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ABSTRACT

It will be politically difficult to liberalize international migration without protecting host-country workers. The paper explores the scope for efficiently managing migration using a competitive market for work permits. Host-county workers would have the option of renting out their citizenship work permit for a period of their choice, while foreigners purchase time-bound work permits. Aggregate labor supply need not rise in the host country. However, total output would rise and workers would see enhanced social protection. Simulations for the US and Mexico suggest that the new market would attract many skilled migrants, boosting GDP and reducing poverty in the US.

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1. Introduction

Barriers to international labor migration are a major factor in explaining inter-country gaps in the marginal products of labor, implying large economic gains from reducing those barriers.[2] The main economic barrier is that, almost everywhere, a foreigner needs official permission—typically in the form of a work permit (WP)—to take-up employment in the host country. Binding quotas on the supply of WPs create an excess demand for permission to work in high-wage countries among people living in relatively low-wage countries.

Despite the likely economic gains from freer migration, there is much resistance in host countries. The citizens of high-wage countries often view migrants as a threat to their living standards, and so resist reforms that would help free up migration. That resistance also reflects a cultural backlash in some quarters against migrants, though to some extent this backlash also stems from economic insecurity.[3] Migration will continue to be restricted unless we can figure out a way to assure that international migrants are seen as an asset from the perspective of citizens of the host country rather than a threat.

A clue into how that might be done is found in the fact that citizens have a legally-recognized right-to-work—an entitlement to accept any job offer in their own country once one reaches the legal working age. We can call this the "citizenship work permit." This is undoubtedly the most valuable asset held by most low- and middle-income workers in high-wage economies—probably 90% or more of their total wealth.[4] However, currently, that asset is not something that a citizen can cash in on. The main asset of most poor people in high-wage economies is a non-marketable entitlement.

Yet, there are times at which some citizens would be happy to rent out their (implicit) WP. At any one time, there are both foreigners who want jobs at the higher wage rates on offer in rich countries and workers in those countries who have something they would prefer to do than work for a wage. We have a missing market in WPs.

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[2] See Clemens et al. (2019) and other estimates surveyed in Clemens (2011).

[3] Inglehart and Norris (2017) discuss how economic insecurity has interacted with cultural changes in America over recent decades. On the role of perceived economic threats from migrants in perpetuating prejudice and opposition to migration see Pereira et al. (2010).

[4] Tamborini et al. (2015) estimate the life-time (50 year) labor earnings of American men to be (in 2009 prices) $1.5 million for those with only high-school education (rising to $2.4 million for those with a Bachelor's degree). The median net (non-labor) wealth of this education group was around $100,000 in 2013 (Boshara et al., 2015).

Restrictions on international migration for work are the root cause of this missing market. Without those restrictions, citizens would still not be able to rent out their WP—to monetize this important asset of citizenship—but that would be a moot point since nobody would have any interest in buying it. However, removing all such restrictions is clearly a tall order. There is another policy option—to create the market that is currently missing.

This paper explores that option. It argues that creating a market for WPs not only generates aggregate output gains from freeing up migration but enhances social protection in high-wage countries—providing both insurance and relief from poverty and doing so in a way that is self-targeted rather than requiring administrative assignment of benefits. Importantly, migrants become an asset rather than a threat to workers in the host country. Simulations of the market for the US and Mexico point to the potential for sizeable welfare gains, though uncertainty remains about some key parameters relevant to impact.

2. The policy and its antecedents

Suppose that all working citizens of a country were free to rent out their WP for a time period of their choosing. The purchasers of those WPs would then be able to take up a job offer in that country. The ownership of the WP would remain with the citizen, and return to its owner at the end of the stipulated rental period. The market is anonymous, with no personalized matching of buyers and sellers. The market is in equilibrium when the price of WPs equates their aggregate supply with the aggregate demand.

A version of only one side of this policy has been around for a while. Gary Becker proposed that the US government should sell citizenship rights (including WPs) to foreigners, rather than requiring quotas and long queues (Becker, 1992; also see Becker and Becker, 1997; Becker and Lazear, 2013).[5] The revenue from selling WPs has also been advocated as a means of compensating those native workers who are vulnerable to competition from migrant workers, as in Weinstein (2002), although the mechanism for such compensation is unclear. There have also

[5] An earlier proposal along similar lines had been mentioned by Chiswick (1982). A market mechanism has also been proposed by Moraga and Rapoport (2014) as an efficient means of allocating migrants across host-countries, using tradable immigration quotas. Selling visas has also been suggested as a means of controlling human smuggling (as in Auriol and Mesnard, 2016).

been various "cash-for-passport" programs, often targeted to a global elite of the very rich (Sumption and Hooper, 2014; Shachar, 2017).[6]

Other approaches to freeing up migration do not entail an explicit market for selling WPs. Posner and Weyl (2008) propose a "Visas between Individuals Program" (VIP). The VIP entails that an individual citizen can sponsor a visa for a specific migrant, and the citizen and migrant share the earnings gain realized by migration.

Another approach advocates that migrants be treated differently to citizens. Freeman (2006) proposes higher taxes on migrants than for citizens. Milanovic (2019) proposes legally-defined differences in citizenship rights between native-born citizens and migrants.[7] To some observers this form of discrimination against migrants is a necessary evil to assuring freer migration (Ruhs, 2013; Milanovic, 2019).

Like these past policy proposals, creating a competitive market in WPs would help address host-country resistance to migrants, stemming from the expectation that migrants take the jobs of citizens—an externality. (There are other potential external costs, such as in providing public services to migrants.) However, the idea of a market for WPs that we study here differs from these past proposals in five main respects.

First, instead of the government supplying some pre-selected (arbitrary) number of WPs at some selected price (also arbitrary), the supply and their price would be market determined, with the efficiency benefits of introducing a competitive market that is currently missing. WPs for foreigners generate revenue for citizens who have something better to do than work for a wage. Furthermore, by balancing the demand for WPs with the supply, the market for WPs avoids an increase in aggregate labor supply in the host country.

Second, in the proposal considered here, only a time-bound WP can be purchased, not citizenship per se. While cash-for-passport programs have been in large part striving to attract rich individuals, and have come with high prices, what we study here is a scheme with competitive prices that is likely to have broader appeal.

Third, this policy would provide an extra source of social protection for workers in high-wage economies. All workers in the host country would have the new option of renting out the

[6] Some but not all of these programs require that one makes an investment, but this is still owned by the applicant. Here we refer to the subset of programs in which the purchaser makes a payment to the government.
[7] Milanovic (2019) refers to "citizenship rent" as the rent derived by a citizens given their rights but does not consider the possibility that this could in fact be rented out.

WP. One can think of many examples of valuable things that people could do by renting out their WP for some period. Someone who lost their job in a company town (such as due to automation) could rent out their WP for a period to cope with the unemployment, while re-training and/or migrating. A young person who has reached the minimum age for paid work may choose to rent out her WP for a limited period to help finance extra schooling or skill-training. Or someone may use this option to help raise their children in a critical period or to provide home-care for a loved one in need (such as an elderly parent or grandparent). It might also help someone deal with the onset of a serious illness or disability.

Fourth, the proposal studied here does not require that migrant workers are treated any differently to citizens. Objections are often raised to the various forms of discrimination against migrants found in some countries, with respect to education, health, housing and social protection.[8] In addition to the concerns about human rights, there is a risk that such discrimination may backfire, by legitimizing prejudiced thinking, and even strengthening the hand of those opposed to migration on xenophobic grounds. Questionable discriminatory practices are not necessary for making migrants more welcome in host countries.

Fifth, a market for WPs does not require sponsorship. The transactions involved are anonymous—there is no contact between the parties involved. This would reduce the transaction costs of the non-tradable VIP, such as in finding each other and dividing up the gains from migration.[9]

In short, creating a market in WPs would eliminate the inefficiency that arises from the current market failure that prevents citizens from renting out the WP, while foreigners want work in high-wage economies, but find that their entry is restricted. By tailoring the number of WPs issued to the amount of work that citizens do not want to do, one removes the current imbalance—the disequilibrium that stems from the missing market—without requiring a change in total employment. And a new form of social protection is created for workers in high-wage economies. Nor does a competitive market in work permits entail high transaction costs or ethically questionable discrimination against migrants.

