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Market concentration in the international drug trade☆

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ABSTRACT

This paper investigates the industrial organization of the international drug trade. From the mid 1970s through the early 2000s, a few large-scale and hierarchically organized cartels dominated the market. Since 2006, dozens of smaller and more-specialized units have emerged. We notice that the prohibition efforts of federal governments (primarily Mexico and the U.S.) imposed costs asymmetrically across differently sized drug trafficking organizations (DTOs). Under president Calderon (office held from 2006–2012), efforts were arranged as "kingpin" or "decapitation" strategies and were primarily focused on arresting key leaders of the largest and most infamous operations. This asymmetric enforcement structure evoked unique strategic responses from differently sized DTOs. Larger DTOs splintered into smaller units. Smaller outfits remained small and sought more specialized roles in the more decentralized and competitive supply chain. Furthermore, we argue that subsequent changes in operating costs amidst this less concentrated environment, tended to exaggerate the asymmetric cost structure across differently sized DTOs. Larger DTOs in a more competitive illicit market cannot exploit economies of scale to maintain internal coordination and loyalty as easily as they once could with fewer rival DTOs. In result, the seemingly persistent industrial organization of the international drug trade has remained less concentrated than in previous decades.

1. Introduction

From the mid 1970s through the early 2000s the international drug trade (primarily across Latin America and the United States) was dominated by a few, large, and hierarchically organized cartels. Since 2006, the industrial organization of this illicit market has substantially changed. Today, the international drug trade is comprised of several dozen, more-independently managed, smaller-scale, and more-specialized drug trafficking organizations (DTOs).

Two aspects of this change are puzzling. First, given the conditional factors of the international drug trade, lessened concentration stands in contrast to what standard theory would predict. The illicit and international conditions of the market coincide with high profits, high contestability, ambiguous expectations regarding enforcement risks, and relatively high operating costs. Such factors suggest suppliers would be inclined to exploit economies of scale by continuously growing larger and producing more output at lower per unit costs. We would also expect larger DTOs with more established comparative advantages in violence to both suppress competition and subsume smaller operations. Such outcomes were arguably in place during the reign of the infamous cartels dominant between the 1970s and early 2000s. But, current outcomes substantially differ.

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Second, at his inauguration in 2006, Calderón announced his War on Drugs, and between 2006 and 2012, dispatched nearly fifty thousand soldiers and around five thousand federal police officers to target Mexican DTOs (Redmond, 2016). These "kingpin" strategies were designed to proverbially "decapitate" the drug supply. Rather than enforce prohibition uniformly across different functions and stages of the drug supply chain, kingpin protocols focused investigation and prosecutorial resources more narrowly upon key leaders and bosses within the top cartels.[1] Under such a targeted enforcement regime, one would expect the market to de-concentrate and host a greater quantity of firms. When larger DTOs face risks from law enforcement above those felt by smaller operations, such costs at least partially offset the profit incentives from economies of scale. Inversely, if kingpin targeting were removed, re-concentration would be expected so long as the standard conditions of illicitness and internationality continued to hold. However, despite Calderon's departure from office in 2012 and a substantial reduction of kingpin efforts, the international drug trade remains less concentrated with a greater number of smaller, more-independently controlled, and more specialized DTOs. Comparable large-scale and hierarchically managed cartels, as dominated during the 1970s and 80s, remain absent. Smaller DTOs have refrained from exploiting economies of scale and thus refrained from expanding into larger operations. Smaller DTOs have also avoided merging into larger organizational units. This paper aims to explain these seemingly anomalous aspects of the international drug trade.

A variety of research provides insight for how we may expect the industrial operations of the international drug trade to function. Beyond standard economic models of crime and punishment,[2] recent institutional theories investigate criminal organizations such as mafias, DTOs, and other illegal enterprises. DTOs are modeled akin to profit-seeking firms (Coase, 1937; Williamson, 1985), wherein groups of rational agents unite by a common criminal purpose (Rubin, 1973). Gangs select and evolve organizational patterns and internal rules to solve collective action and principle agent problems, to maintain and increase profits, and to better strategize around the risks of prohibition. For example, wage distributions within street gangs must balance the need for enticing new members against the challenges of maintaining internal order and compliance (Levitt and Venkatesh, 2000). Similarly, the rules within criminal organizations foster profit making and cost avoidance across diverse social contexts (Leeson, 2007; Leeson and Skarbek, 2010).[3] Gambetta (1996), Skaperdas (2001), and Skarbek (2010,2011,2012) have all described organized criminal syndicates, replete with internal rules, hierarchies of command, and constitutional checks and balances. These sorts of criminal organizations and the unique governance mechanisms therein tend to emerge when traditional states do not effectively provide rights protections, conflict adjudications, and or security services effectively or optimally.[4] Hence, power vacuums tend to inspire a greater number of illicit operations.

Less research has investigated the industrial organization of illicit markets (See: Rubin, 1973; Schelling, 1984, pp. 158–194; Reuter, 1985a). Reuter (1985b) reports on New York City loansharking and concludes that enforced prohibitions impeded suppliers from exploiting economies of scale. Maintaining a low profile was preferable to the greater risks associated with larger scale and more centralized production. Thus, multiple competitors and low mafia involvement were observed. Given that evading prohibition is a substantial (if not majority) share of operating costs for illicit suppliers, Arlacchi (1988), Thornton (1991), and Tanzi (1995) all similarly argue that governments are the primary influence upon the industrial patterns of organized crime. Skarbek and Sobel (2012) empirically examine gang concentrations in U.S. cities and notice greater drug use and enhanced punishments are both correlated with smaller gangs.

It is difficult to discern generalizable insights regarding the sizes of criminal organizations, their likely patterns of vertical and or horizontal integration, or the probable levels of market concentration from the available sample of black market case studies. Production logistics and prohibition enforcements vary across illicit products, governmental regimes, and local conditions. There is no one market and no one set of market conditions that determine how different organizations or the decision-makers therein will operate across diverse circumstances (Boettke et al., 2004). Almost no research investigates the industrial organization of the specifically international drug trade (See: Naranjo, 2010 for one exception). Hence, we aim to understand what conditional factors shape the size of DTOs and the levels of market concentration within this simultaneously illicit and cross-national environment during recent decades.

Again, standard theory implies that the international drug trade would be highly concentrated, i.e. dominated by a few, large-scale, and hierarchically organized cartels. High market contestability, large economies of scale, first mover advantages obtained through anti-competitive violence, and uncertain law enforcement responsibilities; all foment opportunities for a few early cartels to grow, vertically integrate, and secure market dominance. The general histories behind the early Colombian cocaine syndicates like the Medellín and Cali Cartels are in line with these expectations. Centered out of Columbia and southern California respectively, these outfits dominated the international distribution of drugs (especially cocaine) during the 1970s and 80s.

However, in the wake of a series of targeted killings of key organizational leaders came the eventual collapse of the Medellín Cartel in the 1990s, and with it a power vacuum that allowed for the proliferation of several smaller organizations (Gootenberg, 2012; Bagley, 2012). The number of DTOs has continued to grow since, primarily through the splintering of

[1] For thorough descriptions of the kingpin enforcement strategy see: Jones (2013), Phillips (2015), Lindo and Padilla-Romo (2015), and Calderon et al. (2015).

[2] Since Becker (1968), various aspects of crime and punishment have been investigated through applied economic reasoning. Levitt (2004) and Glaser et al. (1996) investigate the determinants of crime, Anderson (1999) the social costs of crime, Levitt (1998) optimal deterrence, and DiIulio (1996) and Miron and Zwiebel (1995) policy implications.

[3] See also: Gambetta (2009).

[4] See also: Anderson (1999), Grossman (1995), and Bandiera (2003).

existing organizations, especially in the wake of Calderon's kingpin strategy begun in 2006. Since 2012 and Calderon's departure, overtly targeted prohibition strategies have diminished but contrary to a re-concentrated market, the international drug trade remains comprised of several dozen organizations (Corcoron, 2012).

