Trade Effects on Substance Abuse: Evidence from Colombia's Liberalization

Julian Diaz-Gutierrez *

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Abstract

This paper examines the impact of trade liberalization on substance abuse in a developing country context. I study a unilateral reform implemented in Colombia in 2010, which reduced tariffs in the manufacturing and mining sectors. Using a Bartik-style measure of local exposure based on pre-reform employment composition and a continuous-treatment difference-in-differences design, I link tariff cuts to municipality-level rates of substance abuse between 2009 and 2014. The analysis relies on administrative health data covering the universe of hospitalizations and emergency room visits, allowing me to capture both intensive (patients) and extensive (services) margins and to distinguish by substance type. I find that municipalities more exposed to the reform experienced statistically significant increases in substance abuse relative to less exposed areas. The effects are driven by alcohol and cocaine, and are more pronounced among middle-aged individuals and women. Evidence from matched employment data suggests that labor market disruptions are a key mechanism. The findings highlight previously overlooked health externalities of trade policy.

JEL Classification: F13, I15, I18, R12

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*Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. Email: juliand3@illinois.edu. For their helpful comments and suggestions, I want to thank Mary Arends-Kuenning, Angelica Sanchez-Diaz, Brian Kovak, Gustavo Canavire-Bacarreza, Marin Skidmore, William Ridley, Hope Michelson, Catalina Herrera-Almanza, Teresa Serra, Carl Nelson, and the seminar participants at the AAEA annual meeting. I am solely responsible for this paper's content.

1 Introduction

Substance abuse is a major global health issue. According to the World Health Organization (WHO), about 1 in 20 adults (ages 15–64) used at least one drug in 2014, and nearly 12% of these individuals suffered from drug-related disorders, with overdose accounting for roughly one-third of drug-related deaths (UNODC, 2016). Although the burden of drug disorders is higher in more developed countries,[1] little is known about how low- and middle-income countries cope with substance abuse. One potential pathway is labor disruption resulting from trade liberalization. In both developed and developing economies, trade shocks in manufacturing and agriculture have been associated with job losses, lower wages, and transitions to less secure employment, particularly among low-skilled workers. Similar patterns are observed at the local economic level (Autor et al., 2013; Dix-Carneiro and Kovak, 2017; Zhou et al., 2022).

This paper examines whether trade liberalization affects substance abuse among the working-age population in Colombia, a country with ongoing economic liberalization and a long history of narcotics use (Dube and Vargas, 2013). Using a continuous-treatment difference-in-differences design, I find that local economies more exposed to the 2010 government-led tariff reform experienced larger increases in substance abuse relative to less exposed areas. The reform, particularly relevant for manufacturing and mining, lowered the average effective tariff from 12% in 2010 to 6.5% in 2013, increasing import competition.[2]

The analysis uses official records from Colombia's Ministry of Health, covering hospitalizations and emergency room (ER) visits in both public and private facilities. Data are classified according to international standards, allowing estimation of both intensive (increased incidence among patients) and extensive (increased demand for services) margins of substance abuse. Provider-reported data also reduce potential bias from self-reported substance use or diagnosis.

The relationship between trade exposure and substance abuse operates through

[1]Countries with high Human Development Index scores experience roughly twice the burden of drug use disorders compared with low- and medium-HDI countries (UNODC, 2016).

[2]Imports (in value) grew by 58% from 2010 to 2014, based on Colombia's Bureau of Statistics.

multiple mechanisms. The first is stress associated with employment and income shocks. Literature shows that involuntary job losses are linked to higher hospitalizations for alcohol-related conditions, self-harm, and traffic accidents (Browning and Heinesen, 2012; Keefe et al., 2002), as well as increased mortality from suicide and substance abuse (Eliason and Storrie, 2009). The health impacts of job loss are generally stronger with prolonged unemployment (Classen and Dunn, 2012). Risk of layoffs also affects mental health among workers and household members and is associated with greater consumption of antidepressants and medications for cardiovascular conditions (Bubonya et al., 2017; Bünnings et al., 2017; Jolly, 2020; Colantone et al., 2019; Hummels et al., 2016).

