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Abstract

We examine the effects of anti-illegal migration and anti-migrant exploitation efforts on the people smuggling market where migrants face the risk of post-migration exploitation by their smugglers. We find that insufficiently resourced anti-illegal migration efforts tend to result in an adverse selection equilibrium where only exploitative smugglers are employed at a low fee even though migrants are willing to pay nonexploitative smugglers a high fee. We suggest that an improvement in border apprehension of smugglers and their clients and an increase in the penalty for smuggling may be preferable because these are likely to reduce smuggling. In contrast, improved inland apprehension of smuggled migrants may increase the incidence of migrant exploitation while failing to decrease smuggling. Better inland apprehension of smugglers and increased penalty for exploitation convert exploitative smugglers into nonexploitative ones and hence are effective in fighting against exploitation but do not reduce smuggling.

Keywords: illegal migration, people smuggling, migrant exploitation, human trafficking, adverse selection
JEL classifications: F22, J68, D82, L15, K42

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1 Introduction

This paper builds on Tamura's (2010) model of the migrant smuggling market where smugglers are heterogeneous in terms of their capacities to exploit smuggled migrant labor. Migrants lose control over the assets they carry with them—their bodies and labor—once the provision of smuggling services is implemented because they are required to obey smugglers in order to achieve a successful border crossing. Since there are no legally enforceable contracts between the providers and the consumers of the illicit services, the migrants cannot ensure that their smugglers will not take advantage of them. These illegal migrants are thus vulnerable to abuse by their smugglers. We relax the informational assumption in analyzing Tamura's (2010) model in order to shed further light on the relationship between the fight against people smuggling and the incidence of abuse of illegal migrants.[1]

There has been little theoretical analysis of the migrant smuggling market in economics so far, even though people smuggling and trafficking have become a major international concern.[2] (In this paper, let trafficking mean smuggling that involves exploitation of smuggled migrants.[3]) Friebel and Guriev (2006) examine the interaction between illegally migrating workers and smugglers. In their model, not all workers can pay for smuggling services up front. Accordingly, a worker may enter into a debt contract with a smuggler if migrating and must then pay back the debt through illegal work at the destination after a successful border crossing. They show that stricter border enforcement discourages both financially constrained and unconstrained workers from migrating illegally, whereas better detection of illegal migrants

[1]We thus provide a response to Väyrynen's criticism in Borjas and Crisp (2005: 146) about economic approaches to migrant smuggling, i.e. inadequate attention paid to its exploitative aspects.

[2]Econometric studies of these illegal activities are also scarce. Exceptions are Gathmann (2008) and Omar Mahmoud and Trebesch (2010).

[3]The terms, smuggling and trafficking, have been used interchangeably by some researchers and practioners but with clear distinction by others. A lack of consensus on the use of the terms complicates the analysis of these activities: see Salt and Hogarth in Laczko and Thompson (2000: 18-23). However, recent effort to create legal instruments to fight against human smuggling and trafficking has provided some distinction between these activities. In December 1998, the UN General Assembly established an ad hoc committee for the purpose of setting up its Convention against Transnational Organized Crime and supplementing protocols specific to human smuggling and trafficking. As a result, the Protocol against the Smuggling of Migrants (UN, 2000b) entered into force on January 28, 2004, while the Protocol to Prevent, Suppress and Punish Trafficking in Persons (UN, 2000a) did so earlier, on December 25, 2003. In this paper, we closely follow Articles 3(a) and 3(b) in these two protocols. Our working definitions are that a *smuggler* is an organization which provides illegal border crossing services, while a *trafficker* is an organization which also provides the same border crossing services but with exploitation of its clients after successful smuggling. By these definitions, traffickers form a subset of smugglers. In our analysis from the next section, we will call traffickers *exploitative smugglers*, and the other smugglers *nonexploitative smugglers*. Whether or not exploitation of migrants is involved is often taken as a distinguishing criterion between trafficking and smuggling, e.g. Kelly and Regan (2000: 3), Salt (2000: 33-34), and Interpol (www.interpol.int). We define *exploitation* as that of labor of a smuggled client, and we ignore, for the sake of economic analysis, elements of intimidation and violence that seem often involved in both trafficking and smuggling. These working definitions will become clear when we describe our analytical framework in Section 2.

working in the legitimate sector encourages the illegal entry of financially constrained workers, which biases the composition of illegal immigrants toward the poorer end. In their model, smugglers face the risk that migrants may default on their debt repayments, but migrants do not face the risk of exploitation by their smugglers.[4]

Dessy and Pallage (2006) argue that the risk of child trafficking may deter parents from sending their children to labor markets, which in turn suggests that efforts to reduce child trafficking increase the parental supply of child labor. They focus on household utility maximization with respect to the supply of child labor, and do not model traffickers explicitly. Dessy et al. (2005) analyze a general equilibrium model with producers who choose between legitimate work and child trafficking. They emphasize the importance of demand for trafficked children in influencing the incidence of child trafficking. These two studies address the issue of abuse, but children are treated as commodities and not as decision makers.

There has not been a study of interactions between smugglers and potential migrants who face the risk of post-migration exploitation except Tamura (2010). In his model, workers wishing to migrate are randomly matched with smugglers. Each smuggler then proposes a fee for an illegal border crossing. The matched worker may or may not accept the proposal. An acceptance requires the worker to agree to submit to the smuggler in order to achieve a successful border crossing. This gives the smuggler a chance to use the client's labor unfairly at the destination. However, smugglers differ in their capacity to exploit smuggled labor, and hence not all smugglers utilize the opportunity to exploit. Assuming that it is ideal to eliminate the incidence of both migrant smuggling and migrant exploitation, his analysis under complete and perfect information suggests that destination countries with limited resources may prefer to improve the apprehension of smugglers and their clients at the border rather than inland, although either one of these anti-smuggling measures would reduce the incidence of migrant exploitation. The reason is that improved border apprehension decreases the incidence of smuggling attempts by causing existing exploitative smugglers to become unemployable in the market. Improved inland apprehension, on the other hand, either maintains or even increases people smuggling by inducing exploitative and unemployed smugglers to take up nonexploitative smuggling.

[4]Guzman et al. (2008) model migrant smuggling explicitly, but their analysis in a two-country dynamic general equilibrium framework treats smugglers as suppliers of cost-saving border crossing services, and migrants do not face the risk of exploitation by their smugglers. It belongs to the theoretical macroeconomic literature on illegal immigration and border enforcement that began with Ethier (1986), Djajić (1987), and Bond and Chen (1987), and does not provide microeconomic analysis of interactions between migrants and smugglers.

In this paper, we relax Tamura's (2010) assumption of complete and perfect information and examine the case where smugglers' capacities to exploit smuggled migrant labor are private information. This introduction of asymmetric information is justifiable because surveys of victims of human trafficking indicate that some potential users of smugglers face uncertainty regarding the risk of post-migration exploitation by their smugglers. Our analysis suggests that the market equilibrium may be characterized by adverse selection, though not necessarily. Adverse selection in this market's context is the situation where only exploitative smugglers are hired, even though potential migrants are willing to pay a higher-than-market fee to smugglers who do not exploit migrants and nonexploitative smugglers are willing to smuggle at that higher fee. We find that when committable resources are limited, anti-illegal migration efforts tend to result in an adverse selection equilibrium where all smuggled migrants are exploited. Although this may be a concern in terms of the welfare of smuggled people, a move to an adverse selection equilibrium implies a fall in the number of smuggling attempts and hence might be desired by destination countries. On the other hand, anti-exploitation efforts tend to result in a full employment equilibrium, although they do discourage post-smuggling exploitation—they convert exploitative smugglers into nonexploitative ones but do not make smugglers unemployable.

More importantly, our results suggest that there might be two types of unintended consequences when fighting against people smuggling and trafficking. First, when committable resources are limited, an insufficient improvement in one of the anti-illegal migration measures—namely, inland apprehension of smuggled migrants—may increase the incidence of migrant exploitation without reducing the number of smuggling attempts. In other words, a half-hearted effort to improve inland apprehension of smuggled migrants is not only ineffective in terms of reducing migrant smuggling but also harmful to smuggled migrants. Second, even if an improvement in inland apprehension of smuggled migrants is sufficient to move the equilibrium to one characterized by adverse selection and hence reduce smuggling per se, its impact might be undermined by a concurrent improvement in inland apprehension of smugglers or a simultaneous increase in the penalty for exploitation, or both. This possibility implies that the status quo might be maintained due to certain combinations of these policy measures in place. Accordingly, we suggest that fighting human smuggling and trafficking inland is inferior to doing so at the border. This in turn suggests that investing in border apprehension is recommended not only in the case of complete and perfect information, as Tamura (2010) has suggested, but also in the case where the exploitation capacities of smugglers are not observable to potential migrants.

In Section 2, we present the model. In Section 3, we discuss policy implications. Section 4 concludes. We do not present stylized facts about people smuggling and trafficking in this paper due to limited space, and refer the reader to the bibliographies in Omar Mahmoud and Trebesch (2010) and Tamura (2010) instead.