The same idea can be used to help make refugees more popular in host countries, and assimilated more productively into the local labor market. Currently few refugees get WPs, and

[8] The U.N.'s Commission for Human Rights has viewed such discrimination against migrants in host countries as an important source of racism and xenophobia (U.N. undated).
[9] Posner and Weyl propose that the gains be shared equally, but in practice this would be open to negotiation.

often turn instead to government handouts or the informal sector, facing exploitation and poor working conditions. Given that people who have fled war-torn countries, or ethnic genocide, are unlikely to have the money needed to purchase WPs, the host government or international community could subsidize their WPs for refugees, financed (in part at least) by diverting funds from existing public spending on caring for refugees. The refugees who then have a legal route for entering the host country labor market, while citizen workers would benefit from the new option of renting out their WP.

3. Model of the market and some implications

We start with a simple expository model that ignores costs of migration but still contains the essence of the idea. This model suggests a high price of WPs. We then introduce costs of migration that suggest a lower price. Some implications are then drawn for social protection in the host countries.

3.1 Benchmark model

There are high-wage and low-wage countries. A single high-wage country introduces the proposed market for WPs, with citizens from some or all low-wage countries being eligible to purchase the WPs. The market is in equilibrium when aggregate supply balances aggregate demand over some period of time, which we call the market-clearing period. The equilibrium price is taken to hold within that period of time, recognizing that the market need not clear at each instant within the period.

In principle, different people may choose different sub-periods to participate in the market, and the distributions of these contracted time periods can differ between the two sides of the market. On the supply side, citizens will probably opt for shorter periods than are desired by potential migrants given the fixed costs of migration. Thus, the number of people renting out their WP in the host country may well exceed the number of people entering the country as migrants with WPs. All that matters to the equilibrium price is the aggregate demand and supply in time units—aggregating over all market participants within the market-clearing period. However, to simplify the exposition we model the market for a common fixed interval such as one year on both sides, though this can be readily relaxed. Thus, the equilibrium equates the number of workers renting out their WP with the number of migrants buying WPs.

In the high-wage country, wages have a continuous distribution function $F(w)$ for the wage $w \in [w^{min}, w^{max}]$ (with $F(.)$ strictly increasing as usual).[10] Thus, $F(w)$ gives the share of the workforce in the high-wage economy that earn less than w. The lower bound to the distribution of wages, w^{min}, can be interpreted as a statutory minimum wage. This is assumed to be binding, i.e., $F(w^{min}) = 0$ (though we can relax this to allow w^{min} to be less than the statutory minimum wage rate). By definition, $F(w^{max}) = 1$. Within the interval $[w^{min}, w^{max}]$, the equilibrium price of a WP, p, is a specific value of w that clears the market. The proportion of the workforce in the high-wage economy earning less than p is $F(p)$ and the country has a workforce of size n_h (h is the index for high-wage country). For the purpose of this expository model we treat n_h as exogeneous, unaffected by the price of the WP. We assume that citizens are willing to rent out their WP for a price exceeding their current wage rate. Then the aggregate supply of WPs is $F(p)n_h$.

On the other side of the market, the workforce of the low-wage countries is n_l. We normalize such that $n_h + n_l = 1$. Let us assume for now that there is a labor surplus in the low-wage economy such that there is no foregone income from migration. Also assume that there are no other costs of moving and no taxes levied by the high-wage country on the purchase of a WP. Also assume that workers in the low-wage countries expect to receive a wage drawn from the same distribution of wages as observed in the high-wage country. The demand for the new WP within the market-clearing period is then $[1 - F(p)]n_l$.

There is a positive excess demand for WPs at w^{min} (given that $F(w^{min}) = 0$ and $n_l > 0$; the necessary and sufficient condition for an excess demand at w^{min} is that $F(w^{min}) < n_l$). There is excess supply at w^{max} (the excess supply is $1 - n_l > 0$). Thus, by continuity and monotonicity of the supply and demand functions, a unique equilibrium exists.[11] The market equilibrium solves:

$$F(p)(1 - n_l) = [1 - F(p)]n_l \text{ implying that } p = F^{-1}(n_l) \qquad (1)$$

[10] There can be some disutility of work, represented by a taste parameter δ, and we can let $\tilde{F}(w, \delta)$ denote the joint distribution of wages and the disutility of work. $F(w)$ is then the marginal distribution integrating out the variation in the disutility of work.

[11] Here and later we invoke standard mathematical properties of continuous functions.

where $F^{-1}(.)$ is the quantile function of wages in the high-wage country. The equilibrium is stable under the standard assumptions about the market's adjustment process out of equilibrium; in this case we require that the price rises (falls) whenever $F(p)$ is less than (greater than) n_l.

The solution in (1) is the point on the quantile function for wages in the high-wage country corresponding to the share of the global workforce in the low-wage countries. This is clearly a high equilibrium price if n_l is high; for example, if $n_l > 0.5$ then the equilibrium price is above the median wage rate in the high-wage country.

3.2 Allowing for costs of migration

A lower equilibrium price is found when we introduce costs of migration that naturally create frictions to migration flows. The costs of migration include foregone earnings back home, remittances sent back home, extra living costs in the US, as well as out-of-pocket migration costs and taxes levied by the host country. Such frictions imply that workers in the low-wage countries cannot reasonably expect to receive a net wage gain drawn from the existing distribution in the high-wage country. Differences in human capital endowments can have a similar effect.

To allow for costs of migration we focus now on the expected distribution of net wages (gross wage less costs of moving). Potential migrants expect to receive a net wage with a cumulative distribution $G(w)$ (with $G(.)$ strictly increasing as usual). Given the costs of moving, the net wage distribution can be taken to be unambiguously "poorer" than the $F(w)$ distribution, in that $G(w) > F(w)$ for all w for all w. Demand for the WPs is now $[1 - G(p)]n_l$. We impose two restrictions on the $G(.)$ distribution, namely that $G\left(w^{min}\right) < n_l$ and $G(w^{max}) = 1$, which imply positive excess demand at w^{min} and an excess supply at w^{max}. Again invoking continuity and monotonicity, a (unique) equilibrium exists at given n_l. Then the new market equilibrium is:

$$p' = H^{-1}(n_l) \qquad (2)$$

where $H(w) \equiv F(w)n_h + G(w)n_l$ is the weighted mean distribution. Clearly $p' < p$.

The high-wage country may want to tax the purchase of a WP. This can be thought of as just another cost of moving (as embedded in the $G(.)$ distribution), but it is instructive to make it explicit. Let that tax be τ (> 0) such that the relevant net wage distribution for potential migrants is now $G(w + \tau)$. Existence of a unique equilibrium is assured under the same assumptions as for the model with $\tau = 0$, with the modification that we assume that $G\left(w^{min} + \tau\right) < n_l$

(although this can be relaxed somewhat while still assuring that an equilibrium exists). The new market equilibrium (p'') solves:

$$F(p'')(1-n_l) = [1- G(p''+\tau)]n_l \quad (3)$$

Evidently $p'' < p' < p$. (Note that $[F(p'') - F(p')]n_h + [G(p''+\tau) - G(p')]n_l = 0$. This cannot hold if $p'' > p'$.) How much lower the equilibrium price will be depends on τ. The higher is the value of τ, the lower is the price solving (3); more precisely:

$$\frac{\partial p''}{\partial \tau} = -\frac{1}{1+\gamma} < 0 \quad (4)$$

where $\gamma \equiv \frac{f(.)n_h}{g(.)n_l}$ and $f(.)$ and $g(.)$ are the density functions (corresponding to $F(.)$ and $G(.)$ respectively) evaluated at the equilibrium price. This suggests that the existence of a binding minimum wage yields a limit to how high the tax can go. If τ is too high then the solution of (3) will reach w^{min} and the market will vanish for any higher value of τ. From (3) it is clear that for the market to exist at the minimum wage we require that:[12]

$$\tau < G^{-1}\left(1 - \frac{F(w^{min})(1-n_l)}{n_l}\right) - w^{min} \quad (5)$$

(where $G^{-1}(.)$ is the quantile function of migrants' net wages).