We argue that this low concentration can be explained by two key factors. First, the prevailing crackdown environment from 2006–2012 is responsible for initially causing large DTOs to splinter into smaller units. Under kingpin crackdowns, operating a larger DTO entailed greater risks compared to previous decades. Hence, large outfits broke into smaller units, and smaller operations refrained from growing as large as previous cartels.

Second, to explain the apparent persistence of this lessened concentration, we propose a framework of production costs more robust to the unique factors shaping international DTOs by updating a classic model (Baumol et al., 1982) with a pivoting rather than shifting cost curve. In short, the costs of maintaining coordination within a larger DTO conform to economies of scale when that large DTO succeeds in establishing a significant degree of market dominance – as was the case prior to 2006. Maintaining trust and cooperation within a large DTO is easier when DTO members have fewer competitor DTOs to turn to as alternative employers (Hirschman, 1970). In contrast, coordination costs are substantially greater for a large DTO situated within a less concentrated environment, as has been the case since 2006. Hence, changes in industry-wide operating costs amidst a more competitive market, exaggerate the asymmetric burdens set by targeted prohibition and felt across differently sized DTOs. Furthermore, such dynamic effects persistently de-incentivize smaller DTOs from growing or re-uniting into larger units. Hence, the international drug market has converged upon a relatively stable pattern of lower concentration with a greater number of smaller and more decentralized suppliers.

This paper proceeds as follows. Section II explains why basic theory would predict a high degree of market concentration for the international drug trade. Section III offers a brief history of well-known Latin American DTOs and the enforcement policies deployed against them. Section IV explains the strategic opportunities related to DTOs. Small DTOs choose to grow in size or remain small. Larger DTOs either engage in rent seeking or splinter into smaller independent units. Post 2006, remaining small and or splintering became preferable strategies. Hence, DTO operating costs behave in an intuitive way with respect to the size and number of firms in the industry, but industry-wide operating costs are not distributed evenly across differently sized firms. Section V provides some supporting historical and empirical evidence. Section VI concludes.

2. Market concentration in the international drug trade

Firms are the predominant organizational models seen throughout modern economies, as they provide a lower cost method of doing business relative to independent contracting (Coase, 1937; Williamson, 1985). A firm will hire more employees, expand operations, and or integrate production processes when the perceived benefits exceed costs and vice versa (Rubin, 1973; Rajan and Zingales, 2001). Hence, the ultimate check upon what a firm will produce internally as opposed to outsource, and the ultimate check upon if a firm will expand or reduce its size, is the spread of relative prices it confronts during production decisions.

Insofar as different firms within an industry face unique price ratios, that industry will contain a variety of differently sized suppliers. Throughout the larger market economy, alternative industries will host different average firm sizes, as average production costs vary. In any given market sector, each firm typically seeks to maximize profits and outcompete rival producers. Hence, monopolization is somewhat of a default motivation for any firm, regardless of industry or market context.

Theory predicts that more monopolized outcomes are most likely to result in those markets characterized by natural resource constraints and or the absence of effective regulation(s) (Blinder et al., 2001, p. 212). Furthermore, in traditional sectors, larger firms tend to dominate industries with larger profits and higher operating costs (Rubin, 1973; Kumar et al., 2001). Though not universal (again, see: Reuter, 1985b), illicit markets often foster incentives for firm growth and high market concentrations. For example, Wainwright (2016) details monopolistic supply chains maintained by domestically operated DTOs. In Peru, Bolivia, and Colombia, coca cultivation has historically been dominated by individual cartels. This makes sense, as supplying illicit goods typically entails higher operating costs from prohibition enforcement, and higher profit potentials shaped by high and inelastic consumer demands. Second, the investments in securing and maintaining a comparative advantage in violence buttress the incentives for illicit operations to engage in anti-competitive and predatory behaviors (Rottenberg, 1973; Buchanan, 1973).

We argue that the international drug trade prior to 2006 contained sufficient conditions for standard theory to predict market domination by a few large and hierarchically organized suppliers. This prediction accords to the predominant role of cartels observed between the 1970s and early 2000s. Three key factors promoted incentives for DTOs to grow and seek market domination: 1) high profits and market contestability, 2) ambiguous responsibilities for enforcing prohibition, and 3) relatively high operating costs. We explain each below.

First, the high quantity and inelasticity of demand for drugs by U.S. consumers made for a highly profitable illicit market (Reuter, 1985a). In conjunction with low material costs for producing and distributing the primary drugs of interest (marijuana, cocaine, and heroin), the convenience of avoiding typical quality regulations for drugs imposed by authorities like the FDA, and artificially high prices from prohibition (Thornton, 1991, pp. 71–88), such conditions provided strong incentives for individuals and groups to enter the drug trade. As Leeson and Rogers (2012) show, such contestability encourages gangs to hierarchically organize their supply chains and labor networks, as clearly delineated rules and authority are needed to select reliable members, formally monitor behaviors, and maintain order within illicit organizations (Granovetter, 1973).

Second, the international drug trade was prone to high concentration because the typical mechanisms against cartelization were less available and less effective in the illicit and international setting. Monopolistic behaviors are ordinarily suppressed via tax schemes, licensure requirements, and other regulatory strategies (Shleifer, 2010). But, prohibition displaces this varied basket of interventions with broadly applied sanctions. Hence, basic price theory recognizes greater inefficiencies from prohibitions compared to tax policies (Stern, 1987). Furthermore, in the international setting, no individual government has the obvious or capable authority to enforce prohibition effectively. Hence, international DTOs can likely exploit economies of scale and centralize production operations better than purely domestic operations.

Last, and probably the most substantial factor contributing to larger DTOs and higher rates of market concentration in the international drug trade, is the greater production costs uniquely relevant therein. In general, operating within a black market entails additional costs over the legitimate sector because illicit trades carry the additional risks of punishment and or confiscated products and profits. In turn, illegal agents and organizations typically invest resources to subvert law enforcement. These costs can be fitted into four distinct groups: 1) the unique material costs of illicit production and smuggling, 2) the costs of privately providing physical and contractual security, 3) the rent seeking costs of violence and bribery, and 4) internal coordination costs. Next, we describe each in turn and explain how they likely shaped DTO growth and market concentration in the international drug trade prior to 2006.

The material costs of producing illegal narcotics primarily stem from relatively simple agricultural procedures (Ward et al., 2008, pp. 2–6). Such expenses tend to be low and easily affordable by potential market entrants. Hence, the high contestability as explained above. But, once an organization has entered the market and secured land, workers, and basic equipment, marginally expanding these rudimentary operations is often both affordable and desirable. Thus, theory predicts general incentives for continuous growth. However, there are unique costs associated with producing illicit rather than legal agricultural outputs, as efforts must be made to assure the secrecy and security from law enforcement authorities and rival DTOs. These higher operating costs further assure the general conditions for DTO growth and market domination efforts.

Unique distribution challenges also raise material costs for international DTOs. Rather than typical shipping and freight, like all illicit purveyors, international DTOs must invest to specifically smuggle their wares. Smuggling across borders is likely more risky than transporting illicit stocks domestically (Andreas, 2014). Apart from raising material costs, smuggling has been shown to also shape the qualitative features of illicit substances and drug potency levels. Smaller more concentrated quantities lessen the risk of detection and defer the costs of subsequent processing (to make substances more directly consumable) onto later stage sellers and or consumers (Thornton, 1991, pp. 95–99; Redford, 2017).