2 Model

We now set up a model of the migrant smuggling market where smugglers are the sellers, and workers the buyers. There are two countries: the home country and the destination country. All workers legally reside in the home country. However, economic prospects for the workers are better in the destination country than in the home country in the sense that the exogenously given earnings per unit of labor are higher in the former than in the latter. Therefore, they may attempt to migrate to the destination country. We assume that a worker cannot migrate except by hiring a smuggler.[5] A *smuggler* in this model is a smuggling organization, rather than one person, operating across the two countries: see footnote 3.

For analytical simplicity, we assume that each smuggler has an identical capacity to smuggle at most one worker. However, smugglers differ in the capacity to exploit smuggled migrant labor in the destination country. Workers are identical. All workers and smugglers are risk-neutral, and there are at least as many workers as smugglers in the market. For convenience, we normalize the measure of smugglers to 1.

The order of events is as follows:

1. Each smuggler is randomly matched with a worker in the home country.

2. In each pair, the smuggler proposes to the worker a fee for a border crossing.

3. The worker either hires or does not hire the smuggler at the proposed fee.

   3A. If the worker does not hire the smuggler, the match breaks.

[5]Our analysis is thus limited to users of smugglers: it does not allow a worker to choose from different migration methods. Accordingly, our analysis cannot fully explain the link between a policy change and a change in the number of users of smugglers, and policymakers should bear this in mind in interpreting our results. An extension of the analysis that gives workers a choice of migration methods is necessary for investigating the full impact of a policy change on the smuggling market, and is left for future research.

3B. If the worker hires the smuggler, the latter attempts to smuggle the former. The worker is required to submit to the smuggler during smuggling.

3Bi. If the border crossing is unsuccessful, the worker pays nothing, and the match breaks.

3Bii. If the border crossing is successful, the worker pays the proposed fee. After receiving the fee, the smuggler may continue to restrict the freedom of the worker for exploitation.

3Bii(a) If not exploited, the worker becomes free to sell all labor.

3Bii(b) If exploited, the worker can sell the labor net of exploitation when released.

Thus, matched smugglers and workers play an ultimatum game in our model. Note the assumption that a worker pays for smuggling services only if the border crossing is successful, which eliminates the possibility that a hired smuggler defaults on the provision of smuggling services after receiving a fee payment from the migrant.[6] However, this payment method does not prevent a smuggler from exploiting the smuggled customer at the post-payment stage if exploitation is profitable.

In order to derive policy implications later on, we introduce six destination-country policy parameters to the model. Let $p > 0$ denote the fixed penalty for smuggling, and $q > 0$ the constant marginal penalty for exploitation in pecuniary terms.[7] Let $\beta_i \in (0, 1)$ denote the given probability of border apprehension of player $i \in \{M, S\}$ where M labels migrant and S smuggler. Let $\lambda_i \in (0, 1)$ denote that of inland apprehension. We distinguish between β and λ, for they usually differ from each other and $\lambda_i < \beta_i$ for many destination countries.[8] It also becomes useful to distinguish between the probabilities for migrants and smugglers when we conduct comparative statics. For analytical simplicity, we assume that the apprehension probabilities are independent of each other.

[6]This is not the only payment method available in this market: see Tamura (2010: Subsection 2.3). In this paper, we limit our analysis to a one-shot game. Without repeated interactions among players, our model suggests that, if a fee is paid in advance, smugglers who cannot generate a positive expected profit from post-smuggling exploitation will default on the provision of border crossing services because the defaulting will not incur any cost. Realizing this, workers never hire nonexploitative smugglers. On the other hand, the other smugglers may smuggle if the expected profit from exploitative smuggling exceeds the fee. In reality, both exploitative and nonexploitative smugglers coexist in the market. In order to inform policymakers better, we need less restrictive modeling than ours to allow for repeated interactions, as well as a choice of payment methods. This is left for future work.

[7]See USDS (2009: 57-307) for various punishments in different countries.

[8]See for instance Miller in Kyle and Koslowski (2001: Chapter 12) and Hanson (2006: Subsection 4.1).

2.1 Smugglers

Smugglers exogenously differ in the capacity to exploit their clients after smuggling into the destination country.[9] We define *exploitation* as the use of labor without remuneration. Let $k \in [0,1]$ denote the given capacity of a smuggler to exploit the migrated client's labor net of exploitation costs. Let $\Phi(k)$ be a smooth, nondegenerate distribution function and $\phi(k) > 0$ $\forall\, k \in [0,1]$ be the corresponding density function. Each worker is endowed with one unit of labor that can generate $y > 0$ in the destination country. Therefore, if exploitation takes place, the smuggler appropriates ky while the client's gain is reduced from y to $(1-k)\,y$.[10]

Suppose that a smuggling operation resulted in a successful border crossing. The migrant then paid a smuggling fee, f. The type-k smuggler's expected profit from the post-smuggling exploitation is a function of the smuggling fee given the exploitation capacity, i.e.

$$\tilde{\pi}(f|k) = (1-\lambda_S)(1-\lambda_M)\,ky - \lambda_S\left[f + p + (1-\lambda_M)\,kq\right]. \tag{1}$$

The second term assumes that the fee payment by the client is seized and forfeited in the case of apprehension. This is equivalent to assuming that the total penalty is increasing in the fee received.[11] Since exploitation is not possible if the migrant is caught, the penalty for exploitation is discounted by λ_M.

We assume that the type-k smuggler exploits the client if $\tilde{\pi}(f|k) > 0$. Let each smuggler's exploitation decision be indicated by the following function:

$$e(f|k) = \begin{cases} 1 & \text{if } \tilde{\pi}(f|k) > 0, \\ 0 & \text{otherwise.} \end{cases} \tag{2}$$

[9] See "Human Trafficking in the News" at the UN Global Initiative to Fight Human Trafficking's website (www.ungift.org) for examples of exploitative incidents.

[10] The model is amenable to the situation where each smuggler offers a package of border crossing plus employment at the destination. In this case, y is the market wage, and $(1-k)\,y$ is the wage that a type-k smuggler is willing to pay to the client. Therefore, k is reinterpreted as the given unwillingness to pay a smuggled migrant.

[11] This assumption endogenizes the exploitation decision making of each smuggler to the exploitation expected by the matched worker. Without f in Function (1), the exploitation decision of each smuggler is exogenously fixed by capacity k. Removing f from Function (1) does not change the subsequent equilibrium results qualitatively, although it makes a slight difference quantitatively. In particular, at a given f, more smugglers are likely to be exploitative without than with f in Function (1) because f affects the expected profit from exploitation negatively in the latter case. Our setting is more general than assuming the absence of f in Function (1) because the case without f in Function (1) is a subset of what we analyze here.

The exploitation decision condition, $\tilde{\pi}(f|k) > 0$, can be rewritten as

$$f < \tilde{f}(k) = (1-\lambda_M)\left(\frac{1-\lambda_S}{\lambda_S}y - q\right)k - p \tag{3}$$

where $\tilde{f}(k)$ is the type-k smuggler's exploitation decision threshold fee. If f is not lower than this threshold, the type-k smuggler does not exploit the client after a successful border crossing because exploitation is not profitable. If $y > q\lambda_S/(1-\lambda_S)$ holds, smugglers with higher exploitation capacities are more likely to exploit their clients for a given fee. The exploitation decision condition can also be rewritten as

$$k > \tilde{k}(f) = \frac{f+p}{(1-\lambda_M)\left(\frac{1-\lambda_S}{\lambda_S}y - q\right)} \tag{4}$$

where $\tilde{k}(f)$ is the exploitation decision threshold capacity at a given fee. Smugglers with $k \in [0, \tilde{k}(f)]$ can commit to nonexploitative smuggling at the f, while the others with $k \in (\tilde{k}(f), 1]$ cannot.

Since the success of a border crossing is uncertain at the pre-smuggling stage, the type-k smuggler's expected profit from smuggling is

$$\hat{\pi}(f|k) = (1-\beta_S)(1-\beta_M)[f + \tilde{\pi}(f|k)e(f|k)] - \beta_S p - c \tag{5}$$

where $c > 0$ denotes the sum of smuggling costs such as expenditures on transportation, hiding places, fraudulent documents and bribes. The first term implies that a smuggler does not face the risk of inland apprehension if not going to exploit the client.[12] It also assumes that a smuggler must deliver the client to the destination country in order to receive a fee.[13]

Lemma 1 *Any smuggler's expected profit from smuggling is increasing in the fee.*

Proof. Inequality (3) suggests $d\hat{\pi}(f|k)/df = (1-\beta_S)(1-\beta_M)(1-\lambda_S) > 0$ for $f < \tilde{f}(k)$. For $f \geq \tilde{f}(k)$, $d\hat{\pi}(f|k)/df = (1-\beta_S)(1-\beta_M) > 0$. □

This feature of the model is important. That is, Functions (1), (2), and (5) suggest that a

[12]Commonly, apprehended illegal workers are not questioned for the purpose of tracing the smugglers who brought them in.