A second mechanism involves behavioral responses to income shocks. Some studies suggest that economic expansions increase risky behaviors, such as alcohol consumption, smoking, and dangerous driving, because the opportunity cost of leisure is high (Ruhm, 2000,0; Adda et al., 2009). Conversely, income reductions may improve some health behaviors through more leisure time for exercise, better nutrition, or reduced exposure to risky activities. However, the procyclicality of mortality has weakened in recent decades, with several causes of death showing limited or countercyclical responses to economic fluctuations (Ruhm, 2015).

My estimates indicate that after the 2010 reform (2011–2014), municipalities more exposed to trade experienced increases of 27% in patient cases and 30.5% in services provided. These effects are primarily driven by alcohol and cocaine use and are concentrated among middle-aged and older adults and women. Results are robust to alternative definitions of trade exposure, model specifications, and placebo tests. Administrative records for formal workers show that trade liberalization also led to short-run reductions in employment, firm creation, and average wages in more exposed local economies, consistent with a stress mechanism operating through labor markets.

To my knowledge, this is the first paper to evaluate the effect of trade liberalization on substance-specific abuse in a developing country. The study builds on Adda and Fawaz (2020), who analyze import competition from China and health outcomes in the U.S., showing that affected commuting zones experienced higher hospitalization and mortality rates, especially where non-routine tasks dominate. Related work by Carpenter et al. (2017) finds that state-level employment declines increase opioid abuse. This paper also contributes to the literature linking trade exposure and health outcomes (Colantone et al., 2019; Lang et al., 2019; McManus and Schaur, 2016; Pierce and Schott, 2020).

The remainder of the paper is organized as follows. Section 2 describes trade liberalization in Colombia, the 2010 tariff reform, and a brief overview of the healthcare system. Section 3 presents the identification and estimation strategies. Section 4 describes the data sources and summary statistics. Section 5 presents the empirical results and robustness checks. Section 6 concludes.

2 Background

2.1 Trade liberalization in Colombia

Colombia's external sector during the first half of the twentieth century has been characterized as an economy relatively dependent on coffee exports and, to a lesser extent, on other commodities under a protectionist scheme. However, with the subsequent drop in coffee prices at the beginning of the 1960s, Colombia began to promote its exports in the industrial sector, especially the textile and food production sectors under the import substitution approach; that is, protecting labor-intensive sectors at the same time as importing some capital inputs for the national industry. Since the 1970s, the Colombian economy has been transitioning out of protectionism through changes in tariffs:[3] the nominal tariff went from 51.9% in 1970 to 25.9% in 1981 and 6.1% in 1991 (Garay, 1998). During the period known as *La Apertura* (1991-1994), Colombia aimed at changing the structure of tariffs, as sectors with initial high levels of protection were

[3]Non-tariff measures such as import quotas tend to be more complicated to monitor over time and by economic sector. According to Goldberg and Pavcnik (2007), the correlation between tariffs and non-tariff measures tends to be high, so the omission of non-tariff barriers does not represent a problem for this research.

the ones with largest cuts but those with already low tariff levels had modest tariff cuts. Further, the dispersion across tariff lines was reduced and non-tariff measures were also eased by 1% (Eslava et al., 2004).[4]

The adoption of unilateral industrial policies and multilateral agreements have in part been influenced by international consensus and attempts for commercial integration with other counties in Latin America (Nieto, 2016). In 1981 Colombia's entry into the General Agreement on Tariffs and Trade (GATT)[5] allowed it to take a first step in consolidating trade policies aligned with other countries. Also, from 2002 to 2007 Colombia maintained the same tariff scheme with countries in the region (Bolivia, Ecuador, Peru, Venezuela) known as the Common External Tariff (CET), which meant that the tariff policy was practically unchanged during that time within the framework of the Andean Community (AC). In 2008 Colombia stopped participating in the CET, which allowed it to adopt tariff policies that were less dependent on agreements between the AC countries (Rivera Pérez et al., 2021).