Second, international DTOs must spend resources to privately secure rights and enforce contracts, as they lack recourse to traditional law enforcement services. Without legitimate police or courts, DTOs are uniquely vulnerable to fraud, theft, and violent predation. Hence, operating costs in the illicit sector typically entail expenses to gain some comparative advantage in violence (Reuter, 2014). Given that international DTOs face risks from more federally financed and militarized policing units, said violent investments are likely greater than those faced by their domestic DTO counterparts.[5]

Third, international DTOs also engage in rent seeking, defined as the capturing and securing of monopoly profits through means that do not increase the quantity of output or enhance quality. DTO rent seeking can take form as either expressions of anti-competitive violence or financial bribery and corruption (Tullock, 1967). Violent rent seeking includes the investments and usages of resources to suppress rival DTOs, enforce territorial exclusivity, and threaten or manipulate government officials.[6] Given the complementarity of violent capital across privately providing security and capturing monopoly rents, larger and more established DTOs have a competitive edge over smaller operations. Once up and running, a militarized DTO can suppress new entrants and or take over smaller suppliers (Correa-Cabrera et al., 2015). Hence, high market concentration and monopolistic outcomes in the illicit sector are at least partially self-affirming processes.[7]

Krueger (1974) explains rent seeking can also take form as lobbying or bribery to foment corruption or gain political clout. Through bribery, DTOs can insulate themselves from enforced prohibition and or redirect law enforcement's attention towards competitors. Available data suggests a cost structure of international drug trafficking dominated by such efforts. Gootenberg (2011) estimates between 1983 and 1993, total annual bribes rose from $3.2 million to $460 million. In 2010, the Latin American Herald Tribune (2010) estimated $100 million *per month* was changing hands between DTOs and municipal police across Mexico.[8] Hence again, larger DTOs are privileged over smaller and newer entrants, as they can better afford more competitive and more influential bribes.

Fourth, a unique production cost stems from enforcing trust and loyalty amongst gang members within a DTO. We refer to these costs of maintaining internal compliance as *coordination costs*. In so far as the operations of a DTO are deemed

[5] The Mexican Office of the Attorney General has seized arms from groups like the Gulf Cartel including "M72 and AT-4-type anti-tank rockets, 37 mm MGL rocket launchers, RPG-7 rocket launchers, fragmentation grenades, and 37 and 40 mm grenades (Brophy, 2008)."

[6] Standard theories of governance similarly predict smaller states would exploit economies of scale and converge towards larger single monopoly providers (Nozick, 1974; Grechenig and Kolmar, 2014).

[7] Such monopolization(s), when coupled with violent resources, partially internalize the costs of conflict within the market and thus afford industry conditions with larger and fewer firms a greater productive potential (Schelling, 1984, p. 163).

[8] In an investigation into Mexican trafficking, Keefe (2012) writes, "bribery may be the single largest line item on a cartel's balance sheet." His figures come from interviews with Mexican officials and former traffickers incarcerated in the U.S. Noe Ramirez Mandujano, for one example, former chief of Mexico's Specialized Investigation of Organized Crime was accused of accepting $450,000 per month.

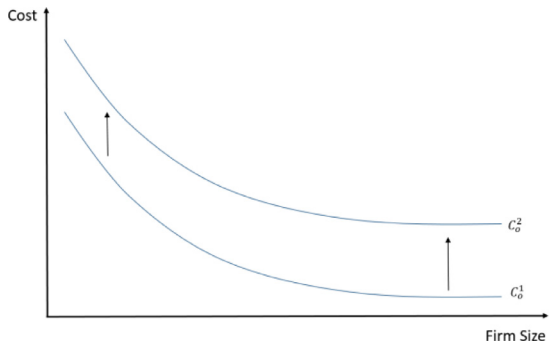

Fig. 1. Economies of scale.

illegal, each gang member or resource supplier represents a substantial risk to the present and future profitability of the organization. If a member choses to defect, he could then share information with government authorities or competing DTOs. Under most circumstances larger firms and organizations are more difficult and costly to effectively manage than smaller (Williamson, 1985). Hence, DTOs tend to leverage elaborate selection and compliance mechanisms to proxy trust and maintain loyalty within their ranks. For example, criminal syndicates often only accept members from a particular race or ethnic background and others commonly threaten death as the only avenue for leaving the group (Gambetta, 1996; Skarbek, 2010, 2014, pp. 108–128).

So long as an individual prefers membership to the likely consequences of defection, he will remain loyal to the DTO (Hirshman, 1970). Hence, gangs with more effective coordination mechanisms or credible threats against defection can better deter defection and protect their interests over competitors. In an environment with few rival DTOs coordination costs lessen as members lack alternative employment opportunities (Iannaccone, 1992). Furthermore, in such conditions, coordination costs likely adhere to economies of scale and are thus easier for larger DTOs to afford, as larger stocks of violent capital and political clout provide enhanced reputational capital to maintain compliance and respect for gang authority throughout the general community. In an environment with one or few dominant and infamous cartels, defectors lack potential support and security from ordinary citizens, law enforcers, and rival DTOs.

We argue that prior to 2006, the aggregation of such conditions and operating costs inclined DTOs to continuously exploit economies of scale as shown in Fig. 1 below. The average total cost per firm was generally decreasing as firms grew larger and attained a global minimum for a small number of concentrated organizations. Hence, a few large hierarchical operations dominated and new entrants were deterred by established organizations that violently suppressed competition. For any greater cost function ($C^2 > C^1$), a larger average firm size and a fewer number of firms was expected. Again, the significant change in market concentration observed recently appears puzzling because increased enforcement efforts are typically modeled as increased costs of operation and associated with greater rather than lessened market concentration. Yet, amidst increased enforcement budgets post 2006, the number of DTOs has grown rather than declined.

3. The puzzle of smaller competing DTOs

Since World War II, the U.S. has increased prohibition efforts against both domestic and international drug trafficking (Gootenberg, 2011). 1961 was a pivotal year, marking the criminalization of cocaine in Bolivia and the signage of the *Single Convention on Narcotic Drugs*, an international agreement in which UN member states promised to take action against drugs (UNODC, 1961). By 1970, drug prohibition became a standard part of U.S. policy under the *Controlled Substances Act*.

Fiscal empirics give a sense of proportion to the changing magnitudes behind U.S. prohibition efforts over time. Fig. 2 reports the U.S. federal drug war budget from 1970–2016, with multiplicative growth in the late 1980s and continual growth throughout the early 1990s and today. As is shown, spending has been dominated by supply reduction efforts more so than demand-side enforcements (Sourcebook of Criminal Justice Statistics Online, 2012).

Following the criminalization of cocaine, authoritarian regimes in South America began trafficking through democratic Chile. However, with a 1973 military coup came a wave of crackdowns, which opened the door to Colombian entrepreneurs who had previously acted mostly as drug mules for traffickers in the south. Between 1973 and 1980, infamous Colombian drug lords like Pablo Escobar and Carlos Ledher began utilizing Caribbean routes and extortion strategies to build larger empires (Beittel, 2017, p. 8). By 1980, the volume of cocaine into the U.S. from Colombia reached 100 tons. This serviced the growing population of over twenty million U.S. users (Gootenberg, 2011). The ensuing rise of Colombian cartels throughout the 1980s attracted attention from the U.S. government, which provided aid to Columbia, and in particular Hugo Martinez's Search Bloc (Martinez was appointed commander of the Columbian National Police in 1992). Throughout the early 1990s, the Search Bloc in an informal alliance with a vigilante group called Los Pepes, wrought havoc on the Medellín Cartel. By 1993, 12 leaders had been hunted down (Bowden, 2001). When Escobar himself was killed in December 1993, the organization crumbled.

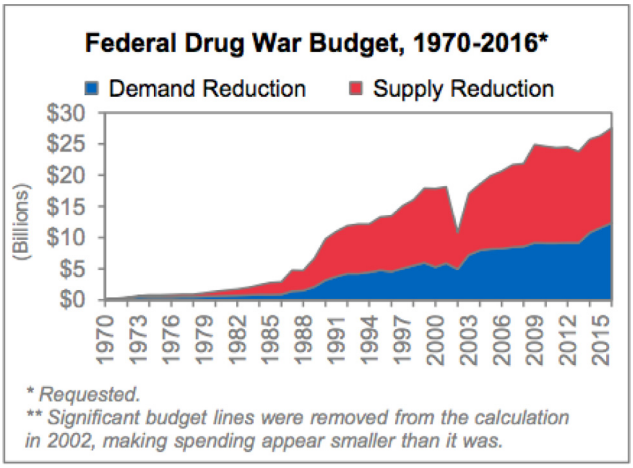

Fig. 2. Federal drug war budget.