[13]See footnote 6. Incidentally, the second term assumes that when a smuggler is apprehended at the border, sufficient evidence will be available to penalize the smuggler even if the client is not caught. If the apprehension of the migrant is necessary to charge the penalty, the second term should be multiplied by β_M.

type-k smuggler always prefers nonexploitative smuggling at an $f \geq \tilde{f}(k)$ to exploitative smuggling at any $f < \tilde{f}(k)$. The two derivatives in the proof suggest that the marginal benefit of the fee is lower for exploitative smugglers than for nonexploitative smugglers, although it is positive for both. This is because a smuggler risks a loss of the fee by prolonging the relationship with the client through exploitation: see Function (1).

Let $\bar{\pi} > 0$ denote the alternative profit available to any smuggler. We assume that the type-k smuggler requires $\hat{\pi}(f|k) > \bar{\pi}$ to smuggle a worker. If a smuggler decides not to exploit the client, i.e. $\tilde{\pi}(f|k) \leq 0$, then the requirement can be rewritten as

$$f > \bar{f} \equiv \frac{\beta_S p + c + \bar{\pi}}{(1-\beta_S)(1-\beta_M)}. \tag{6}$$

Note that the threshold fee, $\bar{f}$, is *any* smuggler's reservation value of nonexploitative smuggling because it is independent of the capacity type. If f is not greater than that, no smuggler makes a positive expected profit from nonexploitative smuggling.

If a smuggler exploits the client after successful smuggling, i.e. $\tilde{\pi}(f|k) > 0$, then the requirement, $\hat{\pi}(f|k) > \bar{\pi}$, becomes

$$f > \hat{f}(k) = \frac{\bar{f} + \lambda_S p}{1-\lambda_S} - (1-\lambda_M)\left(y - \frac{\lambda_S}{1-\lambda_S} q\right) k \tag{7}$$

where $\hat{f}(k)$ is the type-k smuggler's reservation value of exploitative smuggling. If $y > q\lambda_S/(1-\lambda_S)$ holds, the higher the exploitation capacity a smuggler has, the lower the reservation value of the exploitative service. Intuitively, for smugglers for whom $\tilde{\pi}(f|k) > 0$ holds, a high capacity is associated with a high expected gain from exploitation in the post-smuggling period, which enables an exploiting smuggler with a high k to operate at a low fee. Inequality (7) can be rewritten as

$$k > \hat{k}(f) = \frac{f + p - \frac{f-\bar{f}}{\lambda_S}}{(1-\lambda_M)\left(\frac{1-\lambda_S}{\lambda_S} y - q\right)}, \tag{8}$$

which suggests that smugglers with $k \in (\hat{k}(f), 1]$ make a positive expected profit from exploitative smuggling at a given fee if hired. Note that Functions (4) and (8) together imply

$$\tilde{k}(f) \gtreqless \hat{k}(f) \Leftrightarrow f \gtreqless \bar{f}. \tag{9}$$

Lemma 2 *Suppose* $\tilde{f}(1) > \hat{f}(1)$.

(i) *Then,* $\bar{f} \in (\hat{f}(1), \tilde{f}(1))$.

(ii) *There exists a unique* $k \in (0,1)$ *that satisfies* $\tilde{f}(k) = \hat{f}(k)$. *Denoting it by* $\bar{k}$, *we have* $\tilde{f}(\bar{k}) = \hat{f}(\bar{k}) = \bar{f}$.

Proof. (i) Inequalities (3) and (7) imply $\tilde{f}(1) > \hat{f}(1) \Rightarrow \tilde{f}(1) > \bar{f} \Rightarrow \bar{f} > \hat{f}(1)$. (ii) $d\tilde{f}(k)/dk > 0$ and $d\hat{f}(k)/dk < 0$, and $\tilde{f}(0) < 0$ and $\hat{f}(0) > 0$. $\square$

Lemma 2(i) simply states that if $\tilde{f}(1) > \hat{f}(1)$ holds, any smuggler's reservation value of nonexploitative smuggling is in between $\hat{f}(1)$ and $\tilde{f}(1)$. Note that $\tilde{f}(1) > \hat{f}(1)$ is possible only if $y > q\lambda_S/(1-\lambda_S)$,[14] and Inequalities (3) and (7) imply that $\tilde{f}(1)$ and $\hat{f}(1)$ are the maximum of $\tilde{f}(k)$ and the minimum of $\hat{f}(k)$, respectively. Lemma 2(ii) states that if $\tilde{f}(1) > \hat{f}(1)$, then, as k decreases from 1, both $\tilde{f}(k)$ and $\hat{f}(k)$ approach $\bar{f} \in (\hat{f}(1), \tilde{f}(1))$, and they meet at $\bar{f}$ when $k = \bar{k} \in (0,1)$. Since $\tilde{f}(k) \leq \hat{f}(k)\ \forall\ k \in [0,\bar{k}]$, there is no fee which lets smugglers with $k \in [0,\bar{k}]$ benefit from exploitation, as Inequalities (3) and (7) suggest.

2.2 Workers

Each worker is endowed with one unit of labor which is supplied inelastically in either the home or the destination country and generates $y > 0$ in the latter.[15] Let us normalize the alternative income, i.e. the earnings in the home country, to zero. If apprehended, the worker is sent back to the home country without paying a penalty for illegal migration.[16] If apprehension takes place at the border, the worker need not pay a smuggling fee, as Function (5) indicates.

The exploitation capacity of each smuggler is private information, and potential migrants cannot observe the k of any specific smuggler. The expected utility of a successfully smuggled worker at the post-payment stage is

$$\tilde{u}(f) = [1 - (1-\lambda_S)\kappa(f)](1-\lambda_M)y \tag{10}$$

[14] This inequality implies that returns to migrant labor in the destination country are sufficiently high in relation to the penalty for exploitation and the probability of inland apprehension of smugglers.

[15] We thus ignore the case where a worker supplies a fraction of the labor endowment in the home country and the remainder in the destination country. We also ignore the possibility of smuggled migrants being unemployed in the destination country because there appears to be high demand for illegal migrants. See OECD (2000: Chapter 3) for an overview.

[16] This assumption may not be reasonable in some cases. See Tamura (2010: footnote 33).

where $\kappa(f)$ denotes the expected exploitation when a fee is proposed. Since exploitation reduces the worker's share of y, $\tilde{u}(f)$ is increasing in λ_S.

At the pre-migration stage, a worker's expected utility from hiring a smuggler is

$$\hat{u}(f) = (1 - \beta_S)(1 - \beta_M)[\tilde{u}(f) - f] \tag{11}$$

which assumes that the smuggling fee is paid upon a successful border crossing.[17] We suppose that workers are not wealth-constrained in financing clandestine migration.[18]

We assume that a worker hires the matched smuggler if $\hat{u}(f) \geq 0$ or equivalently

$$f \leq \tilde{u}(f). \tag{12}$$

Thus, $\tilde{u}(f)$ is every worker's reservation value of smuggling services.[19]

2.3 Equilibrium

We now characterize the perfect Bayesian equilibrium of our model. Let $f^\circ \equiv (1 - \lambda_M)\, y$, the maximum fee which every worker is willing to pay for nonexploitative smuggling, as Condition (12) suggests. Accordingly, $\lambda_S f^\circ$ is the maximum fee which every worker is willing to pay for the most exploitative smuggling. Tamura (2010) analyzes the model without asymmetric information and characterizes the subgame perfect Nash equilibrium under the assumption that both $\tilde{f}(1) > f^\circ$ and $\lambda_S f^\circ > \hat{f}(1)$ hold. For ease of comparison, we also assume that these two inequalities initially hold. The first inequality means that, as implied by Inequality (3), f° is not sufficiently large to incentivize the type-1 smuggler to give up post-smuggling exploitation, which in turn suggests that the type-1 smuggler will always exploit the client if hired. The second inequality means that, as implied by Inequality (7), $\lambda_S f^\circ$ is sufficiently large for the type-1 smuggler to supply the most exploitative smuggling, which in turn suggests that the type-1 smuggler is in fact hired unless the expected exploitation unreasonably exceeds one. As stated in Tamura (2010: Lemmas 3 and 4), the second inequality also implies $f^\circ > \bar{f}$, i.e. the worker's reservation value of nonexploitative smuggling exceeds the smuggler's. Finally,

[17] See footnote 6.

[18] A financially constrained person does not necessarily enter into a debt contract with a smuggler to finance illegal migration if there is an alternative source of credit such as family members' credit. See Genicot and Senesky (2004: Tables 4 and 5) for some empirical evidence.

[19] This is the highest price which every worker is willing to pay for the service. Recall that a smuggler's reservation value is the price at and below which the smuggler does not make a positive expected profit: see Inequalities (6) and (7).