A tax on the purchase price of the new WPs (or increase in the cost of moving, such as due to a higher forgone income in the low wage economy) is naturally passed on in part to the sellers through the equilibrium price. It is readily verified that a unit increase in τ will (to a first-order approximation) lead to a final purchase price of $p'' + \gamma/(1+\gamma)$ with a final selling price of $p'' - 1/(1+\gamma)$. (In the special case of uniform densities and equal workforces the tax is shared equally.)

3.3 Some policy implications

The proposed market would create a new binding floor to labor earnings in the host country—a new lower bound, above the current floor and potentially above the current minimum wage rate for the contracted period.[13] Workers in the host country will rent out their WP if they

[12] Our assumption that $G(w^{min}+\tau) < n_l$ already implies an upper bound to the tax (namely $G^{-1}(n_l) - w^{min}$), but at that bound the market does not exist at $p = w^{min}$ (assuming that $F(w^{min}) < 1$).

[13] The only estimate of the level of the income floor in America (averaged over reported incomes of the poor, with higher weight on poorer people) puts the floor at about $5 per person per day (Jolliffe et al., 2019). Allowing for (say) one dependent, this implies an income of $10 a day. It would be reasonable to assume that this is lower than

earn less than p'' (and some earning more than p'' will also do so if they experience a disutility of work). Thus, the policy is a means of assuring a normatively-chosen, minimum income, $\bar{p}$.

In rationalizing $\bar{p}$, we can posit a first-best distribution in the host country that maximizes some weighted aggregate of utilities, with the weights reflecting the government's social preferences. The first-best distribution of income is bounded below by $\bar{p}$. However, in the absence of this policy, the first-best is not implementable given other constraints (notably on information and administrative capabilities). The observed distribution has incomes below $\bar{p}$ due to uninsured shocks or longer-term disadvantages. With the policy in place, instead of solving (3) for p'', the host government can now solve for the tax rate on WPs required to assure that $p'' = \bar{p}$, namely:[14]

$$\tau^* \equiv G^{-1}\left(1 - \frac{F(\bar{p})(1-n_l)}{n_l}\right) - \bar{p} \tag{6}$$

Thus, the market for WPs now makes it feasible to implement the host country's socially optimal minimum income. We refer to this as the "inverse problem."

There is another control available to the host country, namely its power over eligibility to purchase or sell WPs. For example, the US might (initially at least) choose to make the market only available to citizens of (say) Mexico (as we simulate later). This can yield discrete changes in n_l but for analytic convenience, we can treat eligibility restrictions as a continuous reduction in n_l (either by restricting migrant eligibility or expanding eligibility to rent out the WP among citizens of the host country). This will reduce the equilibrium price (differentiating (3)):

$$\frac{\partial p''}{\partial n_l} = \frac{1+F(.)-G(.)}{f(.)n_h+g(.)n_l} > 0 \tag{7}$$

The difference between these two policy instruments—the tax on WPs and eligibility conditions—is that the tax instrument can raise revenue, albeit at the expense of both citizens renting out their WP and foreigners buying WPs. It is reasonable to assume that the (positive) partial equilibrium effect of a higher tax rate on revenue dominates the (negative) effect stemming from the deterrent effect of a higher tax on migration.[15] Then the host government faces a trade-off between the level of the income floor, $\bar{p}$, and the extra revenue generated by a

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the equilibrium price of a WP. Indeed, $10 a day is lower than the minimum wage rate in the US for an eight hour day.

[14] Recalling that $G(w) > F(w)$, it is readily verified that a sufficient condition for $\tau^* > 0$ for any desired $\bar{p}$ is that $G(\bar{p}) < n_l$.

[15] This requires that $G(.) + \frac{\tau g(.)\gamma}{1+\gamma} < 1$.

higher tax on WPs. Writing that revenue per capita as $R \equiv \tau[1- G(p+\tau)]n_l/n_h$, we might postulate that a host government maximizes $p + \pi R$ for some $\pi > 0$. Sufficient conditions for the existence of an interior optimum tax rate are that the distributions F and G are locally uniform, which guarantees that R is also strictly concave in τ (though those conditions can be relaxed somewhat). The optimal tax on WPs then sets marginal revenue ($dR/d\tau$) to $1/(\pi(1+\gamma))$.

4. How might the policy be implemented?

There is more than one way to implement a competitive market for work permits. One option is to create a web-platform for online double auctions of WPs—a natural analogue to the economic model of a competitive market in the previous section. This would be managed by the government of the host country, which retains its monopoly over the supply of WPs. A separate bank account would be maintained for deposits and withdrawals associated with the new market.

The government (acting as an auctioneer) first announces the program and opens the site. A citizen interested in participating registers on the site and provides some necessary legal documents that verify eligibility to trade on the site (for example, to verify age).[16] Once cleared, citizen *i* submits an offer to rent out her WP, with a stipulated duration D_i and minimum acceptable asking price, p_i^{min}. At the same time, potential buyer *j* submits their desired duration d_j for a WP and maximum price p_j^{max}.

Once a reasonable number of transactions are in the system, the canned software finds the market-clearing price p such that aggregate labor time is in balance between the two sides of the market. (Recall that balance is only required in the aggregate, and in time units, not people.) The equilibrium price equates the total duration of the proposed spells for renting out the WP for those willing to accept at least p with the total duration of the bids for WPs from those willing to pay no more than p plus the stipulated tax, τ (or other costs of moving). Exact balance is unlikely, but one can instead find the p that gives the least imbalance, i.e.,

$$p = \arg\min \left| \sum_{p_i^{min} > p} D_i - \sum_{p_j^{max} < p+\tau} d_j \right| \qquad (8)$$

[16] If another high-wage economy introduces this market then there may need to be a coordination mechanism to address migrants between the two countries who face little or no restriction on migration, and so should not be eligible for renting out their RTW.

The price is then announced. All those citizens who said they are willing to rent out their WP for at least p will take the offer, while a similar number of people wanting a WP but willing to pay no more than $p + \tau$ take it up.

This is not the only way of implementing the proposed market in WPs.[17] One could give the first WP to the highest initial bidder, and use that to cover the lowest initial selling price, and continue this way. That would entail that the government recouped the individual surpluses as extra revenue from the scheme.

An optional design that may well be more popular for citizens of the host country (for its familiarity as well as transparency) is similar to the auction site *eBay*. Once cleared for using the site, a citizen submits an offer to rent out a WP, specifying the conditions (notably the desired duration and start date) and the price he wants to get. A seller should be able to monitor the ongoing prices for the similar WPs and set up the price for his WP accordingly. After the WP is listed on the site, anybody in the world can bid for that as a WP with the appropriate taxes and charges added. A particular WP will go to the highest bidder. The WPs can also be bundled, so that purchasers get their desired time periods (or something close).

Once the transaction is confirmed, the seller (a citizen) receives the money to his bank account and a note is made in his profile (linked, for example in the US to his Social Security Number) indicating the period when that person is not eligible to work in his own country. From that moment, the seller has no obligation either to the buyer or to the authorities. On the expiration date of the WP, the work status of the seller is reset to an original state and he again becomes eligible to work.

The buyer (most likely a foreign national) receives an official confirmation from the host country's government that he has purchased a WP for a specified period. This confirmation becomes a document supporting the buyer's petition to obtain an entry visa to that country. The confirmation would not guarantee that the entry visa is granted, as there could be other reasons (notably security) why that individual might not be allowed into the country. (Nor does the confirmation guarantee that on arrival the buyer will find a job.)

If the visa is issued, a buyer enters the country and looks for a job (or takes up a pre-contracted job). The start and end day of the visa will be linked to the dates of the WP (allowing

[17] An overview of the generic options for designing auctions can be found in Haeringer (2017).

some grace period). A foreigner with the purchased WP could stay in the country for the duration of the WP plus some extra time for relocation.