As its power waned, the Medellín Cartel left a power vacuum that was for a time filled by the Cali Cartel, but eventually taken over by newer Mexican DTOs (Chernick, 1998). By the late 1990s, as much as 85% of the cocaine coming into the U.S. arrived through Mexico (Astorga, 1995). While Mexican DTOs such as the Guadalajara Cartel had previously existed alongside the Colombian organizations, it was not until the 1990s with changes in leadership and the collapse of the Medellín Cartel, that these Mexican groups truly came into their own.

The effective take down of Medellín reaffirmed the perceived effectiveness of targeted prohibition. At first glance, Colombian and U.S. authorities had successfully brought major drug lords to justice and disrupted one of the largest and most powerful cartels. Hence, Calderon's kingpin strategy in 2006 leveraged similar tactics. However, such targeting also impacted the industrial patterns throughout the larger drug trade. In short, DTOs took notice that centralization and larger scale supply operations carried greater risks from enforcement authorities. "Drug repression in 1990s Columbia ultimately led to more effective drug trafficking organizations. Sellers 'learned and 'adapted' far faster than their global pursuers in hostile times, and developed sleeker, far more anonymous, efficient, and fluid smuggling networks (Kenney, 2007). Instead of a few highly visible regional cartels, Colombia now hosts some six hundred well-camouflaged drug export networks (Gootenberg, 2012, p. 168)."

Once targeted and disrupted, several dominant cartels endured tumultuous processes of leadership churn and territorial conflicts with rival DTOs. Many key organizations eventually splintered from large cartels into multiple smaller operations. Smaller cartels or "cartelitos" took on a more flattened and decentralized organizational form with more narrowly specialized roles in the broader supply chain. Rather than internalizing the full processes of producing and distributing drugs territorially, some smaller DTOs began to narrowly specialize in trafficking across borders; others provided outsourced security and or political influence through armored conflict services such as espionage and kidnappings (Beittel, 2017).

Detailed accounts of DTO internal operations are limited, and quantitative metrics on labor forces, average salaries, production outputs, and profit flows are all but nonexistent. However, investigative government reports and scholarly research do provide evidence suggesting that the outcomes of kingpin strategies occurred as standard theory would predict, mainly, large DTOs splintered, and smaller operations diversified. Though, the international drug trade became less concentrated and DTOs more heterogeneous in both size and functions, the broader conditions of illicitness and internationality were still present and still fostered incentives for DTOs to seek and secure market dominance whenever possible and displace competitors. Hence, leadership churn within DTOs and DTO conflict throughout the larger drug trade were typically violent processes (Dickenson, 2014; Phillips, 2015). As a result, the aggregate flow of narcotics between South America, Central America and the U.S. was largely maintained (UNODC, 2010, p. 68). The notable players of the 1990s included the Sinaloa, Juárez, Gulf, Tijuana, and Familia Michoacana Cartels (Beittel, 2017). We briefly describe the historic operations and changes of each below.

The Sinaloa Cartel began as one of several inheritor operations from the break up of the Guadalejara Cartel (approximately 1989). Sinaloa's specific prominence was most expanded under the reign of Joaquin "El Chapo" Guzman Loera, whose effective leadership was not disrupted despite Guzman's incarceration from a failed assassination attempt against rival DTO leadership during the early 1990s. Lacking his presence, Sinaloa receded from a traditionally territory-oriented cartel and instead began to diversify in the services of cross-national trafficking and armed violence.

Founded during the 1970s, The Juarez Cartel controlled much of the drug trade across the Mexican and U.S. border until the 1990s. A similar targeted killing of the Juarez captain, Pablo Acosta Villarreal in 1987, began a process of leadership turnover and ultimately the cartel's decline and eventual takeover by Sinaloa. Rafael Aguilar Guajardo took over after Villarreal's death, but soon passed the reigns onto Amado Carillo Fuentes. Under Fuentes control, the Juarez cartel sustained itself through a series of strategic alliances until Guzman's prison escape and eventual returned dominance of Sinaloa

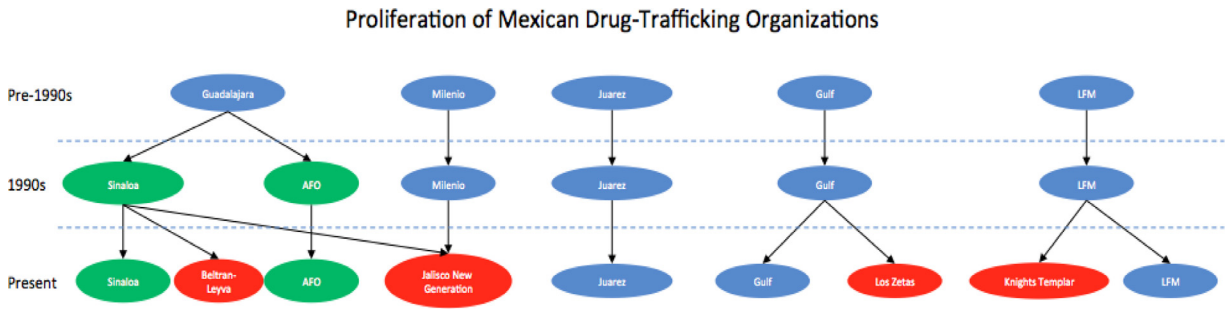

Fig. 3. Timeline of DTOs.

(Longmire and Longmire, 2008). Yet, after the launch of Calderon's more expansive kingpin efforts, Juarez broke back away from Sinaloa in 2008 (Beittel, 2017, p. 15).

Operated out of Matamoros Tamaulipas, Mexico across from Brownsville Texas, The Gulf Cartel is more diversified across different illicit service functions than other DTOs. The Gulf first entered the illicit market during alcohol prohibition in the 1930s, but carved a substantial cocaine market share apart from the Cali cartel during the 1980s. In the 1990s Gulf leader, Juan Garcia Abrego was also targeted and arrested. Again, a process of leadership turnover transpired, along with internal violent conflict. In 1999 Osiel Cardenas Guillen assassinated his rival Salvador Gomes Herrera and took primary control. Perhaps seeking to enhance Gulf Cartel's comparative advantage in violence, Cardenas spent substantial effort recruiting former disaffected members of the Mexican military (McCaul, 2006). These militants eventually splintered into the independent and more narrowly specialized Los Zetas DTO. Zetas is today one of the most technologically sophisticated and violent operations in the drug trade, their current role is distinct from the traditional drug cartels of old, as they often specialize in violent protection and extortion services for hire by other cartels (pp. 106–108).

In operation since the 1980s, the Tijuana Cartel was noted as a major player in the international drug trade as recently as 2001 (Bagley, 2012, p. 8). The remaining early 2000s brought a sequence of dynamic interactions for Tijuana. While alliances were reported with Oaxaca Cartel (another smaller operation, reserved geographically within its own state) (Cook, 2007), in 2011 Tijuana suffered major losses amidst brutal territorial shootouts with Sinaloa. Today the Tijuana Cartel is a much smaller and more specialized trafficking operation with fewer vested interests in either producing narcotics or competing for market share against rival cartels.

The founding of La Familia Michoacana was relatively distinct from the other major cartels described above. In particular, Michoacana began in the 1980s by appealing to the interests and needs of rural Mexican communities. Social order had significantly unraveled in poorer areas, hence Michoacana both provided needed services of security and governance while also appealing to local ideologies surrounding family, religion, and solidarity with the rural poor. Michoacana was once formally allied with the Gulf Cartel, in conjunction with Gulf's more violently specialized armed wing, Los Zetas. The Michoacana splintered from Zetas and it's associated Gulf alliances in concert with the launch of Calderon's kingpin strategy in 2006 (Cook, 2007).