In 2010, the incoming government of President Juan Manuel Santos proposed a structural tariff policy, which would reduce tariffs in the manufacturing and mining sectors for intermediate and final goods (Decree 4114 of 2010).[6] For the agricultural sector there would be no major changes and some protection safeguards when the international prices did not favor national goods.[7] Figure 1 Panel A shows that the average tariffs went from 12% in 2010 to 8% in 2011 and 6.5% in 2013.[8] Figure 1 Panel B displays the evolution of tariffs by sector. It can be seen that the tariffs in the manufacturing sector fall immediately after 2010, while the mining sector experiences major cuts by 2014. As mentioned above, the agricultural sector was widely unaffected

[4]Altogether, going from a protectionist agenda to a more liberalized economy entailed costs in the short and medium run, in terms of employment (Goldberg and Pavcnik, 2003); poverty and inequality (Goldberg and Pavcnik, 2007). For a survey on the political economy of trade liberalization in Colombia, see Echeverry and Santamaria (2004).

[5]In 1995 GATT would be part of the World Trade Organization (WTO).

[6]Some tradeable services were included in the policy reduction. Following Kovak (2013) and Dix-Carneiro and Kovak (2017) our analysis is focused on the tradable sectors only.

[7]For example, the Andean System of Price Bands (ASPB) worked with a ceiling price, a floor price and a reference price for each of 13 agricultural products that were sensitive to changes in international prices. Even after the reform in 2010 the ASPB was kept in place.

[8]Following the unilateral tariff cuts in 2010 (irrespective of any country), Colombia signed Free Trade Agreements with the United States (2012), the European Union (2013), and South Korea (2016).

by the reform so it will be omitted from the main analysis.

2.2 Healthcare system in Colombia

The main hypothesis of this paper is that the enactment of tariff cuts followed by the reform impacted workers' health through an increasing rate of substance abuse. This subsection briefly explains the general structure of Colombia's healthcare system: its two insurance regimes and the way they operate to provide medical services.

In Colombia there are two types of regimes for access to health services: contributory and subsidized, covering the beneficiary's dependent family members (children and spouse). In the contributory regime people pay to the social security system through payroll, this includes those directly employed by firms and self-employed workers.[9] Payment for health and pension contributions in this regime is mandatory for all formal employees. The subsidized regime, on the other hand, includes people in conditions of vulnerability, who must meet a poverty score or be part of a susceptible group to belong to this regime. In general terms, healthcare coverage is above 95%, and it is estimated that 56% of those insured are part of the subsidized regime and 44% of the contributory regime (Camacho and Mejía, 2017).

Nearly universal access to healthcare allows for coverage of generalist and specialist medical attention at a moderate cost, and in the event of an emergency, those without insurance can be seen without restriction. According to the Demographic Health Survey (DHS) in 2015, the percentage of respondents with health problems who sought medical treatment (e.g., a doctor, therapist, hospital, clinic, ER) within the last 30 days was 64.6%. The remaining 35.4% went to a drug store (8.5%), prepared homemade remedies (9.7%), self-medicated (13.9%), or did not seek for any medical assistance (3.3%) (Profamilia, 2015). For those in the contributory regime, access to consultations and procedures has a fixed copay based on their income. If the employee earns less than two minimum wages, he pays 11.7% of the daily minimum wage; between 2 and 5

[9]In the contributory regime, the health contribution is 12.5% of the monthly salary, of which 8.5% is paid by the employer and 4% by the employee. The pension contribution is 16%, of which 12% is paid by the employer and 4% by the employee. Independent contractors must pay for both health and pension contributions over 40% of the gross monthly value of the contract

minimum wages 46% of the daily minimum wage, and those who earn more than five minimum wages pay 121.5% of the daily minimum wage. In the subsidized regime people do not have to pay for any medical consultation or emergency, but in some cases a capped copay of 10% for the total cost of medical services must be paid by the beneficiary.[10]