A secondary market might develop to provide services and support both to the buyers and sellers. The legal services could be offered assisting sellers with the preparation of the necessary documents to confirm their eligibility to rent out the WP. The services for buyers would be more extensive. Because not all foreigners will be able to pay for the WP upfront, commercial banks (most likely in the receiving country) could provide loans to buyers to pay for the WP. The loan application will include checking the applicant's qualifications and will be given based on the likelihood of the buyer finding a job in the country, possibly in a form of an employment contract or binding employment offer. Legal and immigration support might also be privately provided. Insurance instruments could be developed to insure buyers against the events of not obtaining a visa or failing to find a job while in the country.

5. Illustrative application to the US and Mexico

We simulate the scenario when only currently employed citizens of the US can sell their work permits, and only citizens of Mexico are allowed to purchase a yearlong work permit in the US. We only model the market for WPs.

5.1 Data and methods

We use data from the 2018 Annual Social and Economic Supplement of the US Current Population Survey (CPS), US Census Bureau (2019), and the Mexico National Survey of Occupation and Employment (ENOE) (INEGI 2019). The CPS is a monthly survey of approximately 60,000 US households. The survey provides information on the labor force, employment, unemployment, persons not in the labor force, hours of work, earnings, and other demographic and labor force characteristics. The supplement of the CPS includes detailed questions on income received in the previous calendar year. We use the official poverty lines for the US, which gives a poverty rate of 12.3% (Semega et al., 2019).

For Mexico, we use the National Survey of Occupations and Employment (ENOE). This is a trimonthly survey applied to a representative household sample in Mexico. The survey aims at providing statistical information on the population's occupational and substantive socio-demographic characteristics at the national level. We do the currency conversion at Purchasing

Power Parity (PPP).[18] However, we also allow for extra costs of living in the US. For example, given that this is temporary migration, the worker will probably still incur costs back home, such as in maintaining the permanent residence.

We illustrate the impact of creating a market for work permits on the US economy through a series of simulations imposing different assumptions about the parameters of our empirical model. We assume that a US citizen i would sell his work permit for a year if offered a price p exceeding her current yearly wage (w_{US}^{US}); the total number of US citizens willing to sell their work permit is then given by:

$$n_s = \sum_{i=0}^{n_{US}} 1[w_{US}^{US} < p] \tag{9}$$

where n_{US} is the number of employed in the US. A Mexican migrant j will purchase the work permit if his expected net wage in the US ($\widehat{w}_{MX}^{US}$) is higher than the price of the work permit and additional fees and costs associated with moving to the US. The expected gross wage of each Mexican worker in the survey is predicted based on Mincer-type earnings regressions estimated on the US data and the characteristics of the Mexican worker. The net wage is post-tax, where the taxes take two forms: the tax on earnings levied by the US government and the implicit "tax" levied by the family back home—the "remittance tax." Thus, the number of buyers is:

$$n_b = \sum_{i=0}^{n_{MX}} 1[(1-\tau_r)(1-\tau_w)\widehat{w}_{MX}^{US} > p(1+\tau_{wp}) + C_{Mov} + C_{US} + w_{MX}^{MX}] \tag{10}$$

Here n_{MX} is the number of working-age Mexicans, $\tau_r \geq 0$ is the "remittance tax," $\tau_w \geq 0$ is the tax on a migrant's earnings in the US, $\tau_{wp} \geq 0$ is the tax a migrant pays on a purchase of the work permit, C_{Mov} is the out-of-pocket cost of moving to the US, that includes travel expenses to the US and back and visa fees, C_{US} is the cost-of-living adjustment for the US, and w_{MX}^{MX} is the migrant's wage rate in Mexico.

The market-clearing price of the work permit (p^*) minimizes the difference between the numbers of sellers n_s and buyers n_b:

$$p^* = \underset{(p)}{\operatorname{argmin}} |n_s - n_b| \tag{11}$$

We can be more confident about some parameters than others. We apply standard US tax rates for the expected wages of a migrant, as given in the Appendix (Table A1).[19] There is more

[18] We use the Mexico PPP rate for 2018 of 9.38 (World Bank 2019).

uncertainty about the remittance tax. Yang (2011) reports that Mexican migrants in the US remit, on average, 31% of their US earnings. As Yang also notes, this is on the high side compared to other data. We will allow values of τ_r over a wide range up to 40% of post-tax earnings in the US. A seemingly reasonable assumption for the out-of-pocket cost of moving (and returning) is $4,000. This includes legal costs of obtaining a US visa as well as travel and relocation costs.[20]

To predict expected wages of Mexican migrants in the US, we first estimate the coefficients (β^{US}) of a Mincer earning regression for the log yearly earnings of US worker *i* on a set of their productive characteristics using the CPS data:

$$\ln\left(w_{USi}^{US}\right) = \beta^{US} X_i^{US} + \varepsilon_i \tag{12}$$

where ε_i is a standard $(0, \sigma^2)$ error term. We predict the expected earnings of Mexican migrants ($\widehat{w}_{MX}^{US}$) if they migrate to the US using the estimated coefficients ($\hat{\beta}^{US}$) and characteristics of Mexican workers (X_i^{MX}) from the ENOE data.[21]

$$\widehat{\ln w_{MXi}^{US}} = \hat{\beta}^{US} X_i^{Mx} \text{ and } \widehat{w}_{MX}^{US} = \exp\left\{\left[\widehat{\ln w_{MXi}^{US}}\right] + (\hat{\sigma}^2/2)\right\} \tag{13}$$

where $\hat{\sigma}^2$ is the unbiased estimator of σ^2 from (12) (Wooldridge 2012).

We postulate that a migrant makes a migration decision assuming that his earnings in the US are functions of his specific human capital characteristics and his occupation in Mexico. Here, the migration decision is also a function of migrant's professional experience in his home country. A Mexican electrician plans to work in that occupation in the US forming his wage expectations ($\widehat{w}_{MX}^{US}$) based on information about wages of electricians in the US. The other explanatory variables $\left(X_i^{US}\right)$ include information about age, gender, marital status, race, the highest level of education, citizen status, job classification, and whether a worker works full- or part-time. The detailed regression results can be found in the Appendix.

We estimated a second specification that drops the worker's occupation, on the grounds that this is endogenous. Causal inference is not the objective of the predictions, but it is nonetheless

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[19] In other words, a migrant is assumed to make calculations based on his net income in the US, given prevailing tax rates. (So, if a migrant's expected gross wage in the US is $100,000, he will be expected to pay taxes at the rate of 24 percent on that income, based on Table A1.)

[20] We took an approximate amount of $1,700 for processing of H1B visa.

[21] When predicting migrant wages in the US, we assume that Mexican migrants in the US are employed in the private sector (not working for the federal, state, or local government, and not are in the arm forces); we also assume that all migrants are Hispanic, single (for the purpose of work migration), and have no US Citizenship or permanent residency status.

of interest to see if the results change much if we do not condition on occupation, which may well change in the US. The Appendix also provides results for this alternative restricted specification. The results turn out to be very similar. The following discussion focuses on the full model.

5.2 Results

Table 1 gives the simulation results for various combinations of parameter values. Column 1 is for the benchmark model of no costs of moving (though official taxes on earnings in the US remain). We consider a wide range of other parameters to reflect the likely frictions, as indicated in Table 1. Figure 1 provides a graphical representation of solutions of the optimization problem in (11) for two illustrative scenarios in Table 1.

Introducing migration costs greatly reduces the equilibrium price (comparing column 1 with other columns). Without the costs of migration, the price is almost $29,000 with 47 million workers participating in the market. This scenario brings the largest gains to the host country, with net wage gains of over 7% of US GDP and a poverty rate falling to about 8% (from 12.3%). Simply adding a 10% remittance tax brings the price of a WP down by $5,000 (Scenario 2). Adding further frictions, we find equilibrium prices in the (wide) range $13-22,000. The gap in wages between those selling their WP and those buying it remains large with the frictions, and more so the lower the equilibrium price, as one would expect. With frictions, the count of participants in the simulated market varies from 18 to 36 million workers depending on the parameter values. Tax revenue is highest at lower tax rates on the WP. The gain in earnings (earnings of migrants less forgone earnings of natives) varies from 4.4-7.4% of US GDP. The policy brings the poverty rate in the US down to somewhere between 7.9 and 10.8%, with lower poverty impact as the equilibrium price falls reflecting greater frictions to migration. Figure 2 shows the impact on poverty for a wide range of possible poverty lines.