Inequalities (3), (4), (7), (8), and Lemma 2 imply that both $\tilde{k}(f)$ and $\hat{k}(f)$ are less than one for $f \in (\hat{f}(1), \tilde{f}(1))$ when $\tilde{f}(1) > f^{\circ}$ and $\lambda_S f^{\circ} > \hat{f}(1)$ hold.

We assume that, prior to listening to a fee proposal, each matched worker has a belief about the type of the matched smuggler according to the distribution of smugglers across different capacities.[20] That is, the prior belief that the probability of the matched smuggler being of type k is simply $\phi(k) \in (0,1)$. When making a decision, each matched worker knows the fee proposal by the matched smuggler only and does not know the fee proposals in the other matches. Once the matched smuggler proposes a fee, the belief is updated to $\mu(k|f) \in [0,1]$.

We assume that workers believe that any particular f can be proposed by all smugglers who can make a positive expected profit if workers accept it. This assumption is reasonable because, as Lemma 1 suggests, the expected profit of every smuggler is strictly increasing in the fee. In other words, workers are aware that smugglers have an incentive to masquerade as less exploitative than they actually are in order to receive a fee higher than what workers would be willing to pay if the exploitation capacity is not private information.

Accordingly, if the proposed fee is greater than $\bar{f}$, we have

$$\mu\left(k|f > \bar{f}\right) = \phi(k)\ \forall\, k \in [0,1] \tag{13}$$

because all smugglers can make a positive expected profit at any $f > \bar{f}$. Inequality (6) suggests that all smugglers can make a positive expected profit from nonexploitative smuggling at such a fee. Inequality (4) suggests that all smugglers with $k \leq \tilde{k}(f)$ can commit to nonexploitative smuggling at any $f > \bar{f}$. By Inequality (8) and Relation (9), all smugglers with $k > \tilde{k}(f)$ can make a positive expected profit from exploitative smuggling and is unable to commit to nonexploitative smuggling at any $f \in (\bar{f}, \tilde{f}(k))$.

If the proposed fee is greater than $\hat{f}(1)$ but does not exceed $\bar{f}$, Inequality (6) implies that no smuggler can make a positive expected profit from nonexploitative smuggling. Inequalities (4) and (8) and Relation (9) suggest that smugglers with $k \in (\tilde{k}(f), \hat{k}(f)]$ cannot make a positive expected profit from exploitative smuggling, either. However, smugglers with $k > \hat{k}(f)$ can make a positive expected profit from exploitative smuggling. Hence workers believe that an

[20] This assumption may not be overly unrealistic if, for example, workers are aware of human trafficking incidents due to rumors in their communities and the media.

$f \in (\hat{f}(1), \bar{f}]$ is proposed by smugglers with $k > \hat{k}(f)$ only, i.e.

$$\mu(k|f \in (\hat{f}(1), \bar{f}]) = \begin{cases} 0 & \text{for } k \in [0, \hat{k}(f)], \\ \frac{\phi(k)}{1-\int_0^{\hat{k}(f)} \phi(k)dk} & \text{for } k \in (\hat{k}(f), 1]. \end{cases} \tag{14}$$

Finally, if the proposed fee does not exceed $\hat{f}(1)$, then no smuggler can make a positive expected profit from either exploitative or nonexploitative smuggling. Therefore,

$$\mu(k|f \leq \hat{f}(1)) = 0 \; \forall \, k \in [0, 1]. \tag{15}$$

The expected exploitation at a given fee is

$$\kappa(f) = \int_0^1 \mu(k|f) \, ke(f|k)dk. \tag{16}$$

Lemma 3 *Suppose $\tilde{f}(1) > f^{\circ}$ and $\lambda_S f^{\circ} > \hat{f}(1)$. The expected exploitation is then decreasing in f over $(\hat{f}(1), \tilde{f}(1))$ and is continuous except at $\bar{f}$.*

Proof. The expected exploitation for $f > \bar{f}$ is

$$\kappa(f|f > \bar{f}) = \int_0^1 \phi(k) \, kdk - \int_0^{\tilde{k}(f)} \phi(k) \, kdk. \tag{17}$$

Since Function (4) implies $d\tilde{k}(f)/df > 0$, we have $d\kappa(f|f \in (\bar{f}, \tilde{f}(1)))/df < 0$. The expected exploitation for $f \in (\hat{f}(1), \bar{f}]$ is

$$\kappa(f|f \in (\hat{f}(1), \bar{f}]) = \frac{\int_0^1 \phi(k) \, kdk - \int_0^{\hat{k}(f)} \phi(k) \, kdk}{1 - \Phi(\hat{k}(f))}. \tag{18}$$

Function (8) implies $d\hat{k}(f)/df < 0$, and the denominator in Expression (18) increases more than the numerator as $\hat{k}(f)$ decreases because $k \in [0, 1]$. Therefore, $d\kappa(f|f \in (\hat{f}(1), \bar{f}])/df < 0$. The discontinuity at $\bar{f}$ is due to the discrete change in $\mu(k|f)$ for $k \leq \tilde{k}(f)$ at $\bar{f}$, i.e. $\mu(k|f > \bar{f}) = \phi(k) > 0$ but $\mu(k|\bar{f}) = 0 \; \forall \, k \in [0, \tilde{k}(\bar{f})]$ where $\tilde{k}(\bar{f}) = \hat{k}(\bar{f})$. □

Accordingly, Function (10) suggests that the expected post-migration payoff to each worker is increasing in the fee over $(\hat{f}(1), \tilde{f}(1))$. Note that $\kappa(f|f \geq \tilde{f}(1)) = 0$ because all smugglers can commit to nonexploitative smuggling at an $f \geq \tilde{f}(1)$, i.e. by Lemma 1, $e(f|k) = 0 \; \forall \; k \in [0,1]$ if $f \geq \tilde{f}(1)$.

Since Condition (12) suggests that workers accept any fee which ensures them a nonnegative expected utility, Lemma 1 suggests that every smuggler will propose

$$f = [1 - (1 - \lambda_S)\,\kappa(f)]f^{\circ} \tag{19}$$

if a positive expected profit is guaranteed by this fee. If this fee causes a nonpositive expected profit, the smuggler will not propose it but will propose any fee at which the expected profit is positive if hired. Such a fee is too high for the worker to accept, and allows the proposing smuggler to avoid supplying nonprofitmaking smuggling.

At this point, the reader might question the reasonableness of the worker's belief. Why do workers believe that an f can be proposed by all smugglers who can make a positive expected profit at the fee when the f in question is greater than $\tilde{u}(f)$? Shouldn't workers anticipate that smugglers know such a fee is rejected? Therefore, shouldn't workers realize that the smugglers making such a proposal are trying to avoid being hired? Shouldn't workers then become aware that the smugglers who can make a positive expected profit at $\tilde{u}(f)$ do not propose any fee higher than that because they desire to be hired? In other words, shouldn't workers regard a fee higher than $\tilde{u}(f)$ as a signal that the proposing smuggler is the one who is adversely affected in the market and hence deserves the high fee being proposed?

Suppose that workers do know that the smugglers who can make a positive expected profit at $\tilde{u}(f)$ do not propose a fee higher than that. Suppose that they also know that the smugglers who cannot make a positive expected profit at $\tilde{u}(f)$ will propose a fee higher than that in order to avoid being hired. However, if workers regard the high fee as a signal for less exploitative smuggling which deserves the high fee and will accept it, the smugglers who can make a positive expected profit at $\tilde{u}(f)$ will also propose the high fee, as Lemma 1 suggests. Thus, the high fee is not a credible signal for less exploitative smuggling. Therefore, it is the worker's best interest to believe that an f can be proposed by all smugglers who can make a positive expected profit if workers accept it even if the f in question is greater than $\tilde{u}(f)$.

Lemma 4 *Suppose both $\tilde{f}(1) > f^{\circ}$ and $\lambda_S f^{\circ} > \hat{f}(1)$. Then, there exists at least one $f \in [\lambda_S f^{\circ}, f^{\circ})$ which satisfies Equation* (19) *if either*

(i) $\tilde{u}(\bar{f}+\varepsilon) \geq \bar{f}+\varepsilon$ *with an arbitrarily small* $\varepsilon > 0$,

(ii) $\tilde{u}(\lambda_S f^\circ) > \lambda_S f^\circ$ *and* $\tilde{u}(\bar{f}) \leq \bar{f}$, *or*

(iii) $\tilde{u}(\lambda_S f^\circ) = \lambda_S f^\circ$.