The above is consistent with the comparatively low cost incurred by patients: as a percentage of current health expenditures, out-of-pocket expenditure was 16%, lower than the average in Latin America (29.8%), middle income countries (36.39%) and upper-middle income countries (32.5%), respectively .[11] Thus, my analysis benefits from the broad access and inexpensive costs in medical services for the patients, as I intend to make inference at an aggregate level of increases in substance abuse as a response to trade liberalization. It alleviates the concern of self-selection into healthcare access based on confounders such as income. As I will discuss with further detail in section 4, the health records I employ are instrumental in providing a reliable source for substance abuse in Colombia.

3 Empirical strategy

3.1 Baseline model

I exploit the cross-sectional variation in exposure to trade at the municipality level,[12] as well as the timing of the policy induced by the 2010 tariff reform to estimate the effect of such reform on substance abuse in Colombia. The treatment variable is a Bartik-style version of a regional tariff vulnerability measure, TVM, widely used in the literature (Dix-Carneiro et al., 2018; Dix-Carneiro and Kovak, 2017; Erten et al., 2019). TVM is a weighted average of industry-level import tariffs during 1996-2005. It accounts for the employment composition of manufacturing and mining sectors in

[10]A comprehensive introduction to the set of benefits, costs and regulatory laws for the Colombian health system can be found here.

[11]Figures reported for 2014. Data comes from the Global Health Expenditure Database: https://apps.who.int/nha/database.

[12]Municipalities in Colombia are analogous to counties in the US. Colombia has 1120 municipalities.

2005 for a given municipality m, and the average 2-digit tariff of the Standard Industrial Classification (SIC) Revision 3 for industry j between 1996 and 2005 (see equation 1). TVM measures the *potential* exposure of a given municipality to the reform: the higher TVM is for a given municipality, the more vulnerable the municipality will be to subsequent tariff cuts. Figure 2 shows that there is considerable geographic variation across municipalities.

$$TVM_m = \sum_{j}^{J} \frac{Emp_{m,j,2005}}{TotalEmp_{m,2005}} \times \overline{Tariff}_{j,(1996-2005)} \tag{1}$$

This empirical approach follows a shift-share (or Bartik) design, which is widely used to estimate the effect of aggregate shocks on local outcomes (Autor et al., 2013; Goldsmith-Pinkham et al., 2020). The identification strategy leverages cross-sectional variation in initial industrial composition and national-level changes in tariffs. The key identifying assumption is that the interaction between pre-determined municipal employment shares and subsequent national tariff changes is as-good-as-random, conditional on the fixed effects and controls. This assumption would be violated if municipalities with a higher TVM were on differential trends in substance abuse unrelated to the reform. The parallel trends evidence presented in Section 5.1 and the battery of robustness and placebo tests in Section 5.2 provide support for the validity of this design.

It is important to mention that this episode of liberalization in Colombia (2010-2014) overlapped with negotiations of some bilateral trade agreements. For example, the Colombia-United States Free Trade Agreement (FTA) started negotiations in 2006. In 2007 and 2011 the Colombian and US congress approved its implementation, respectively. In 2012 all the different sections in the agreement took action. The fact that the terms of some trade agreements could have favored specific sectors in Colombia given their productivity or comparative advantage poses a potential threat to my identification strategy, as the government could have protected more (less) some sectors based on observable characteristics (e.g., employment, productivity) or any other unobserved factor. To circumvent this, I take into consideration the cross-sectional variation of employment composition in 2005, which helps to avoid any bias associated with anticipatory changes in sectoral dynamics as a response to the reform. Likewise, taking the average of tariffs in the period 1996-2005[13] helps to get around the concern of linking tariffs that could have been more favored in any round of negotiations while also capturing all information on tariffs available prior to the reform (Topalova, 2007).[14]