We have chosen the succession in pairs of scenarios to help assess the partial effect of parameters and policy choices. For the pairs of scenarios (2, 3), (5, 6), (8, 9) and (9, 10), we see the impact of a higher tax rate holding other parameters constant. This brings the equilibrium price down by around $1,000-1,500. Tax revenue falls in each case. The impacts on the GDP share and the poverty rate are small. The scenario pairs (3, 4) and (6, 7) show the effect of adding a 10 percentage point allowance for the extra cost of living in the US (beyond what PPP rates

allow for). This brings the price down more substantially, by around $2-3,000. The pairs (1, 2), (4, 5) and (7, 8) give the effect of a change in the remittance tax; as expected, this reduces the equilibrium price of a WP in each step, though the effect is small after the first increment (from 0 to 10%). This also slightly reduces the GDP share and slightly reduces the poverty impact.

As discussed in Section 3.2, we can also solve the inverse problem of finding the tax rate that attained any desired price of the work permit, which can be interpreted as a socially desirable minimum level of earnings. A natural choice (though certainly not the only possibility) for the latter is $14,500, which is the annual income for someone working a 40 hour week for 50 weeks at the Federal minimum wage rate of $7.25 an hour. Table 2 gives the results for the six distinct parameter combinations in Table 1. The required tax rate varies substantially depending on the two cost parameters, decreasing with respect to both. With no frictions, the tax rate would need to be 143%, but falls to 25% in the "high-cost" scenarios (8, 9 and 10). Given that the price is fixed (by construction) other outcome variables are affected rather little; indeed, on the seller's side the impact is zero (for example, the poverty rate falls to 10.6% in all cases). There is some adjustment on the Mexican side in earnings and tax revenue, which generates modest differences in the net earnings gain to the US, which represents 4.5-5.2% of GDP.

The partial-equilibrium simulations above point to large welfare losses from the missing market. Given this, a general equilibrium analysis is probably called for before implementing such a policy at scale. The above simulations also suggest that one might not want to go to full scale too quickly. The government might start instead with a high tax rate on WPs and/or restrictions on eligibility (on either side of the market), and expand scale later, with fuller information.

6. Discussion of the policy issues

Creating a market for work permits, so as to realize the potential gains, would require new legislation. A number of issues are likely to arise.

One issue is how the citizenship work permit should be interpreted legally. There is already a well-recognized right to own property, and this comes with a right to rent that property out to others. A citizen's WP can be thought of as their property—a non-physical asset, which should come with the right to rent it out. Against this view, one might respond that "property" only refers to physical objects. However, that is clearly not the case in practice given that

intellectual property is well recognized. Once one sees the citizenship WP as a property right, renting out that right for a period (while retaining ownership) is no more problematic than renting out other assets, whether physical or not.

There are precedents. For many jobs, one signs a contract saying that one will take no other employment at the same time. Then one has already implicitly forgone one's WP during the contracted period of employment. Surrogate motherhood is another example. We are also reminded of past land and housing policy in some countries whereby these assets had previously been administratively assigned to individuals, such as agricultural land in Vietnam or housing in China or the Russian Federation, without the right to sell the asset. Thus, an important asset for many poor people was not marketable, effectively reducing their wealth. Subsequent reforms made these property rights marketable, and active markets emerged in these assets.[22] Another example is the longstanding system of taxi medallions in New York City (NYC). Each (American) owner of a medallion has the right to drive a yellow cab in NYC, but he or she may instead rent out the medallion to another driver, often immigrants.[23]

While there is a case for making some rights of citizenship marketable, including the WP, the case is weaker for some other rights. We can distinguish two types of citizenship rights, namely those that come with a social responsibility and those that do not. It is well recognized that citizenship comes with both rights and responsibilities, including abiding by the country's constitution and participating in its governance (such as by voting).[24] When rights are tied to responsibilities, making those rights marketable calls for a means of enforcing the attendant responsibilities. That would clearly be problematic for many rights of citizenship. For example, in this respect, the right-to-vote is fundamentally different from the right-to-work—the citizenship WP. Nor is it clear what problem would be solved by creating a market in (say) voting rights. The aim here is not to create markets in all rights but rather to address a specific problem arising from the hostility to immigration in host countries, and the existence of restrictions on international migration.

It is also notable that WPs are already being monetized in the form of (legal and illegal) payments to intermediaries (including human smugglers). The present system is essentially one

[22] For an analysis of the efficiency and equity implications of the reform to introduce a market in land-use rights in the context of Vietnam see Ravallion and van de Walle (2008).
[23] We are grateful to Michael Clemens for pointing out this example.
[24] See, for example, the statement on citizenship rights and responsibilities by US Citizenship and Immigration Services (2019).

of formal quotas and (largely informal) side payments. The difference here is that a competitive market in WPs will eliminate the quotas and channel the payments from people who could benefit from access to the high-wage segment of the global labor market to citizens who can make good use of the money in some other activity for some period.

Some useful insights on the issues raised by this policy can be obtained by comparing it to other options for domestic social protection.

6.1 Comparison with other social protection policies

The insurance provided by the proposed market for WPs is universal in that it would be available to all workers in the host country—it is not means-tested, so even a high-wage worker who suffers a shock can turn to the program. Nonetheless, there is a self-targeting mechanism. People with low current wages would undoubtedly be more willing to participate in this market and gain more from doing so. This would put upward pressure on wages for low-skilled workers, reducing poverty and inequality in rich countries. Indeed, as noted, this can be thought of as a policy for lifting the floor to labor earnings in the host country. Note, however, that this reasoning makes two key assumptions. The first is that the change in earnings distribution does not attract too many more illegal workers. The second is that the scheme is introduced on top of existing social protection schemes, such as unemployment allowances. The extra benefits (including insurance) arise from the fact that anyone can rent out their WP at any time. There may be some displacement of existing private transfers, such as support from other family members. On balance, net gains can be expected.

There would also be non-pecuniary benefits (or at least benefits not reflected in current incomes). Many of those who take up the new option of renting out their WP can be expected to be doing things that yield such benefits. For example, extra time spent by parents with their young children can be expected to bring gains in terms of child development. Similarly, home care given to one's elderly parent yields a non-pecuniary benefit. The same can be said of other examples of potential take-up discussed in Section 2.

In thinking about the redistributive aspect in the host country, it is of interest to consider how this policy compares to other schemes that aim to guarantee a minimum income.[25] One such

[25] Ravallion (2019) reviews all these policy options in greater depth. Here we just note key differences with a market for WPs, viewed as a social protection policy.

scheme entails topping up all incomes until they reach the desired minimum.[26] The information requirements of such a scheme are considerable, as one must know each person's income. The incentive effects can also be a concern given that it implies a 100% marginal tax rate on poor people. Alternatively, one can consider a job guarantee program, which aims to provide work to anyone who wants it at a stipulated minimum wage rate.[27] This also has an in-built self-targeting mechanism, whereby the program is more attractive to low-wage workers, with no explicit pro-poor targeting required, such as based on some proxy means test. The major difference is that, under the proposed market for WPs, the direct beneficiaries in the host country are not compelled to work to receive payments. Work requirements can generate welfare losses (including foregone incomes) and also require (often sizeable) costs of monitoring the work and providing non-labor inputs.[28] Against these disadvantages, it has been argued that such "workfare" schemes may be able to generate useful assets (although that has not, it seems, been the norm in workfare schemes) and instill a work ethic in transfer recipients.

Viewed as an option for reducing poverty, the proposed market for WPs also has a notable advantage over proposals for raising the statutory minimum wage. Both options can attain the same level of the floor to living standards, and so reduce current poverty. The difference is that the proposed market for work permits would free up the worker's time and so it will encourage productivity-enhancing investments that require time. Thus, the policy can be expected to have longer-term gains in promoting people from poverty.