Proof. First, since $\kappa(f) \in [0,1]$, Equation (19) does not hold for any $f \notin [\lambda_S f^\circ, f^\circ]$. Second, $\tilde{f}(1) > f^\circ$ and $\lambda_S f^\circ > \hat{f}(1)$ imply $\kappa(f^\circ) > 0$, i.e. there always is at least one exploitative smuggler who can make a positive expected profit at f° by assumption: see Tamura (2010: Lemma 3). Hence $\tilde{u}(f^\circ) < f^\circ$. Third, from Lemma 3, we know that $\tilde{u}(f)$ is increasing in $f \in [\lambda_S f^\circ, f^\circ]$ and continuous except at $\bar{f}$. (i) The weak inequality ensures that at least one $\tilde{u}(f) = f$ exists over $(\bar{f}, f^\circ)$. (ii) The gap between $\lambda_S f^\circ$ and $\hat{f}(1)$ is large enough to allow some smugglers with $k < 1$ to make a positive expected profit from exploitative smuggling at $\lambda_S f^\circ$, i.e. $\lambda_S f^\circ > \hat{f}(k)$ for these type-$k < 1$ smugglers. In such a case, $\tilde{u}(\lambda_S f^\circ) > \lambda_S f^\circ$. Hence $\tilde{u}(\bar{f}) \leq \bar{f}$ ensures that at least one $\tilde{u}(f) = f$ exists over $(\lambda_S f^\circ, \bar{f}]$. (iii) The gap between $\lambda_S f^\circ$ and $\hat{f}(1)$ is so small that any smuggler other than the type-1 cannot make a positive expected profit from exploitative smuggling at $\lambda_S f^\circ$. □

The conditions (i) and (ii) may hold simultaneously. In such a case, there are at least two fees which meet Equation (19) over $(\lambda_S f^\circ, f^\circ)$. The conditions (i) and (iii) may also hold simultaneously. However, it is obvious that the conditions (ii) and (iii) cannot hold simultaneously.

Note that the conditions in Lemma 4 are sufficient but not necessary for the existence of an $f \in [\lambda_S f^\circ, f^\circ)$ which satisfies Equation (19). For example, even if $\tilde{u}(\bar{f}+\varepsilon) < \bar{f}+\varepsilon$, there may exist some $f \in (\bar{f}+\varepsilon, f^\circ)$ at which Equation (19) is met, depending on $\Phi(k)$. This can happen if many smugglers switch from exploitative to nonexploitative smuggling as soon as f is gradually increased from $\bar{f}+\varepsilon$, and the number of switching smugglers becomes very small soon afterwards. In such a situation, $\tilde{u}(f)$ cuts the 45-degree line twice over $(\bar{f}+\varepsilon, f^\circ)$ as f increases in the $(f, \tilde{u}(f))$ space: the first from below, and the second from above.[21]

Proposition 1 *Suppose both* $\tilde{f}(1) > f^\circ$ *and* $\lambda_S f^\circ > \hat{f}(1)$.

(i) *If at least one* $\tilde{u}(f) = f \in (\bar{f}, f^\circ)$ *exists, then we have a unique pooling equilibrium where all*

[21]See Wilson (1980), for instance.

smugglers propose

$$f^\star \equiv \max\{f : f = \tilde{u}(f) \in (\bar{f}, f^\circ)\} \tag{20}$$

and are hired. Smugglers with $k \leq \tilde{k}\,(f^\star)$ *do not exploit their clients, while the others with* $k > \tilde{k}\,(f^\star)$ *do.*

(ii) *Suppose* $f \neq \tilde{u}(f)\ \forall\ f \in (\bar{f}, f^\circ)$ *so that Case* (i) *does not apply. If at least one* $\tilde{u}(f) = f \in [\lambda_S f^\circ, \bar{f}]$ *exists, then we have partially pooling equilibria where all smugglers with* $k > \hat{k}\,(f')$ *propose*

$$f' \equiv \max\{f : f = \tilde{u}(f) \in [\lambda_S f^\circ, \bar{f}]\}, \tag{21}$$

are hired, and exploit their clients. Smugglers with $k \in (\tilde{k}\,(f')\,, \hat{k}\,(f')]$ *propose any* $f > \hat{f}(k)$ *and are not hired. Smugglers with* $k \leq \tilde{k}\,(f')$ *propose any* $f > \bar{f}$ *and are also not hired.*

Proof. (i) If Equation (19) holds over $(\bar{f}, f^\circ)$, Lemma 1 suggests that every smuggler maximizes the expected profit by proposing $f^\star$, whether or not Equation (19) holds over $[\lambda_S f^\circ, \bar{f}]$. (ii) If Equation (19) does not hold over $(\bar{f}, f^\circ)$ but it does over $[\lambda_S f^\circ, \bar{f}]$, Lemma 1 suggests that every smugglers with $k \in (\hat{k}\,(f')\,, 1]$ maximizes the expected profit by proposing f'. Smugglers with $k \in (\tilde{k}\,(f')\,, \hat{k}\,(f')]$ propose any $f > \hat{f}(k)$ in order to avoid loss-making smuggling. Smugglers with $k \leq \tilde{k}\,(f')$ propose any $f > \bar{f}$ also in order to avoid being hired.[22] □

Proposition 1(ii) suggests that the equilibrium might be characterized by adverse selection à la Akerlof (1970): only exploitative smugglers are hired at f', and all nonexploitative smugglers are driven out of the market even though migrants are willing to pay f° to hire nonexploitative smugglers and nonexploitative smugglers are willing to be hired at that fee. Note that nonexploitative smugglers are not able to signal the nature of their services by proposing an $f > f'$ because workers believe that any particular f can be proposed by all smugglers who can make a positive expected profit if workers accept it. Signaling à la Spence (1973, 1974) is not available either, for our model does not contain a costly investment opportunity which some smugglers may use to indicate their capacity to exploit.

[22] Alternatively, smugglers with $k \leq \hat{k}\,(f')$ can also propose any $f > f'$ knowing that it will not be accepted anyway.

Before we examine policy implications, let us compare the equilibrium we have characterized with the one characterized by Tamura (2010: Proposition 1) who assumes that k is not private information.

Proposition 2 *Suppose both $\tilde{f}(1) > f^{\circ}$ and $\lambda_S f^{\circ} > \hat{f}(1)$. Then, both equilibrium measure and proportion of employed nonexploitative smugglers are smaller with unobservable k than with observable k.*

Proof. Inequality (4) indicates that smugglers with $k \in [0, \tilde{k}(f)]$ are nonexploitative if hired. As Tamura (2010: Proposition 1) shows, they propose f° and are hired in equilibrium when k is observable. Since $f^{\star} < f^{\circ}$, we have $\tilde{k}(f^{\star}) < \tilde{k}(f^{\circ})$. Besides, all nonexploitative smugglers are not hired in Case (ii) of Proposition 1, whereas there are always employed nonexploitative smugglers when k is observable. □

As Lemma 1 suggests, a type-k smuggler maximizes the expected profit by proposing f° if $\tilde{f}(k) < f^{\circ}$ and the exploitation capacity is observable to the matched worker. However, when the worker cannot observe the exploitation capacity, the fee which this smuggler can charge is reduced by the existence of other smugglers for whom $\tilde{f}(k) \geq f^{\circ}$ holds. Some smugglers for whom $\tilde{f}(k) < f^{\circ}$ holds then end up providing exploitative smuggling because the reduced fee is not greater than $\tilde{f}(k)$ but still exceeds $\hat{f}(k)$ for them. As a consequence, when the exploitation capacity is private information, more workers are exploited in the market where all smugglers are employed: compare Proposition 1(i) with Tamura (2010: Proposition 1). This means that although the pooling equilibrium fee under asymmetric information, $f^{\star}$, is based on the average exploitation, it is lower than the average of the symmetric-information equilibrium fees.

When not all smugglers are hired in the market as in Proposition 1(ii), some may argue that the unobservability of the exploitation capacity is not necessarily bad. This is because the asymmetric information shrinks the market by making all nonexploitative smugglers unemployed. Note that, since $\hat{k}(f') > \hat{k}(f^{\circ})$, the equilibrium measure of employed exploitative smugglers is also smaller with unobservable k than with observable k.

3 Policy implications

We now examine the ceteris paribus effects of policy measures on the market equilibrium. For illustrative purposes, we suppose that the market is initially characterized by Proposition 1(i). That is, there initially exists a unique pooling equilibrium where all smugglers propose an identical fee $f^{\star} \in (\bar{f}, f^{\circ})$ and are hired: some are exploitative, and the others nonexploitative.

3.1 Increasing the penalty for smuggling

Conditions (3), (6), and (7) imply that an increase in p increases both $\bar{f}$ and $\hat{f}(k)$ but reduces $\tilde{f}(k)$. The penalty for smuggling clearly penalizes the act of smuggling, and hence the reservation values of both exploitative and nonexploitative smuggling are increasing in p for all smugglers. However, p also affects the profitability of post-smuggling exploitation because exploitation prolongs the risk of apprehension, and exploitative smugglers will be punished for both exploitation and smuggling if apprehended inland. As $p \to \infty$, we have $\bar{f} \to \infty$, $\hat{f}(k) \to \infty$, and $\tilde{f}(k) \to -\infty$. Hence a very high penalty for smuggling should eliminate the market by achieving both $\tilde{f}(k) \leq \hat{f}(k)\ \forall\, k \in [0,1]$ and $f^{\circ} \leq \bar{f}$, provided that the apprehension probabilities are positive.