In summary, prior to the early 2000s existing DTOs tended towards operational growth and expanded market influence. However, since the late 1990s and especially since kingpin targeting in 2006, several major cartels splintered into smaller scale operations.[9] Thus, there has been a substantial increase in the overall number of DTOs. Many attribute the growth in the number of DTOs to the tactics of the Mexican government under Calderón (Beittel, 2017). As described above throughout the late 1990s and early 2000s despite splintering effects, smaller outfits engaged in substantial levels of anti-competitive violence to regrow market dominance and displace rival DTOs.

In the wake of Calderon's presidency, overt kingpin efforts have partially subsided, but the international drug trade has not proportionately re-concentrated as a greater number of smaller scale DTOs persist, as does inter-DTO violent contestation. Furthermore, the previously typical trends of expanding operations and securing market dominance are less apparent. Smaller firms do not seem to be exploiting the economies of scale associated with the agricultural components of drug production. Small DTOs are instead choosing to remain small, independent, and decentralized. Drawing from field interviews in Mexico during 2011, Bagley (2012, p. 9) recreates a sort of timeline of various DTOs in operation, tracking the splintering of 6 main cartels in 2006 to 12 DTOs in 2010. Though obviously not an exhaustive accounting, we have expanded upon his table with a longer timeline and attempted to add descriptive lines for important lineages; see Fig. 3 below.

[9] "In [a December 2012] interview with the radio network MVS, Attorney General Jesus Murillo Karam discussed the changes in the drug trafficking industry over the past several years: 'I would calculate between 60 and 80 [groups], including medium and small ones (Corcoran, 2012)." Similarly, Bagley (2012) tracks the splintering of 6 major DTOs in 2006 to 12 smaller operations in 2010. See also: Carpenter (2010), Shirk (2012), Heinle et al. (2015), and Kilpatrick (2014).

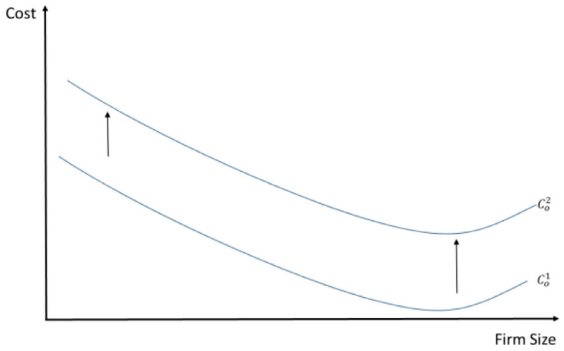

Fig. 4. Diminishing returns to economies of scale.

There is disagreement over whether the fragmentation of the DTOs is a desirable outcome.[10] While smaller organizations might seem easier to individually combat, intense competition between rival organizations has created a much more violent environment (Carpenter, 2010; Dickenson, 2014; Phillips, 2015; Lindo and Padilla-Romo, 2015). With the rise of new organizations like the Knights Templar, Beltrán-Leyva, Jalisco New Generation, and the brutal Los Zetas, much of Latin America has endured violent turmoil and the associated social costs of declined economic performance that come with it (Enamorado et al., 2014).

Furthermore, just as DTOs are adapting organizationally and beginning to specialize in drug trade related services apart from production and distribution, smaller DTOs are also likely re-vamping their proportioned product levels. In other words, a perhaps not so spurious correlation can be drawn between the expectations for future U.S. marijuana liberalizations, greater investment efforts towards heroin, and contemporary increases in opioid addictions and overdoses (Gavrilova et al., 2018). No easy law enforcement resolution appears obvious or available in the near future. What has developed is a twisted game of whack-a-mole. As one DTO is displaced another quickly replaces it, as DTOs have become more strategic and adaptable entities, and thus law enforcement resources are continuously strained.

To perceive this fragmentation as evidence that DTOs are losing force is a mistake. Los Zetas, which splintered off from the Gulf Cartel, was originally composed of members of an elite counter-insurgency group (Brands, 2009). The Jalisco New Generation Cartel is believed by some analysts to have the potential to reach the scope of the infamous Sinaloa Cartel's operations at its height (Beittel, 2017). Hence, we do not perceive the lessened concentration of the international drug trade as an obvious improvement, nor a necessary step towards better future outcomes. Our claim is merely that the sustainability of a greater number of smaller DTOs is evident and stands at odds with the predictions of basic industrial organizational theory and demands a closer examination and explanatory efforts.

4. Patterns of organizational cost in the international drug trade

From 2006–2012, Mexican federal prohibition efforts substantially embraced kingpin strategies by imposing an asymmetric structure of enforcement across differently sized suppliers. This asymmetry partially offset the incentives for organizational growth and in turn offset the tendencies towards high levels of market concentration. Amidst this asymmetric cost structure, DTOs adapted away from their normal strategic behaviors to maintain profits and better cope with the newly structured costs of prohibition. Under targeted prohibition, operating costs for international DTOs are not likely to be uniformly decreasing in organization size (as depicted in Fig. 1 above). Instead, larger DTOs face greater costs than smaller operations. Hence, the right side of the cost function likely rises for larger firms, as shown in Fig. 4 below.

Again, we depict a general shift in operating costs ($C^2 > C^1$) to represent the larger sustainable organization size in illicit relative to traditional trades, but notice with rising costs on the largest providers, the global minimal cost for a higher function will result in lower average firm sizes and a greater number of firms than with a uniformly downward sloping structure.

Fig. 5 below outlines some strategic decisions DTOs face when entering into and operating within the international drug trade. First, DTOs choose whether to organize into small or large-scale production units. Second, Fig. 4 identifies the different opportunities across small and large DTOs once they are established within the international drug trade. In the presence of targeted prohibition, existing DTOs and new entrants alike face increased costs of selecting larger scale operations. With more intensive prohibition efforts, larger DTOs either pay higher bribes to curry influence with officials or leverage more violent resources to fight against law enforcement. Smaller DTOs are encouraged to avoid these costs by staying small.

[10] Given, the inherently violent tasks of governance, Buchanan (1973), Backhaus (1979), and Chang et al. (2005) have all argued that the socially efficient level of organized crime can be greater than zero (Sobel and Osoba, 2009 provide empirical support). Whether the social welfare losses of decentralized crime are greater or less than those that stem from organized crime is an empirical matter shaped by local market conditions and enforcement strategies.

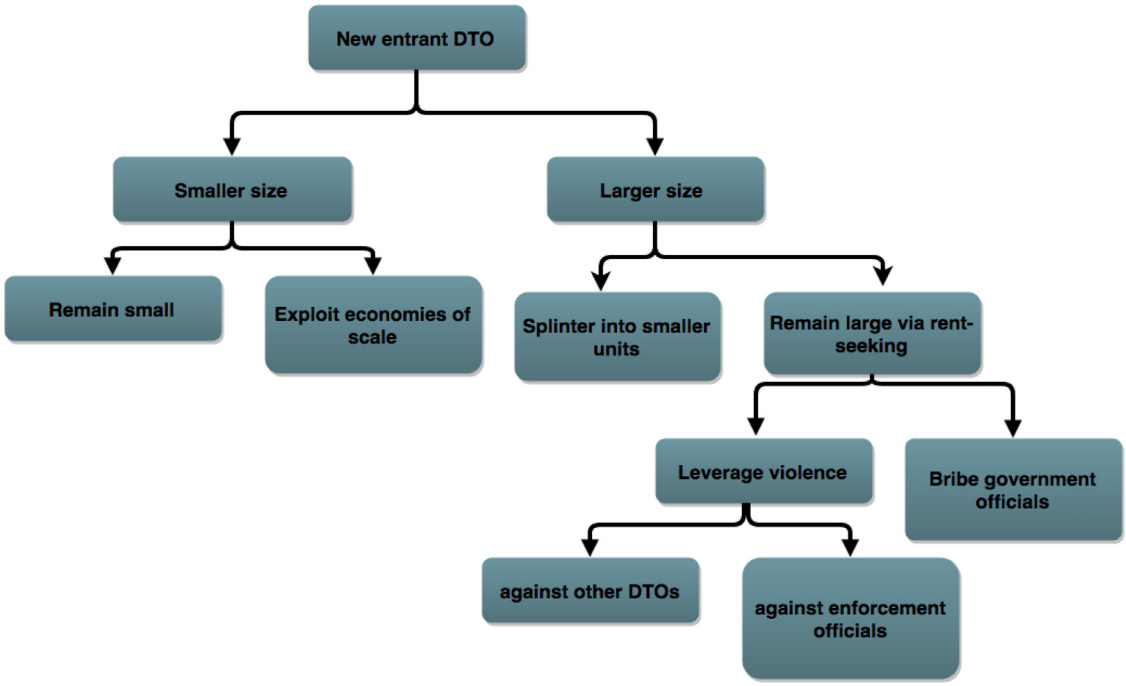

Fig. 5. Strategic opportunities across differently sized DTOs.