An interesting comparison is with a Universal Basic Income (UBI)—one of the most talked about social policies today. This provides a uniform transfer to everyone, whatever their income level. (Though, of course, the net gains may be far from uniform once one allows for the extra taxes or spending cuts needed to finance the policy.) There are some similarities. Like a UBI, the proposed market in WPs provides a new income source for people who presently have little or no option but to work and must forgo personally and socially valuable pursuits in doing so. Like a UBI, there is no explicit targeting mechanism; since the proposal relies on a

[26] Famous examples include the *Speenhamland System* of 1795, which aimed to guarantee a minimum income through a sliding scale of wage supplements (Himmelfarb, 1984). Another example is the Di Bao program in China, which similarly aims to top up all incomes until they reach stipulated minima (set by each city) (Ravallion and Chen, 2015).

[27] An example is the National Rural Employment Guarantee Scheme in India. A Federal Jobs Guarantee scheme has also been proposed for the US (Paul et al., 2017).

[28] See, for example, the cost-effectiveness calculations for the National Rural Employment Guarantee Scheme in the state of Bihar, India, in Murgai et al. (2016).

competitive market mechanism; in equilibrium, everyone (rich or poor) has this new opportunity and everyone faces the same price for renting out their WP. Thus, like a UBI, creating the proposed market in WPs can be expected to have broader appeal, and hence be more sustainable politically, than finely targeted transfers.

There are some important differences. The market for WPs will probably have a more pro-poor incidence than a UBI; specifically, it will bring both direct (first-order) gains to poor people in host countries who take up the option of renting out their WP—the aforementioned self-targeting mechanism—and indirect gains to others via the likely tightening in the low-wage labor market. UBI has been advocated as a means of addressing job-loss due to automation (as in, for example, Yang, 2018). But why would one give the transfer to everyone, including those who stay working? A market in work permits would directly help those who lose their job due to automation. Also, unlike a UBI, it is self-financing. This overcomes a widespread concern about UBI proposals that require higher domestic taxes or are only available as an option to existing welfare programs, thus reducing the net gains to poor people from the UBI. And the proposed market for WPs can attain a (domestically) self-financed guaranteed minimum labor earnings in a way that is self-targeted to poor people.

A long-standing social protection issue that the policy could address is home care for the elderly. The policy would open up a new option for financing such care. Governments who are already providing assistance for this purpose may well be willing to divert some of that towards a subsidy to citizens who apply to rent out their WP for this purpose. To help assure that this is in fact the purpose, the application may be filed jointly between the elderly person and the person (such as a family member) willing to forgo the WP in order to provide that care.

The policy shares some of the concerns about past social protection policies. It may discourage work. If the equilibrium price is very high then there will be concerns about so many people dropping out of the workforce in rich countries. Given that there can be many good reasons why they do not want to work, it is not clear how much we should be concerned about this. (A similar point has been made about UBI; see the discussion in Bregman, 2017.)

In low-wage economies, there will be first-order gains for people who cannot otherwise get a permit to work in a high-wage economy. Those gains will be greater for those with a potentially higher wage in the destination country. The scheme would probably not attract many low-skilled workers in low-wage economies, but nor would it matter much for the highly skilled

who can probably gain access anyway. Rather, introducing this new market seems more likely to attract middle-level skills to high-wage economies. The wage gains depend mainly on both their skills (determining realized wages in the host country) and foregone earnings (or other costs of migrating). Our expectation is that the gains will tend to be in the middle of the income distributions in the low-wage economies. This can be modified by a number of other factors with bearing on the distributional outcomes, including access to credit for purchasing the WPs and the incidence of remittances.

There may be concerns about brain drain from developing countries. A selection effect is evident in the fact that the new WPs come at a price. Note, however, that this is temporary migration. There will be remittances generated. And the returns to education in developing countries will almost certainly increase. The scheme will probably also reduce the widespread problem of the educated unemployed in developing countries that has been seen as stemming (in part at least) from queues generated by restrictions on international migration (Fan and Stark, 2007). (To the extent that the scheme draws heavily on the educated unemployed currently waiting for WPs in low-wage economies, this will imply lower foregone income and hence a higher equilibrium price.) Improvements in credit markets in developing countries (possibly with the help of external development assistance) could help broaden access to the new opportunities for migration. The host country could also allow migrants to pay off the WP through higher taxes (similarly to how some countries help students finance tertiary education).

We have discussed the policy as if it is implemented by only one host country. Multiple host countries need not face the same price in equilibrium given differences in their attractiveness to potential migrants, including differences in their tax rate on WPs. Putting those differences aside, if additional rich countries introduce this market (a higher n_h) then the equilibrium price will fall. Potential migrants in low-wage economies will benefit from greater competition among high-wage countries.

6.2 Other issues

There are other issues related to the design that we note briefly, though none seem to pose insurmountable challenges:

- An important design issue is whether eligibility should be confined to those currently in the workforce. Broader eligibility would allow welfare gains to those not in the

workforce. However, some restrictions could be considered. It would make sense to confine eligibility to those with legal and free access to the labor market, i.e., those of working age and not incarcerated. Confining eligibility to people who have previously been employed as wage-workers for some period may also be desirable behaviorally—to assure that the person is making a well-informed decision. It can also be supported from the perspective of reducing inequality as it would restrict the "idle rich" from renting out their unused WP. However, exceptions could reasonably be allowed for those who have only just reached the minimum working age. They could be allowed to rent out their WP for a designated period, such as to help finance schooling.

- One could also consider the option of allowing workers to rent out their WP for only part of each working week, retaining it for the rest of the week. This could clearly be an attractive option at some stages of the life-cycle, such as when a family has young school-age children. A full time position of a migrant would essentially be "funded" by contributions of several citizens who want to work only part time.
- Other restrictions on eligibility might be considered, possibly on a trial basis. Eligibility might be restricted to citizens in poor areas hit by economic shocks; for example, a town that has been hit by the collapse or departure of the main employer. Newly unemployed workers might then be given the option of renting out their WP for a period, to help finance migration and/or retraining.
- To obtain current employment, citizens will need to show that they have not rented out their WP. This should not be difficult. Even now, employers in the United States (for example) check work eligibility through the Social Security number. This can indicate that a person is not eligible to work because she rented out her WP.
- Citizens who have rented out their WP would also be able to buy it back before the end of the contracted period. One could add an insurance option whereby those who rent out their WP are guaranteed that they can buy it back before the end of the contracted period at a price no greater than the price they received initially (adjusted to be fixed per unit time). This could be made actuarially sound by a charge on the initial price.
- The demand need not be confined to foreigners, though they would be the bulk of it given how many people want to migrate internationally for work. Someone may have rented out their WP for two years (say) but decided after one year to rent it back. An important

design choice is whether domestic firms are allowed to buy WPs. If so, then regulations may be needed to assure that large firms do not distort the market.

- The purchaser could be allowed to sell back their WP (adjusted for the time used). This would provide an insurance value. The WP could also be given a positive termination value at the end of the period, which can only be cashed in on leaving the host country. This would provide an incentive for the migrant worker to not overstay the period.
- The sectoral/occupational composition of aggregate employment could well be affected. This could generate internal social conflicts and political resistance, although it should be noted that a market in work permits has an in-built (financial) compensation mechanism for those in occupations or sectors that experience declining domestic demand. These structural changes in the economy could be managed by creating occupational WPs, with separate market price and taxes. (For example, a lower tax rate can be applied to WPs for workers with skills in shortage.)
- The tax on WPs can cover the administrative costs (such as for creating the market) and any other external costs of migrants. Raising the tax rate will impact the likely skill profile of migrants, but (given the pass on through the equilibrium price of the WP) it will also alter the skill profile of those choosing to rent out their WP (in the opposite direction). Given that it retains the power to tax these transactions, the host government will not lose control over the number of people entering the country.
- There are other implementation issues that we have not discussed, including: How should the payments received by those renting out their WP be treated for tax purposes? Are the migrants fully eligible for existing welfare benefits in the host country? Should migrants be allowed to bring their families? Should the host country provide public services to them? Existing tax and migration policies in host countries will undoubtedly have something to say about these issues, which are shared with current policies.