However, it may be difficult to set p sufficiently high in many countries, even though doing so is inexpensive, because penalties for different illegal activities are set in relative terms. For instance, the penalty for smuggling cannot exceed the penalty for homicide in most legal systems. What happens to the equilibrium when an increase in the penalty is not large enough to eliminate the market? In Figure 1, we plot a worker's post-migration payoff (10) against the fee. The solid plot is associated with the initial situation. Lemma 4 suggests that the domain of $\tilde{u}(f)$ is $[\lambda_S f^{\circ}, f^{\circ}]$. As implied by Lemma 3, the plot is increasing in f and is discontinuous at $\bar{f}_1$ where subscript 1 indicates that it is associated with the initial situation. The discontinuity results from the fact that the employment of all nonexploitative smugglers depends on whether $f > \bar{f}$ holds. The full employment is maintained for any $f \in (\bar{f}, f^{\circ}]$, and all nonexploitative smugglers do not propose any $f \in [\lambda_S f^{\circ}, \bar{f}]$. Since Proposition 1(i) suggests that the number of hired smugglers do not change over $(\bar{f}, f^{\circ}]$, the fact that $\tilde{u}(f)$ is increasing in f suggests that more smugglers decide not to exploit at a higher fee without affecting their employment over this interval. The initial equilibrium is illustrated by the point where the solid plot crosses the 45-degree line, holding Equation (19). For ease of comparison, the same solid plot appears in all the other figures which we will discuss subsequently.

‹ *The figures are attached to the end of the paper.* ›

The dashed plot results from an increase in p, while holding everything else at the initial values. The figure shows that the segment of $\tilde{u}(f)$ to the right of $\bar{f}$ exclusive shifts upward. This can be seen from Expressions (4), (17), and (10) that suggest $\partial\tilde{k}/\partial p > 0$, $d\kappa/dp < 0$, and hence $d\tilde{u}/dp > 0$ for this segment. An increase in p penalizes exploitative smugglers more than nonexploitative ones because there is a chance of paying p even after smuggling for the former but not for the latter. Hence at each fee over this interval, workers can expect more smugglers to decide not to exploit when p gets higher.

However, this upward shift does not result in a higher equilibrium fee in this example because $\bar{f}$ has increased from $\bar{f}_1$ to $\bar{f}_2$: see Condition (6). Consequently, nonexploitative smuggling becomes less profitable than before, and the equilibrium fee proposed by employed smugglers moves on to the segment of $\tilde{u}(f)$ to the left of $\bar{f}$ inclusive. The new equilibrium is thus characterized by Proposition 1(ii) where the equilibrium is not unique because unemployed smugglers can propose different fees which are unacceptable to workers, but the fee proposed by employed smugglers is the same in these partially pooling equilibria. Note that this segment has shifted downward as a result of an increase in p. This can be seen from Expressions (8), (18), and (10) that suggest $\partial\hat{k}/\partial p > 0$, $d\kappa/dp > 0$, and hence $d\tilde{u}/dp < 0$ for this segment. All smugglers who propose an $f \in [\lambda_S f^\circ, \bar{f}]$ are exploitative, and an increase in p affects them negatively by the same magnitude, as Functions (1) and (5) imply. As a result of an increase in the penalty, there are fewer smugglers who can profit at each fee than before. The dot-dashed plot shows that a further increase in p induces a further fall in the partially pooling equilibrium fee proposed by hired smugglers because only very highly exploitative smugglers can profit in the market after the increase.

In summary, an increase in the penalty for smuggling effectively reduces the number of employed smugglers. However, an insufficiently high penalty would leave a small number of highly exploitative smugglers being employed. Note that Tamura's (2010) Proposition 2(ii) implies that, when k is not private information, nonexploitative smuggling can remain profitable for all smugglers even when exploitative smuggling becomes unprofitable for all. In contrast, we have found that nonexploitative smuggling becomes unprofitable for all before any exploitative smuggler becomes unemployed when the exploitation capacity is private information.

3.2 Improving apprehension at the border

Conditions (6) and (7) imply that an increase in either β_M or β_S, or both, will increase the reservation value of both nonexploitative and exploitative smuggling for all smugglers. This is because any gain from smuggling, whether derived from the border crossing fee or from exploitation, is conditional on a successful border crossing. Either $\beta_M \to 1$ or $\beta_S \to 1$ implies $\bar{f} \to \infty$ and hence $\hat{f}(k) \to \infty$. Since f° is finite, improving the border apprehension is thus an effective way of eliminating the market, provided $\tilde{f}(1) \neq \infty$.

However, it may be very costly to significantly increase the border apprehension rate, and it is therefore practical to consider improvements that fall within a range of low probabilities. Figure 2 illustrates an example of small increases in β_S. The impact is similar to that of increasing p which we have examined. However, the segment of $\tilde{u}(f)$ to the right of $\bar{f}$ exclusive does not shift. (Note that we do not see the dashed and dot-dashed plots of this segment in the figure because these are covered by the solid plot, but they do exist.) The profit from exploitation is conditional on a successful border crossing, and the exploitation decision is made given a successful border crossing, i.e. $\partial\tilde{k}/\partial\beta_S = 0$. This, together with the fact that the number of hired smugglers does not change over $(\bar{f}, f^\circ]$, explains why this segment shifts neither upward nor downward. It should be noted that, although this segment does not shift, the increases in $\bar{f}$ causes the segment to shrink as the border apprehension improves. This impact on the reservation value of nonexploitative smuggling for all smugglers subsequently drives nonexploitative smugglers away from the market: the dot-dashed plot illustrates an example of adverse selection caused by an improvement in the border apprehension rate.

The impact of increasing β_M is qualitatively the same as that of increasing β_S. However, we note that its marginal impact is smaller than that of β_S, as Inequality (6) implies. As in Tamura's (2010) Proposition 2(iii) where k is assumed observable to workers, the measure of nonexploitative smugglers is unaffected by the border apprehension probabilities, as long as the fee is greater than $\bar{f}$. However, in contrast to the case with observable k, nonexploitative smuggling becomes unprofitable for all before any exploitative smuggler becomes unemployed when the exploitation capacity is private information.

3.3 Improving the inland apprehension of migrants

The maximum fee which the workers are willing to pay for nonexploitative services, f°, is decreasing in λ_M because each worker's expected gain from migration falls as λ_M rises. Since the post-migration payoff (10) is a fraction of f°, λ_M negatively affects the fee that smugglers can charge. Conditions (3) and (7) suggest $\tilde{f}(k) \to -p < 0$ and $\hat{f}(k) \to (\bar{f} + \lambda_S p)/(1 - \lambda_S) > 0$ as $\lambda_M \to 1$. Accordingly, together with its effect on f°, a sufficient improvement in the inland apprehension of smuggled migrants can make all smugglers unemployed. Note that the reservation value of nonexploitative smuggling for all smugglers is unaffected by a change in λ_M because they are free from inland apprehension if not exploiting: it is implicitly assumed in the model that the inland apprehension of a smuggled migrant does not provide a clue that can lead to the inland apprehension of the smuggler: see footnote 12.

Let us consider moderate increases in the inland apprehension rate of migrants, for these are more realistic scenarios, given the fact that a government cannot commit unlimited resources to the control of illegal migration. Figure 3 shows that, as λ_M increases, the domain of $\tilde{u}(f)$ shifts to the left and shrinks by reducing f°. We also observe that $\tilde{u}(f)$ is shifting downward over the whole domain. Expressions (8), (18), and (10) suggest $\partial\hat{k}/\partial\lambda_M > 0$, $d\kappa/d\lambda_M > 0$, and hence $d\tilde{u}/d\lambda_M < 0$ for the segment to the left of $\bar{f}$ inclusive. Expressions (4) and (17) suggest $\partial\tilde{k}/\partial\lambda_M > 0$ and hence $d\kappa/d\lambda_M < 0$ for the segment to the right of $\bar{f}$ exclusive. Function (10) then implies, for $f \in (\bar{f}, f^{\circ})$,

$$\frac{d\tilde{u}}{d\lambda_M} = (1 - \lambda_S) y \phi(\tilde{k}) \tilde{k}^2 - [1 - (1 - \lambda_S)\kappa] y$$

where the second term is the direct impact of λ_M on the post-migration payoff, and the first term the indirect impact via the expected exploitation. This can be rewritten as

$$\frac{d\tilde{u}}{d\lambda_M} = \left[(1 - \lambda_S)(\phi(\tilde{k})\tilde{k}^2 + \kappa) - 1\right] y$$

where the first term in the square brackets is less than one. Therefore, we have $d\tilde{u}/d\lambda_M < 0$ also for the segment to the right of $\bar{f}$ exclusive.

The dashed plot illustrates a situation where better inland apprehension of migrants has raised the proportion of exploitative smugglers while allowing all smugglers to stay employed, resulting in a lower pooling equilibrium fee. This outcome is probably the most undesirable, for the number of smuggling incidents is not reduced while, at the same time, the number of exploitation incidents is increased. The dot-dashed plot indicates that a further increase in λ_M can reduce the number of employed smugglers by leading the market to adverse selection. Unlike Tamura's (2010) Proposition 2(ii) where k is assumed observable to workers, when the exploitation capacity is private information nonexploitative smuggling becomes unprofitable before any exploitative smuggler become unemployed.