Simultaneously, individual members within larger DTOs perceive new profit potentials from splintering into smaller units as opposed to leveraging bribery or violence in order to remain large.

Next, we attempt to explain the persistence of small scale DTOs and low market concentration since 2012, Calderon's departure from office, and the substantial relaxing of kingpin programs. Not only did larger firms splinter into smaller units, but also, despite the passage of time and a substantial reduction of targeted prohibition efforts, smaller and mid-sized DTOs have continued to avoid growth and or re-unification. We argue that larger DTOs persistently face higher costs than smaller firms even under the relatively diminished kingpin conditions after 2012 from two primary sources. First, and most obviously, the mere expectations set by decapitation efforts likely deters splintered firms from re-growing or merging into larger operations. This is unlikely to be the full story, as one would expect new start ups or new combinations of organizational mergers to eventually be tempted by the extreme profit potentials of economy of scale operations and market domination to inspire more frequent bouts of experimentation and in turn more frequent renewals or cycling of kingpin targeting.

Hence we argue secondly, that there are persistent and systematically greater production costs for larger DTOs in the less concentrated market. Apart from the increased challenges associated with illicit and international conditions, unique costs stem from the heightened competition and reduced concentration in the post 2006 international drug trade. We argue that this dynamic aspect of operating costs has not been well captured by standard theory. Hence we adjust a traditional cost function (Baumol et al., 1982) to twist rather than shift, as in Fig. 6 below.[11] Amidst less concentrated conditions, changes in industry wide operating costs tend to exaggerate the asymmetric structure felt across differently sized DTOs.

Changing cost functions impose greater expenses on larger DTOs, but reduce operational challenges for smaller DTOs. Such makes intuitive sense when situated within the decision tree outlined in Fig. 5. Large DTOs face a strategic decision to either spend additional amounts via rent seeking or splinter into smaller operations. Rent seeking can take form as either bribery to government officials for complicit enforcement or as investments in violent resources to counteract enforcement officials and or suppress competition. Both forms of rent seeking and both manifestations of violence are more costly in the less concentrated environment. Hence smaller DTOs and splintered operations continuously avoid the extra costs of operating as larger units.

The primary reason for the pivoting nature of our proposed cost curve is the influence of increased interaction with a greater number of supplier DTOs. There are multiple reasons to suspect that the asymmetric structure of operating costs exaggerates under lessened market concentration. First, larger firms expend more resources to evade punishments and or obtain political influence amidst the more targeted enforcement regime. Government resources are scarce. When prohibition efforts are dispersed across several smaller DTOs, the overall risk of losing assets, or an organization fully collapsing, are

[11] Similar relative price effects were theorized by Alchian and Allen (1964) and modeled similarly through pivoting dynamics in deciphering between Slutsky versus Hicks substitution effects (Varian, 2014).

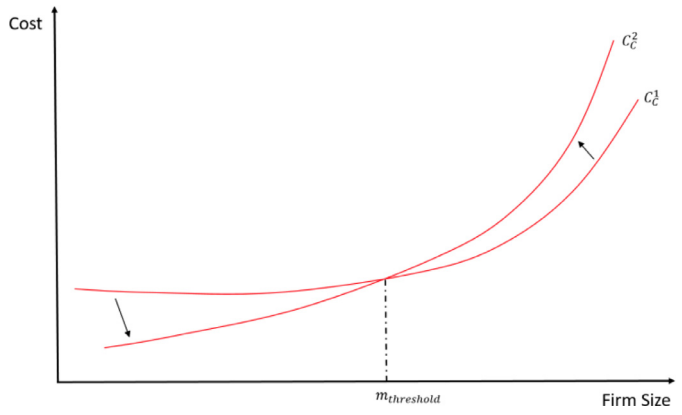

Fig. 6. Coalescence cost curve.

lower. In turn, smaller DTOs obtain relative benefits amidst lessened market concentration. Avoiding targeted enforcement is increasingly easier for small DTOs as the number of suppliers increases. Colombian trafficking history is a lesson to this effect. Whereas the Medellín Cartel relied upon a highly centralized leadership under Pablo Escobar, the rival Cali Cartel was a loose collection of 5 organizations (DEA, 1994). Hence, the relatively small Cali Cartel was able to establish their trafficking empire while enforcement efforts were focused upon larger operations.

Furthermore, the increased role of specialized services contributes to the asymmetric cost structure across differently sized DTOs. As noted, some cartelito operations have now abandoned production efforts dominated by material production and distribution in favor of narrowly focusing on trafficking and or providing violent services. With specialized violent services available, those smaller DTOs who specialize in non-violent services can better economize on the rate of return for their violent investments. In so far as they gain marginally more violent security and strength through outsourcing they will chose to externalize those costs. Hence inversely, larger DTOs face a greater and more efficient threat of violent contestation amidst lessened concentration.

Defection of current gang members away from larger DTOs is also a greater challenge in a less concentrated market. With more competitors in the market, laborers perceive greater and easier profit potentials from joining competitors or splintering away into new operations. Hence, larger DTOs have to expend even greater efforts to maintain coordination and internal compliance. At the same time, smaller firms obtain a strategic advantage as they confront a larger and more affordable labor supply.

Amidst lessened market concentration, DTO leaders face higher costs of merging or growing into larger organizations. We term these "coalescence costs." Coalescence costs are unique to organizations that face substantial challenges to continued operation (as opposed to startup costs). We can think of coalescence costs as the costs associated with coordinating resources given the size of the firm. In this vein, coalescence costs are primarily driven by 1) the risk of capture and 2) the costs of collective action within the organization.

The combination of these two factors produces a cost function with interesting dynamics. Given the opposing forces, there should exist some threshold firm size at which the forces offset. At this configuration, increased federal pressure means cooperation would increase the risk of capture but at the same time reduce the costs of collective action. Under the kingpin strategy, firms at this threshold level perceive as much risk in concentrating their supply chains as they perceive benefits from a more fluid allocation of resources. See Fig. 7 below.

C_o represents typical operating costs as explained earlier and represented in Fig. 1. The function C_c above represents our dynamic model of coalescence costs. Shocks to the coalescence cost curve do not uniformly shift it one way or another. Rather, it exhibits a "twisting" action about the threshold point m. So long as coalescence costs are a substantial and or especially dominant form of total operating costs, total operating costs represented by C_t will also exhibit a similar twisting dynamic. Given the relative stability of material production and shipment costs, if the median DTO size is lower than the threshold point, but output is stable, then the median output per DTO drops (as represented by the downward shift in Y_m).

For the duopolist, invigorated crackdown tactics makes it such that the advantages to merging the two existing firms due to decreased costs of collective action are not enough to offset the increased risk of capture. Hence, the duopolist experiences a rise in coalescence cost. On the other hand, the atomistic DTO perceives little to no risk from the federal crackdown, but has much to gain from the coordination of resources through collective action. Its coalescence cost falls in this environment. Collusion and centralization of decision-making in an environment with many DTOs would be very difficult, whereas within a market of fewer suppliers, fewer leadership structures are involved and can more efficiently reach decisions about the use of resources.

