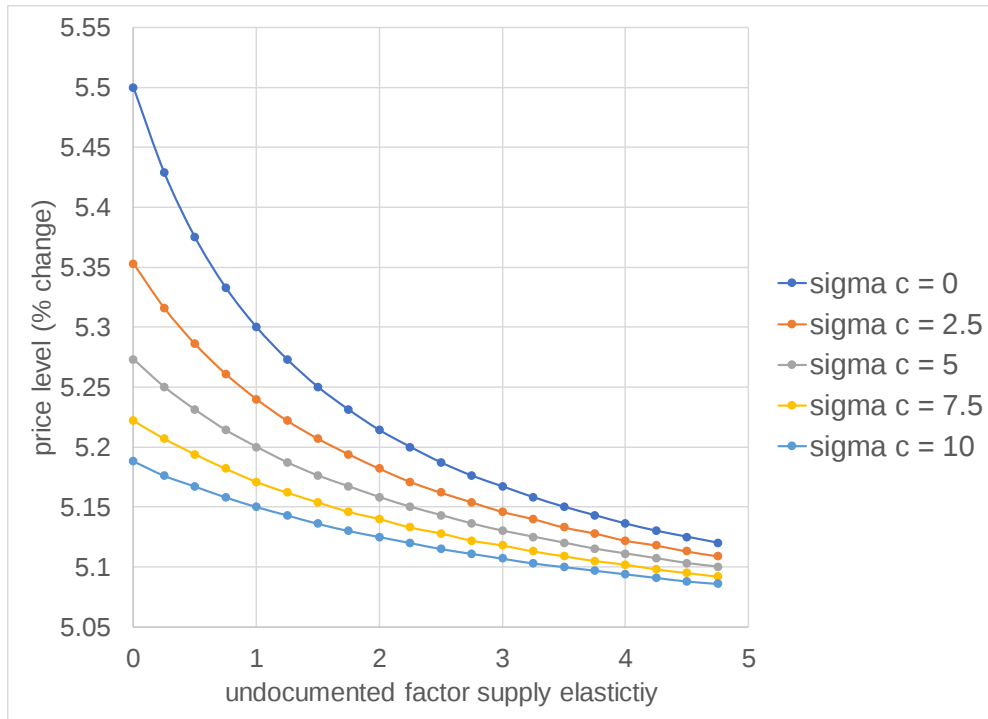


Figure 4C. Change in price level under varying undocumented supply & demand response

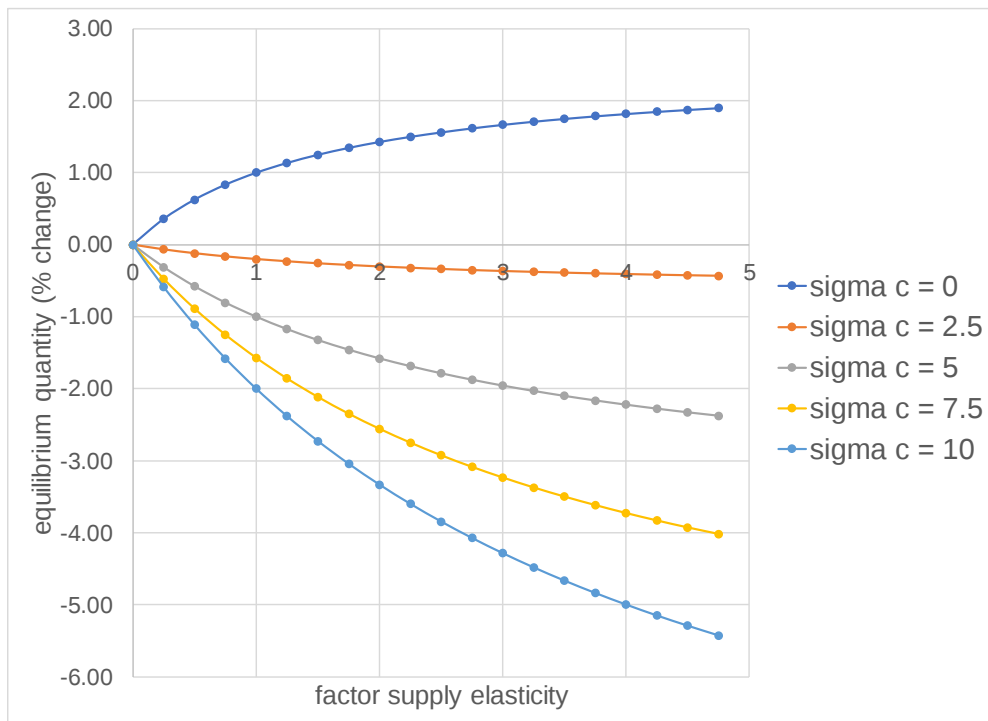


Figure 5A. Change in undocumented labor market under varying supply & demand response