7. Conclusions

It is widely agreed (at least among economists) that there are likely to be substantial efficiency and equity gains globally from freer international migration. As Clemens (2011) puts it, there are "trillion-dollar bills on the sidewalk." Yet freer international migration is not a very popular idea; indeed, some people are extremely hostile to it. As Dustmann and Preston (2019)

point out, there are political and economic challenges in how to find a feasible mechanism to capture the gains from international migration. Given that host countries have the power to restrict entry, any politically feasible mechanism will entail sharing those gains with host-country workers.

The policy we have studied here is an anonymous market exchange that provides working-age citizens with the option of renting out their asset of a work permit, which comes with citizenship, while someone else can buy a (taxable, time-bound) work permit. The currently missing market for work permits would no longer be missing. Creating such a market would help capture the economic gains from freer migration, while keeping the host-country government in control of the migration flows and (hence) domestic labor supply. A minimum income can be assured for workers in host countries, financed by tapping into the unexploited gains from international migration. Thus, this market would offer a new instrument for social protection, as well as an efficient, growth-promoting, means of managing immigration. The policy will clearly not pick up all those trillion-dollar bills on the sidewalk, but it will recover some of the loss.

There have been past proposals for selling passports or work permits, and some examples in practice. However, we have argued that the past proposals have been incomplete in an important respect: they have not eliminated the underlying market failure. Alongside the current excess demand for work permits, there is a potentially large supply side, namely all those workers in high-wage economies who would be happy to rent out their work permit as long as they are adequately compensated. There is much they could then do, including coping with economic and health shocks, financing education or training, homecare of loved ones, or simply taking a long vacation. The host country will benefit from adopting this policy in several ways: Relatively low productivity workers who currently have little option but to join the labor market would be replaced with high productivity workers, raising GDP and tax revenues. The former workers would have new opportunities, including raising their future returns in the labor market. The scheme can be designed to avoid changing the total number of jobs (or total hours worked) in the host country, though the skill composition of employment will change, probably lowering wage inequality. There would be important complementarities with social protection goals. Creating a market in WPs also avoids the need to discriminate against migrants by extra taxation or diminished rights, thus, avoiding the trade-off between migrant welfare and freer migration. Most importantly in our view, this new market would help relieve the public's concerns about

freer migration, by attenuating the negative externalities in the host countries seen to be generated by migrants and refugees. International migrants would surely become more popular in the host countries.

We have provided illustrative calculations for the US and Mexico. The results suggest that the missing market is large, with 18-36 million participants (depending on the chosen tax rate on WPs and other parameters). For example, with a 10% host-country tax on the WPs and a 10-20% "remittance tax" on the US wage earnings of the Mexican migrants, the equilibrium price of the WPs would be about $20,000 per year, and around 30 million workers would participate. The US tax revenue would be around $300 billion, and the gain in earnings would represent about 6% of US GDP. The poverty rate in the US would fall to under 10%, reflecting the pro-poor feature of the market's implicit targeting mechanism.

Our simulations for the US and Mexico are only intended to be broadly indicative of orders of magnitude under certain (explicit) assumptions about the key parameters, including the policy choice of the tax rate on WPs. The sensitivity of the precise empirical results to the extent of the frictions to international migration points to the need for further research on specific costs of migration. Although the stylized policy leaves aggregate employment unchanged, the likely compositional effects on labor supply point to general equilibrium implications. Further exploration of these and other issues discussed in this paper appears to be warranted, given the potential benefits of a market for work permits.

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Table 1: Policy simulations for a one-year work permit under various assumptions

	1 (No frictions)	2	3	4	5	6	7	8	9	10
Parameters										
Tax on purchase of Work Permit (%)	0	0	10	10	10	20	20	20	30	40
Extra cost of living in US (% of US earnings)	0	0	0	10	10	10	20	20	20	20
Remittance "tax" on net earnings in US (π as %)	0	10	10	10	20	20	20	30	30	30
Simulation results										
Price of Work Permit ($)	28,700	23,700	22,100	19,900	19,700	18,200	15,400	15,000	14,000	13,100
Average earnings of sellers ($)	15,800	12,800	12,400	10,300	10,300	9,900	8,400	8,400	7,400	7,000
Expected earnings of buyers in the US ($)	48,400	50,500	51,100	52,800	53,800	55,300	57,800	58,100	60,100	60,800
Number of sellers(buyers) (M)	47.3	36.2	34.7	31.6	27.7	26.4	22.1	22.0	19.0	18.1
Total earnings of migrants ($B)	2273	1823	1759	1552	1449	1366	1175	1119	1048	1024
Total earnings of migrants net of total earnings of natives as % of the US GDP	7.4	6.6	6.5	6.2	5.7	5.4	4.8	4.6	4.4	4.4
Tax revenue from migrants' earnings ($B)	443	362	352	315	295	283	247	233	222	218
Net gains for sellers ($B)	608	394	337	266	261	220	153	145	125	109
The US poverty rate (excluding migrants); base=12.3%	7.9	8.9	9.1	9.3	9.6	9.8	10.5	10.5	10.7	10.8

Table 2: Policy simulations under various assumptions for the inverse problem of setting the tax rate to attain minimum earnings of $14,500

	1 (No frictions)	2,3	4	5,6	7	8,9,10
Parameters						
Tax on purchase of Work Permit (%)	143	93	63	58	29	25
Extra cost of living in US (% of US earnings)	0	0	10	10	20	20
Remittance "tax" on net earnings in US (π)	0	10	10	20	20	30
Simulation results						
Price of Work Permit ($)	14,500	14,500	14,500	14,500	14,500	14,500
Average earnings of sellers ($)	7,500	7,500	7,500	7,500	7,500	7,500
Expected earnings of buyers in the US ($)	63,200	61,500	60,400	60,300	59,400	59,400
Number of sellers(buyers) (M)	19.3	19.3	19.3	19.3	19.3	19.3
Total earnings of migrants ($B)	1204	1143	1146	1134	1113	1073
Total earnings of migrants net of total earnings of natives as % of the US GDP	5.2	4.9	4.9	4.8	4.7	4.5
Tax revenue from migrants' earnings ($B)	270	251	248	245	237	226
Net gains for sellers ($B)	135	135	135	135	135	135
The US poverty rate (excluding migrants)	10.6	10.6	10.6	10.6	10.6	10.6

Figure 1: Graphical representation of the numerical solution for the market-clearing price of year-long work permits for selected scenarios