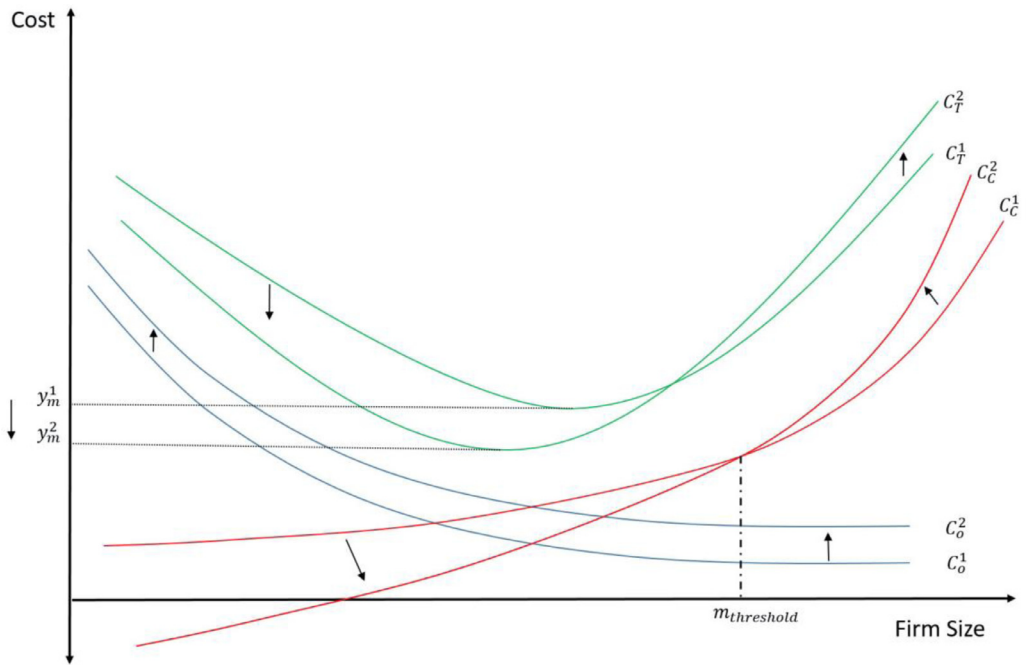

Fig. 7. Updated model of operating costs.

Table 1
Estimated drug seizures and eradications in Mexico[12].

	Govt. Spending		Seizures of Illegal Narcotics					Eradication		
	Mexican Public Security, Justice & Order Budget per Cuenta Publica (MXN bn)	US Aid to Mexico (mm USD)	Cocaine (Metric Tons, MT)	Heroin Seizures (kg)	Opium Gum (kg)	Marijuana (MT)	Meth (kg until 2010, then MT)	Opium Poppy (ha)	Marijuana (ha)	Production Labs
Annual average, pre-2006	2.7	21.4	27.0	249.8	297.8	1,335.1	330.4	16,291.7	26,286.3	17.5
Annual average, post-2006	71.3	137.6	14.2	287.7	689.5	1,487.4	12,670.9	13,110.0	12,529.6	150.1
Median, pre-2006	2.6	12.0	23.6	269.0	245.0	1,459.0	0.6	15,926.0	28,699.0	19.0
Median, post-2006	80.9	67.0	7.7	291.0	520.0	1,336.3	12,850.0	13,594.5	11,39.0	160.0

5. Empirical support

There are several examples of the sorts of splintering strategies predicted by our model of twisting rather than shifting cost curves. Los Zetas was originally a group of elite ex-special forces recruited by the Gulf Cartel (Freeman, 2006). Now considered the most brutal DTO in Mexico, they broke away in 2007 after the former Gulf Cartel leader was extradited to the United States (Brands, 2009). The Knights Templar is another extra-violent DTO that formed from a rift in La Familia Michoacana Cartel. By 2011, shortly after breaking away, the Knights had successfully claimed some of the territory of La Familia (Grillo, 2016). The Beltrán-Leyva Organization broke away from the Sinaloa Cartel in 2008 when Mexican authorities arrested a Sinaloa leader after reportedly receiving intelligence from within the gang's leadership (Beittel, 2017). Cartel Jalisco-New Generation, which garnered notoriety for its 2015 shooting down of a military helicopter, was one of two DTOs that spawned from the decades-old Milenio Cartel.

Aggregate empirics also comport to our proposed narrative. Federal prohibition efforts heightened in 2006, and subsequently reshaped the equilibrium composition of firm sizes and competition throughout the illicit international market. The U.S. government's *International Narcotics Control Strategy Reports* shows declining estimates for drug confiscations and eradications after 2006 (INCSR, 2016). When juxtaposed against Mexican federal military spending, the two trends appear

[12] All data taken from INCSR (1993–2016).

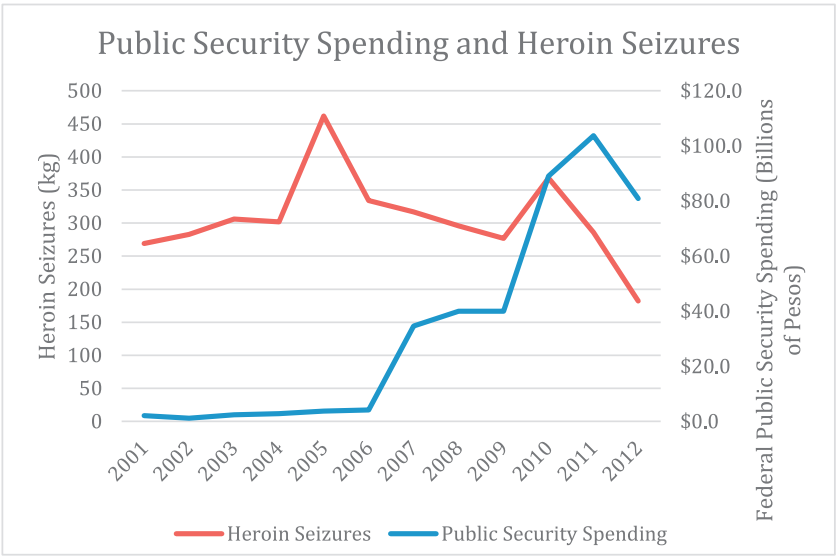

Fig. 8. Public security spending and heroin seizures.

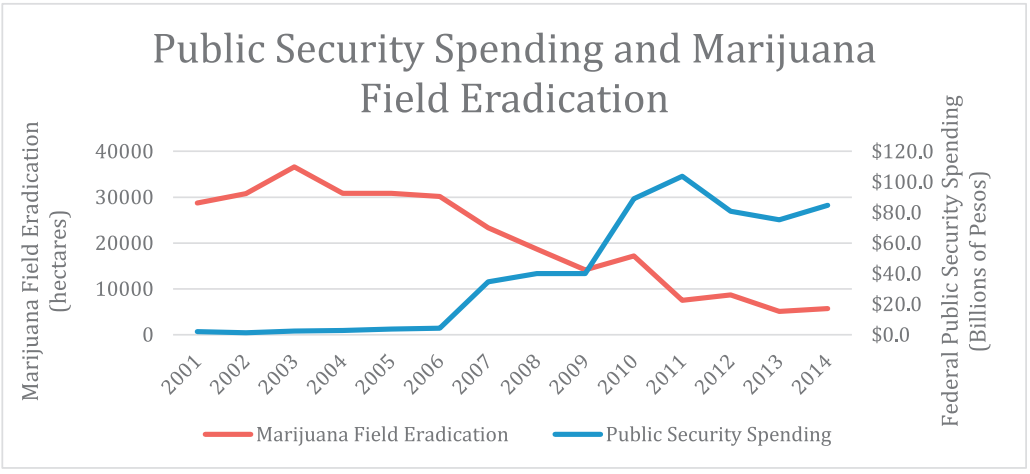

Fig. 9. Public security spending and marijuana field eradication.

inversely related after 2006. This is especially pronounced for heroin seizures, marijuana field eradications and cocaine seizures as shown in Figs. 8, 9, and 10 respectively. 2006 marks a distinct change in the growth rate of military spending and yet a similar marked decline in the average rate of eradications and seizures.