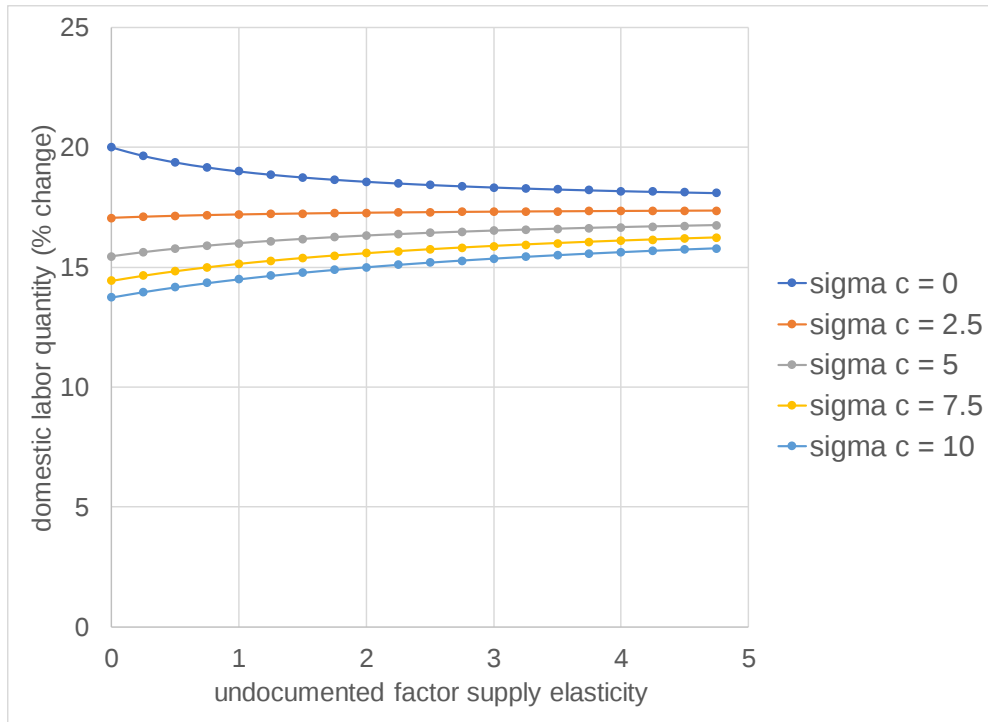


Figure 5B. Change in domestic labor under varying undocumented supply & demand response