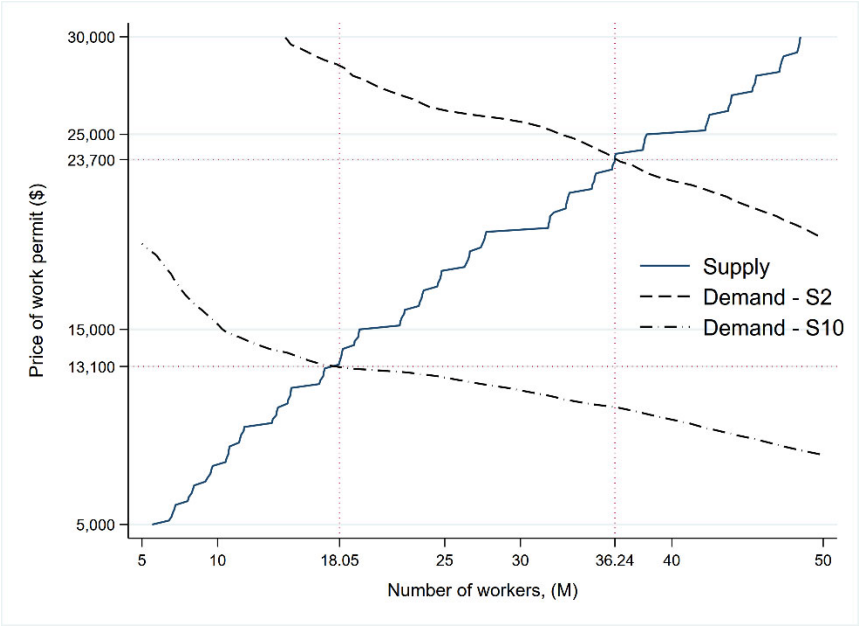
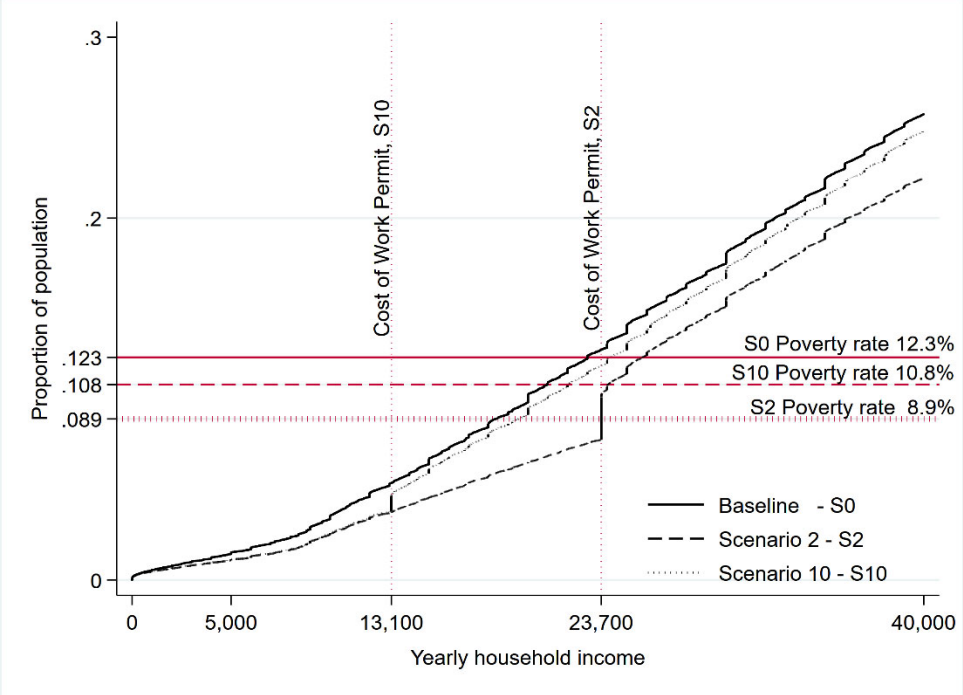


Figure 2: Simulated cumulative income distribution and poverty rates for selected scenarios



Appendix: Supplementary tables

Table A1: Tax rate on migrants' earnings in the US

Yearly Income	Tax rate
Less than $9,700	10%
$9,701 – $39,475	12%
$39,476 – $84,200	22%
$84,201 -- $160,725	24%
$160,726 -- $204,100	32%
$204,101 – $510,300	35%
More than $510,301	37%

Source: IRS (under "2018 Tax Rate Schedule.)"

Table A2: Log-earning regression estimated on the CPS 2018 sample of the US workers. Specification 1 includes occupational dummies while specification 2 excludes them

	Specification 1		Specification 2	
	Coeff.	*Std. Error*	Coeff.	*Std. Error*
Age	0.159	*0.007*	0.171	*0.007*
Age squared	-0.003	*0.000*	-0.003	*0.000*
Age cubed	0.000	*0.000*	0.000	*0.000*
Gender: male=1	0.227	*0.006*	0.259	*0.006*
Marital Status	*Reference category: Married*			
Widowed	-0.030	*0.023*	-0.052	*0.024*
Divorced	-0.054	*0.009*	-0.070	*0.009*
Separated	-0.124	*0.019*	-0.152	*0.019*
Never Married	-0.116	*0.007*	-0.138	*0.007*
Education	*Reference category: Preschool*			
Primary school	0.174	*0.072*	0.154	*0.074*
Secondary school	0.167	*0.071*	0.156	*0.073*
High school	0.345	*0.069*	0.368	*0.071*
Normal school	0.450	*0.070*	0.516	*0.071*
Technical career	0.464	*0.070*	0.565	*0.071*
Bachelor's degree	0.723	*0.070*	0.877	*0.071*
Master's degree	0.955	*0.070*	1.140	*0.071*
Doctorate	1.137	*0.072*	1.342	*0.073*
Race	*Reference category: White*			
Black	-0.111	*0.009*	-0.139	*0.009*
Hispanic	-0.061	*0.008*	-0.083	*0.009*
Asian	-0.008	*0.012*	0.010	*0.013*
Native American	-0.018	*0.033*	-0.044	*0.033*
Mixed	-0.069	*0.022*	-0.081	*0.022*
Citizen Status	*Reference category: Born in the US*			
Born in Pr/OA	-0.002	*0.035*	-0.019	*0.035*
Foreign born, US parents	0.003	*0.026*	-0.005	*0.027*
Foreign born, naturalized	-0.009	*0.011*	-0.024	*0.011*
Foreign born	-0.102	*0.011*	-0.132	*0.011*
Job classification	*Reference category: Private*			
Federal government	0.122	*0.017*	0.127	*0.016*
State government	-0.039	*0.013*	-0.102	*0.013*
Local government	0.005	*0.012*	-0.070	*0.011*
Self-employed, incorp.	0.155	*0.015*	0.196	*0.015*
Self_employed, no incorp.	-0.309	*0.012*	-0.313	*0.012*
Without pay	-1.231	*0.228*	-1.332	*0.233*
Type of employment	*Reference category: Full time*			
Part-time, full year	-0.759	*0.009*	-0.823	*0.009*
Full-time, part year	-0.584	*0.010*	-0.618	*0.010*
Part time, part year	-1.610	*0.012*	-1.682	*0.012*
Occupation	*Reference category: Management occupations*			
Business and financial	-0.082	*0.014*		
Computer and mathematical science	0.017	*0.016*		
Architecture and engineering	0.010	*0.019*		
Life, physical, and social science	-0.178	*0.027*		
Community and social service	-0.494	*0.021*		
Legal	0.030	*0.026*		
Education, training, and library	-0.409	*0.014*		
Arts, design, entertainment	-0.299	*0.020*		
Healthcare practitioner and technical	-0.017	*0.014*		
Healthcare support	-0.441	*0.019*		
Food preparation and serving	-0.209	*0.021*		
Building & grounds cleaning	-0.561	*0.015*		
Personal care and service	-0.577	*0.017*		
Sales and related	-0.564	*0.016*		

Office and administrative support	-0.356	*0.012*		
Farming, fishing, and forestry	-0.349	*0.011*		
Construction and extraction	-0.547	*0.033*		
Installation, maintenance, and repair	-0.255	*0.015*		
Construction and extraction	-0.304	*0.017*		
Production	-0.321	*0.014*		
Transportation and material moving	-0.379	*0.014*		
Constant term	***7.846***	***0.113***		
Adjusted R^2	0.519		0.491	
Number of observations	76,200		76,788	

Table A3: Policy simulations under various assumptions using Specification 2 of Table A2

	1 (No frictions)	2	3	4	5	6	7	8	9	10
Parameters										
Tax on purchase of Work Permit (%)	0	0	10	10	10	20	20	20	30	40
Extra cost of living in US (% of US earnings)	0	0	0	10	10	10	20	20	20	20
Remittance "tax" on net earnings in US (π)	0	10	10	10	20	20	20	30	30	30
Simulation results										
Price of Work Permit ($)	28,700	23,700	22,100	19,900	19,700	18,200	15,400	15,000	14,000	13,100
Average earnings of sellers ($)	15,800	12,800	12,400	10,300	10,300	9,900	8,400	8,400	7,400	7,000
Expected earnings of buyers in the US ($)	48,400	50,500	51,100	52,800	53,800	55,300	57,800	58,100	60,100	60,800
Number of sellers(buyers) (M)	47.3	36.2	34.7	31.6	27.7	26.4	22.1	22.0	19.0	18.1
Total earnings of migrants ($B)	2273	1823	1759	1552	1449	1366	1175	1119	1048	1024
Total earnings of migrants net of total earnings of natives as % of the US GDP	7.4	6.6	6.5	6.2	5.7	5.4	4.8	4.6	4.4	4.4
Tax revenue from migrants' earnings ($B)	443	362	352	315	295	283	247	233	222	218
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The US poverty rate (excluding migrants)	7.9	8.9	9.1	9.3	9.6	9.8	10.5	10.5	10.7	10.8