3.4 Improving the inland apprehension of smugglers

Conditions (3) and (7) imply that an increase in λ_S decreases $\tilde{f}(k)$ and increases $\hat{f}(k)$. However, it affects neither f° nor $\bar{f}$ because nonexploitative smugglers are assumed to never be subject to inland apprehension as they end the relationship with their customers as soon as the customers are smuggled successfully and then pay the agreed fee. Thus, λ_S penalizes only smugglers who prolong the relationship with their clients through exploitation. As $\lambda_S \to 1$, both $\tilde{f}(k) \to -(1-\lambda_M) qk - p < 0$ and $\hat{f}(k) \to \infty$. Therefore, a significant improvement in the inland apprehension of smugglers results in the situation where all smugglers are hired and provide nonexploitative smuggling, given that $f^\circ > \bar{f}$ initially holds. In this sense, this policy measure cannot eliminate the market even if unlimited resources are available. This implication is similar to the corresponding case under symmetric information in Tamura's (2010) Proposition 2(i).

Figure 4 clearly illustrates this point. We observe that $\tilde{u}(f)$ is shifting upward over its entire domain. The shift of the segment to the right of $\bar{f}$ exclusive can easily be seen from Expressions (4), (17), and (10). As for the shift of the segment to the left of $\bar{f}$ inclusive, Expression (8) suggests

$$\frac{\partial \hat{k}}{\partial \lambda_S} = \frac{(\bar{f}+p)y + (\bar{f}-f)q}{(1-\lambda_M)\lambda_S^2 \left(\frac{1-\lambda_S}{\lambda_S} y - q\right)^2} > 0,$$

which in turn implies $d\kappa/d\lambda_S > 0$ according to Function (18). Intuitively, λ_S negatively affects the profit from exploitation and hence raises the average exploitation at each $f \in [\lambda_S f^\circ, \bar{f}]$ due to the unemployment of less exploitative smugglers. Function (10) indicates that $d\tilde{u}/d\lambda_S > 0$ only if the direct impact of λ_S on $\tilde{u}$ dominates the indirect impact via κ. We have

$$\frac{d\tilde{u}}{d\lambda_S} = (1-\lambda_M) y \left[\kappa - (\kappa - \hat{k}) \frac{\phi(\hat{k})}{1-\Phi(\hat{k})} \frac{\partial \hat{k}}{\partial \lambda_S} \right]$$

where $\kappa > \hat{k}$ because $\hat{k}$ is just below the lowest capacity among hired smugglers who are all exploitative along this segment. Since both $\phi(\hat{k})/(1-\Phi(\hat{k}))$ and $\partial\hat{k}/\partial\lambda_S$ are a fraction, the direct impact of λ_S on $\tilde{u}$ does dominate the indirect impact via κ, i.e. $d\tilde{u}/d\lambda_S > 0$. Notice that the segment of $\tilde{u}(f)$ to the left of $\bar{f}$ inclusive shrinks as λ_S increases. This is because the highest fee which the workers are willing to pay for the most exploitative services, $\lambda_S f^\circ$, is increasing in the apprehension probability.

In summary, since λ_S penalizes exploitation, more and more smugglers decide not to exploit as it increases. Accordingly, the equilibrium fee rises, and full employment is maintained because the reservation value of nonexploitative smuggling for all smugglers remains constant. It should be noted that, although the average exploitation per migrant is falling as λ_S increases, the small number of those who unluckily hire exploitative smugglers suffer a large ex post loss from migration because these smugglers are endowed with the highest exploitation capacities while the equilibrium fee is relatively high.

3.5 Increasing the penalty for exploitation

Conditions (3) and (7) imply that an increase in q decreases $\tilde{f}(k)$ and increases $\hat{f}(k)$. But the penalty for exploitation affects neither f° nor $\bar{f}$. As $q \to \infty$, both $\hat{f}(k) \to \infty$ and $\tilde{f}(k) \to -\infty$. Hence the consequence of sufficiently increasing this penalty is the same as that of increasing λ_S sufficiently. In other words, severely punishing exploitation does not harm nonexploitative yet illegal smuggling businesses. The similar implication was also given in Tamura's (2010) Proposition 2(i) for the case where k is not private information.

Figure 5 shows that the impact on a worker's expected post-migration utility is, however, not exactly the same as that of λ_S. According to Expressions (4), (17), and (10), we have $\partial\tilde{k}/\partial q > 0$, $d\kappa/dq < 0$, and hence $d\tilde{u}/dq > 0$ for the segment of $\tilde{u}(f)$ to the right of $\bar{f}$ exclusive. This indicates that, as the marginal penalty for exploitation increases, the expected cost of exploitation rises, which causes more smugglers to decide not to exploit. This in turn increases the unique pooling equilibrium fee. However, the segment of $\tilde{u}(f)$ to the left of $\bar{f}$ inclusive is shifting downward, which can be seen from Expressions (8), (18), and (10). Since q does not directly affect the post-migration utility, its impact comes only via the expected exploitation. Recall that smugglers who propose any $f \in [\lambda_S f^\circ, \bar{f}]$ are all exploitative. As q rises, exploitative smuggling becomes unprofitable for smugglers with relatively low values of k. This leaves a smaller number of more exploitative smugglers at each f over this interval, which raises κ and hence shifts $\tilde{u}(f)$ downward. Notice that the slope of $\tilde{u}(f)$ gets steeper, as q increases. This reflects the fact that an increase in q increases the range of k for which smuggling becomes unprofitable when the fee falls marginally. In other words, the number of profit-making smugglers becomes more sensitive to the fee, as the penalty for exploitation becomes severer.

It should be noted that the transition from the dashed to the dot-dashed plot in the figure does not imply that multiple equilibria may arise as a result of an increase in q. As stated in Proposition 1(i), when Equation (19) holds over both $[\lambda_S f^\circ, \bar{f}]$ and $(\bar{f}, f^\circ)$, the equilibrium is given by the unique pooling fee, $f^\star \in (\bar{f}, f^\circ)$, as implied by Lemma 1. Thus, the effect of increasing the penalty for exploitation is to reduce the proportion of exploitative smugglers while maintaining full employment.

4 Conclusion

We have examined the effects of anti-illegal migration and anti-exploitation policy measures on the migrant smuggling market by building on Tamura (2010) who set up and analyzed a model of migrant smuggling and migrant exploitation under the assumption that information is complete and perfect. In this paper, we have characterized the market equilibrium under the assumption that the exploitation capacity of each smuggler is private information because stylized facts imply that some potential users of smugglers face uncertainty regarding the risk of being exploited by the smugglers after a successful border crossing.

We have found that the market equilibrium may be characterized by adverse selection. Adverse selection in the present context can arise from the presence of heterogeneity in the exploitation capacity across smugglers. The heterogeneity depresses the market fee because, although potential migrants are willing to pay a high fee for nonexploitative services, they cannot distinguish between exploitative and nonexploitative smugglers. As a result, the fee acceptable for workers is depressed, and the market may be supplied by a small number of highly exploitative smugglers at a low fee in equilibrium.

Our analysis suggests that destination countries can eliminate the migrant smuggling market if sufficient resources are committed to appropriate anti-illegal migration efforts. On the other hand, anti-exploitation efforts can prevent smugglers from exploiting their clients, but cannot stop them from providing nonexploitative smuggling. In fact, anti-exploitation efforts convert initially exploitative smugglers into nonexploitative smugglers, not into unemployed smugglers, thus maintaining the number of illegal border crossing attempts. Tamura (2010: Proposition 2) found the same under the assumption that the exploitation capacity is not private information. Therefore, the inability of workers to observe the exploitation capacity does not seem to affect policy implications when sufficient resources are available.

In reality, available resources are never unlimited. When committable resources are limited, a worker's ability to observe the exploitation capacity of the matched smuggler does make a difference to policy implications. First, we have found that increased anti-illegal migration efforts tend to result in an adverse selection equilibrium where all smuggled migrants are exploited more or less, which may be a concern to those who care about the welfare of migrants regardless of their legal status. However, an adverse selection equilibrium is not necessarily a bad outcome for destination countries that desire to stop migrant smuggling, as it implies a fall in the number of smuggling attempts via unemployment of smugglers with low exploitation capacities. The equilibrium outcome under complete and perfect information differs—Tamura (2010: Proposition 2) shows that increased anti-illegal migration efforts make exploitative smuggling unprofitable first, and initially exploitative smugglers become either nonexploitative (in the case of increased penalty for smuggling or improved inland apprehension of smuggled migrants) or unemployed (in the case of improved border apprehension of smugglers or migrants). This implies that a reduction in informational asymmetry between smugglers and potential migrants decreases the incidence of migrant exploitation.