Using 2006 as our benchmark year, we notice also, lower average annual seizures of Cocaine, lower median seizures of Cocaine and Marijuana, lower average annual eradications and lower median eradications of opium poppy and marijuana. See Table 1 below.

First and foremost we lack accurate and reliable quantity estimates regarding drugs produced, distributed and or consumed. Given the punitive threats of prohibition, data surrounding eradications and confiscations are inherently biased. Hence, empirical verification of the specific causal processes we are describing is difficult to establish. One obvious possibility is that targeted prohibition effectively curtailed cultivation, hence the decline in seizures. However, related evidence regarding the estimations of drugs consumed and perceptions of drug consumption and health related expenses tell a narrative closer to ours, rather than one of effective and successful prohibition efforts (UNODC, 2017). In short, estimated opiate usage, perceptions of opiate usage and overdose rates therefrom have all substantially grown for the U.S. in recent years (ibid., pp. 22–23). Similarly, data from the U.S. and Canada show strong correlations between estimated usage and seizure rates for cocaine, of which little to none is domestically grown (ibid., p. 28). Hence, it seems reasonable to infer that foreign production and distribution of such narcotics has not been substantially curtailed despite ever more expensive prohibition efforts.

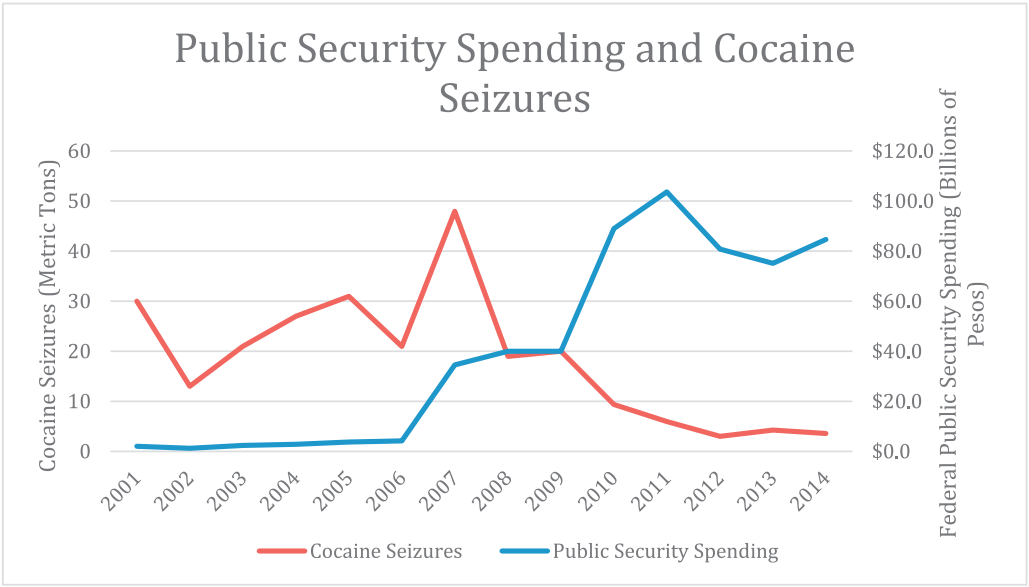

Fig. 10. Public security spending and cocaine seizures.

Table 2
Violent crime in Mexico.[13]

	assault			kidnapping			intentional homicide	
	count	rate	%chnage	count	rate	%chnage	count	rate
2003				169	0.16		10,087	9.44
2004	246,338	227.55		323	0.30	0.875	9329	8.62
2005	239,166	217.92	−0.042	325	0.30	0	9921	9.04
2006	245,507	220.42	0.011	595	0.53	0.767	10,452	9.38
03–06 averages	243,670.333	221.963333	−0.0155	353	0.3225	0.547333333	9947.25	9.12
2007	261,295	230.95	0.048	438	0.39	−0.492	8867	7.84
2008	250,932	218.25	−0.054	907	0.79	1.026	14,006	12.18
2009	244,623	209.41	−0.041	1162	0.99	0.253	19,803	16.95
2010	230,687	194.48	−0.071	1284	1.08	0.091	25,757	21.71
2011	212,141	176.25	−0.094	1344	1.12	0.037	27,213	22.61
2012	211,921	173.60	−0.015	1512	1.24	0.107	25,967	21.27
2013	211,714	171.10	−0.014	1888	1.53	0.234	23,063	18.64
2014	39,937	31.85	−0.814	1621	1.29	−0.157	20,010	15.96
2015	45,452	35.78	0.123	1160	0.91	−0.295	20,762	16.35
	189855.778	160.185556	0.1035556	1257.33333	1.03777778		20605.3333	17.0566667

While the DEA states that its biggest concerns lie with the Sinaloa Cartel, which controls anywhere from 40–60% of Mexico's drug trade and earns an estimated $3 billion annually, no DTO in existence today ought to be considered innocuous (Beittel, 2017). In short, the Mexican government has failed to effectively suppress international DTOs and or mitigate their associated violence. Again while we do not have exact or detailed estimates of violence specifically associated with drug trafficking apart from latent levels of unrelated violent crime, we can see that our relevant time periods in question (prior to 2006, 2006–2012, and post 2012) appear to have substantially different rates and different rates of change for the forms of violent crime most relevant to drug trafficking over other forms of violent crime (kidnapping and intentional homicide relative to assault). See Table 2 below.

As can be seen, 2007–2012 nearly tripled the rate of kidnappings and doubled the rate of intentional killings as 2003–2006, with such heightened levels persisting into the post 2012 era.

We argue that the multiplicity of DTOs can be seen as a partial consequence of prohibition strategies deployed by national governments. In short, the militarized nature of prohibition enforcement in the international arena imposes costs structurally throughout the supply function of different DTOs. Hence, international enforcement efforts have incentivized the current organizational structure and market concentration of the international drug trade wherein multiple smaller firms are now the norm. Unfortunately this outcome appears to entail more violence than previous monopoly conditions.

[13] All data taken from UNODC (2017).

To assess the net social welfare impact of such policies would require fully accounting for such costs and weighting them against some objective benefits stemming from the absence of larger and previously notorious DTOs.

6. Conclusions

This paper provides several unique contributions. First, it fills a previous gap in the literature dedicated to the economics of crime and punishment, as only limited attention had been paid to the industrial organization of the specifically international drug trade. The cross national context of drug distribution makes for a unique setting of market incentives and prohibition strategies wherein the typical tendencies suppressing economies of scale appear to be reversed. The contemporary case of the cross-national Latin American drug trade represents a particular scenario wherein the tendencies for monopolistic behaviors, hierarchical organization, and high market concentration have been reshaped following a unique enforcement strategy. Secondly, this paper provides an explanation for the apparently puzzling features of the contemporary international drug trade. Previous theory suggested high market concentration but contemporary trends showed an increase in smaller-scale and less hierarchically ordered DTOs alongside more decentralized networks of competition. Low market concentration and the splintering of established drug cartels are first the bi-product of enforcement efforts specifically targeting large DTOs and leaders therein. Furthermore, the incentives against operating in large gangs and for splintering or remaining small are reaffirmed by the dynamic effects of strategic behaviors across differently sized DTOs amidst a less concentrated market. Large firms face higher costs of rent seeking via bribery, violence, and coordination costs while smaller firms gain a strategic advantage as their likelihood of being targeted by governments or large DTO competitors wane at the margin. Lastly, this paper provides a dynamic conception of relative changes in operating costs for the unique institutional setting of the contemporary international drug market. Changes in operating costs are not uniformly felt across all firms but accrue uniquely upon larger operations and marginally reduce operating costs for smaller producers.

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