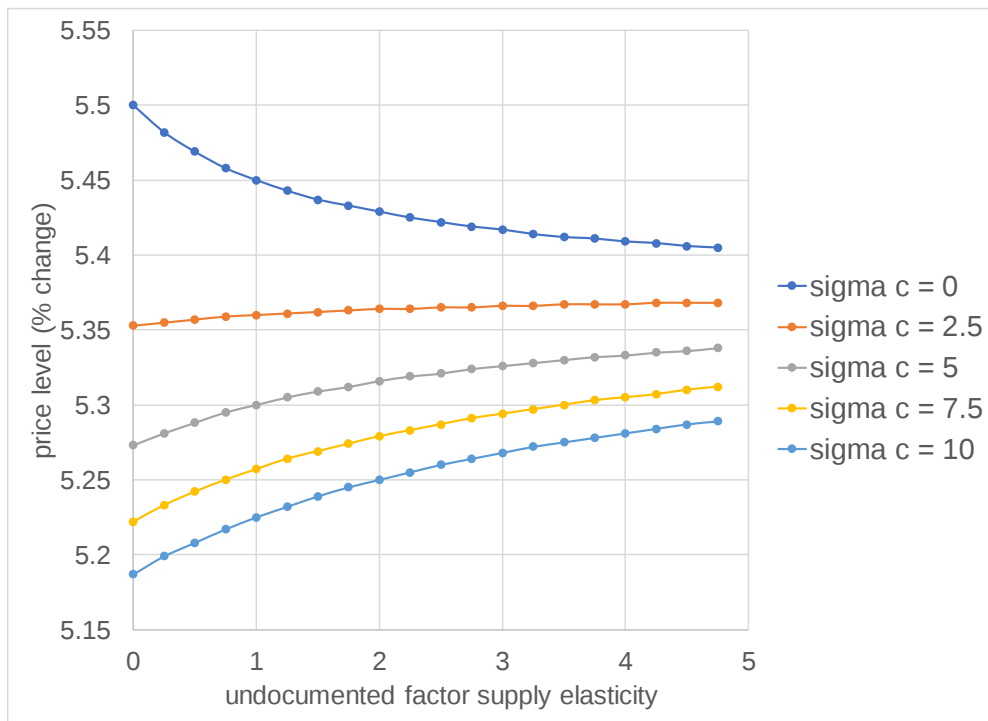


Figure 5C. Change in price level under varying undocumented supply & demand response

Table A1. Literature on migrant labor, input substitution

Elasticity of Substitutions:		
<i>Domestic and foreign workers</i>	20	Ottaviano and Peri (2012) . When the nested model is constrained to same substitutability between any pair of education group and any pair of experience group with same education. Table 2, Panel A, the estimated coefficient $-1/\sigma_N$ range between -0.024 and -0.071 . Most of them are around -0.05 implying estimates of σ_N in the neighborhood of 20.
	12.5	If the same substitutability among education groups restriction is taken out the elasticity of substitution between native and immigrants is around 12.5. See notes below.
	20 to 30	Card (2007) , using US city data for year 2000, Raphael and Smolensky (2008) , using US data over 1970–2005, and D'Amuri et al. (2010) , using German data
		Jaeger (1996) uses metropolitan data. Maybe subject to attenuation bias and endogeneity problems related to the use of local data
<i>Domestic and foreign unskilled workers</i>	5 to 10	Ottaviano and Peri (2006)
	Low	Cortes (2008) Uses metropolitan data
<i>Documented and undocumented foreign unskilled workers</i>	Econometric estimation absent	
<i>Immigrant labor and other production inputs</i>	(0.7482, 0.8247).	Values are determined from Ray (1982)'s translog cost analysis of US agriculture. Keller's formula: $\sigma_{AG} = \sigma_{i,j} = \eta_{i,j} / \theta_j$ cross price elasticity of demand for immigrant labor relative to the price of other inputs/cost share of immigrant labour
<i>Native and immigrants who are both less educated (no HS degree or HS diploma only)</i>	11.1	Ottaviano and Peri (2012)
<i>Native and immigrants who are both higher educated (some college degree or college degree)</i>	33	Ottaviano and Peri (2012)
<i>Low skilled native and immigrant workers</i>	Low substitution	Cortes (2008) , uses metropolitan area data
<i>Workers with no degree and workers with a high school degree</i>	25 or above	Ottaviano and Peri (2012)
<i>Broad education groups: Low (Workers with some college education or more) and High (those with a high school education or less)</i>	Around 2	Ottaviano and Peri (2012) , The relatively balanced inflow of immigrants belonging to these two groups from 1990 to 2006 implies very small relative wage effects due to immigration.

<i>Narrow education groups (among no degree and high school degree; among some college degree and college degree)</i> 10	10	Ottaviano and Peri (2012)
<i>College educated native and immigrant workers</i>	Very close to zero	Ottaviano and Peri (2012)
<i>Among native and immigrants workers who have no high school degree, who have high school degree and who have some college education</i>	Imperfect substitution	Ottaviano and Peri (2012) , the estimates of $-1/\sigma_N$ for the groups up to “Some college education” are very significant and between -0.06 and -0.10 , with an average value around -0.08 . They imply an average elasticity of substitution of 12.5.
<i>Among different experience groups</i>	5.5 to 6.25	Ottaviano and Peri (2012)

Table A2. Literature on migrant labor, input substitution

Wage Elasticities of Labor Supply		
Wage elasticity of labor supply is often too inelastic to employ at competitive prices in unskilled industries	Taylor, 2010; Taylor et al., 2012	
Wage elasticity of labor supply for Mexican nationals in the US	5.3 to 6.3 (wrt to work hours demanded)	Buccola et. Al (2011) , data from Oregon nursery industry which employs mostly Mexican workers.
Wage elasticity of labor supply in Mexico wrt Mexican ag. wage	1.25 to 1.43	Hanson, 2007 ; uses Mexican employment data from 1990 to 2000
Wage elasticity of labor demand in Mexico wrt Mexican ag. wage	-0.3 (low-skill workers); -0.28 (high skill workers)	Fajnzylber and Maloney, 2005
Wage elasticity of hired ag. labor demand in US	0.79	Espey and Thilmany, 2000

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