Second, when workers cannot observe the exploitation capacity of their smugglers, improved inland apprehension of smuggled migrants may have an unintended consequence of increasing the incidence of migrant exploitation, at the same time failing to reduce the number of smuggling attempts. This happens when the impact of this apprehension improvement on the workers' reservation value of smuggling is so weak that the equilibrium cannot move from a pooling to a partially pooling one but to a new pooling one where every smuggler remains employed but some initially nonexploitative smugglers have become exploitative. In this sense, a half-hearted effort to improve inland apprehension of smuggled migrants is not only ineffective in terms of reducing migrant smuggling but also harmful to smuggled migrants. Hence, inland apprehension of smuggled migrants is a policy parameter which requires careful consideration if destination countries wish to avoid exacerbating the exploitation risk faced by users of smugglers.

Finally, our comparative statics suggest some trade-offs between anti-illegal migration and anti-exploitation efforts. The figures in the previous section suggest that an improvement in inland apprehension of smugglers might offset an improvement in inland apprehension of smuggled migrants. The former shifts the worker's reservation value of smuggling upward while the latter shifts it downward. A similar trade-off exists between an increase in the penalty for exploitation and an improvement in inland apprehension of smuggled migrants. An implication is that the status quo might be maintained due to certain combinations of these policies in place. On the other hand, an increase in the penalty for smuggling and an improvement in border apprehension of smugglers and migrants are likely to dominate the impact of anti-exploitation efforts. This is because these two anti-illegal migration measures increase the reservation value of nonexploitative smuggling for all smugglers, which in turn reduces the range of fees at which nonexploitative smuggling remains profitable. This makes it difficult for the equilibrium to remain pooling, resulting in a partially pooling adverse selection equilibrium.

In summary, it seems that destination countries may prefer to improve apprehension of smugglers and their clients at the border rather than inland. An improvement in border apprehension avoids the potential problem resulting from improved inland apprehension of smuggled migrants, namely, an increase in migrant exploitation while maintaining the employment of smugglers. Its impact is also likely to avoid being offset by anti-exploitation efforts in place simultaneously. Note that Tamura's (2010) analysis of the symmetric information case also suggests improved border apprehension is preferable, although for different reasons. Therefore, destination countries may choose to invest their limited resources in border apprehension whether or not the exploitation intentions of smugglers are correctly known to their clients.

It should be noted that our results are not applicable to all cases of migrant smuggling. One limitation is that we have assumed that a migrating worker does not pay a fee unless a border crossing succeeds so as to remove the incentive for the smuggler to default on the provision of border crossing services. However, this payment method is not the only one used in this market: see Tamura (2010: Subsection 2.3). In some cases, a migrating worker has to pay before a border crossing, and the smuggler provides border crossing services even if post-smuggling exploitation is unprofitable. Nonexploitative smugglers would behave in such a way if reputation matters, which suggests that dynamic extension of our model where the payment method is endogenous may be promising. Dynamic analysis will also be useful for examining the market equilibrium with information transmission over time, for descriptive evidence suggests that potential migrants often make use of social networks in their search for reliable smugglers. By explicitly modeling information transmission, our results for asymmetric information can be linked with Tamura's (2010) results for symmetric information. For preliminary results covering such a case, see Tamura (2007: Chapter 4).

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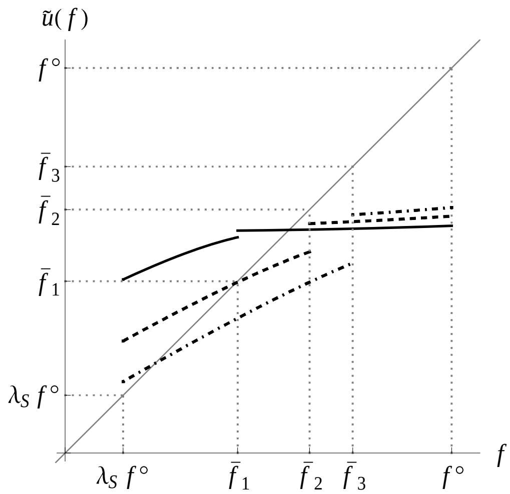

Fig.1 Impact of increasing *p*

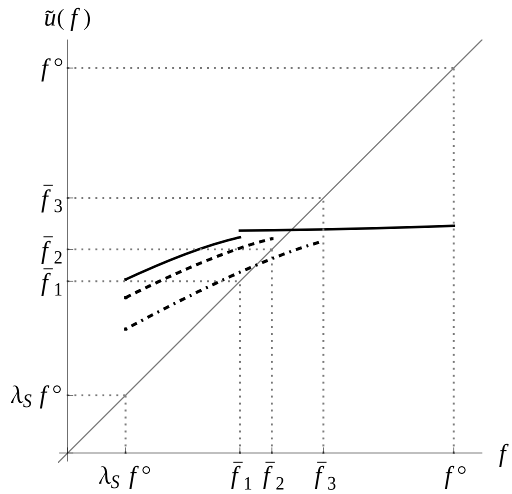

Fig.2 Impact of increasing $\boldsymbol{\beta_S}$

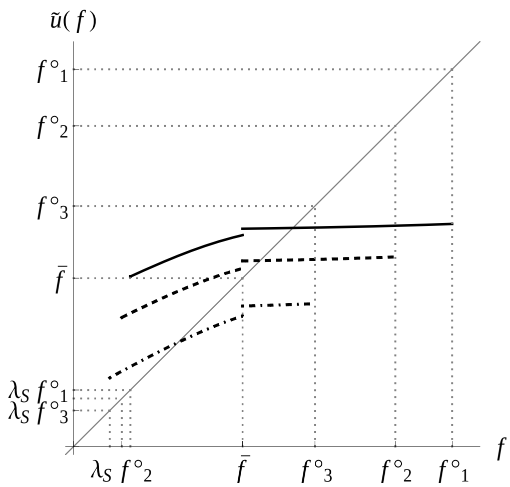

Fig.3 Impact of increasing $\boldsymbol{\lambda_M}$

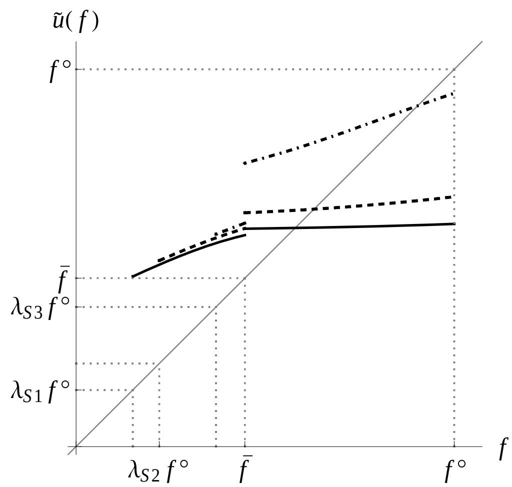

Fig.4 Impact of increasing $\boldsymbol{\lambda_S}$

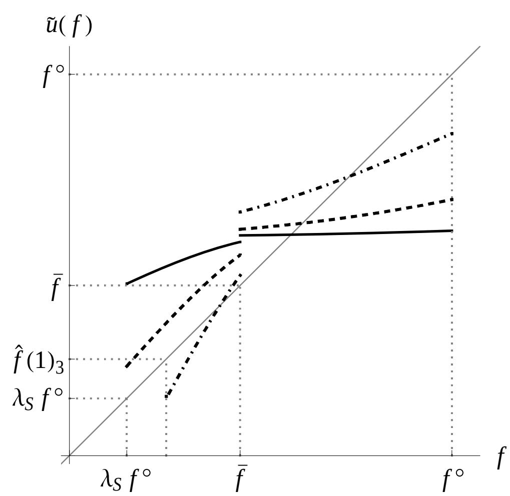

Fig.5 Impact of increasing *q*

Note: In all these figures, the origin is zero, and the solid plot is the same benchmark based on $y = 12$, $c = 1$, $\bar{\pi} = 1$, $p = 2$, $q = 2$, $\beta_M = .3$, $\beta_S = .2$, $\lambda_M = .2$, and $\lambda_S = .15$. The dashed plot results from an increase in the parameter in question in each figure (i.e. $p = 7$, $\beta_S = .28$, $\lambda_M = .32$, $\lambda_S = .22$, $q = 35$, respectively) while holding the other parameters at the benchmark. The dot-dashed plot is a result of a further increase in the parameter (i.e. $p = 10$, $\beta_S = .38$, $\lambda_M = .49$, $\lambda_S = .37$, $q = 47$, respectively). Subscripts 1, 2 and 3 that appear in some labels along the axes are associated with the benchmark, dashed and dot-dashed plots, respectively. The capacity distribution is assumed to be beta for convenience of its domain $(0,1)$, and we use 2 for both parameters of the beta distribution. Accordingly, $\phi(k) = (1-k)k$. (Strictly speaking, this violates our assumption of $\phi(k) > 0 \forall k \in [0,1]$ because $\phi(k) = 0$ for $k = 0,1$.) Each point where a plot crosses the 45-degree line gives an equilibrium fee.