I employ Ordinary Least Squares (OLS) to estimate the baseline specification in Equation 2. Outcome Y for municipality m in year $t = \{2009, \ldots, 2014\}$ includes the rate of hospitalizations and ER visits due to substance abuse per 100,000 population to account for the likelihood that larger municipalities might have larger number of patients and services provided. The parameter of interest is β, which measures the impact of a change in TVM after the tariff cuts. $Post_t$ is a *dummy* variable that indicates the years after 2010. Time fixed effects (λ_t) and municipality fixed effects (μ_m) capture common shocks in a given year and municipality-invariant characteristics like geographic and institutional factors, respectively. Note that I do not include TVM separately in equation 2 as it would be absorbed by the municipality fixed effects.

$$Y_{m,t} = \alpha + \mu_m + \lambda_t + z_{mt} + \beta \left(TVM_m \times Post_t\right) + \sum_{\tau \in X_m} \gamma' \left(\tau \times Post_t\right) + \epsilon_{m,t} \tag{2}$$

In order to control for the effect of possible trade barriers, z_{mt} is an employment-weighted tariff for Colombia's exports to its main trading partners (Erten and Keskin, 2021).[15] X_m is a vector of municipality-level attributes measured before the reform (2005).[16] As it is common in the literature (Edmonds et al., 2010; Topalova, 2007), I interact each characteristic with $Post_t$ to flexibly control for differential trends that could affect the change in substance abuse, parameterized by each municipality char-

[13] I also use alternative specifications to test that my results are not driven by the period choice. See section 5.2.

[14] As noted by Kovak (2013) it is one of the key assumptions to validate if causality estimates are pursued: tariffs must be exogenous. It is, in sum, one of the reasons to choose equation 2 as the baseline specification.

[15] In alphabetical order, the trading partners that account for more than half of Colombia's exports in 2014 are: Brazil, Chile, China, Ecuador, India, Panama, Peru, United States, Venezuela.

[16] Table 1 Panel B provides summary statistics of these variables.

acteristic. X_m consists of the share of people that is between 18 and 24 years old, an index of poverty, the share of public investment in health and education, the share of employment in manufacturing, and the rate of homicides per 100,000 people. Including the share of people that is between 18 and 24 years old is important because it is the bracket of population that is more likely to consume drugs and other substances (Camacho González et al., 2016). The inclusion of the level of poverty in the form of unmet basic needs index, the share of public investment in health and education acts as a set of proxies that control for baseline economic and social conditions that could determine substance abuse, for example, through access to healthcare. I also control for the share of employment in manufacturing, as the sectoral composition of municipalities could be disproportional in other sectors other than manufacturing (Pierce and Schott, 2020). Finally, I include the rate of homicides per 100,000 population to account for the link between mental health and external factors, that is, places with higher incidence of violence could also have higher incidence of mental health problems, including substance abuse (Cuartas and Roy, 2019; Hessel et al., 2019; Molano et al., 2018).

3.2 Dynamic model

The main specification is a continuous version of a difference-in-difference model (DD). The underlying assumption of a DD model is that in the absence of treatment, control and treatment units would have followed a similar trend; thus, we would expect no effects before the year of the trade shock—2010. Using OLS, I test the legitimacy of the "parallel trends" assumption estimating the following model:[17]

$$Y_{m,t} = \alpha + \mu_m + \lambda_t + z_{mt} + \sum_{t \in T} \beta_t \left(TVM_m \times \delta_t \right) + \sum_{\tau \in X_m} \gamma' \left(\tau \times Post_t \right) + \epsilon_{m,t} \tag{3}$$

Where δ_t are dummies for each year, taking 2010 as the base year to avoid mul-

[17]Due to data limitations, I am only able to observe one year before the reform to explore pre-treatment dynamics.

ticollinearity. The parameters of interests are β_t, which measures the difference in outcome Y between municipalities that were highly exposed to the reform versus those relatively less exposed in year t relative to 2010, the year in which the reform was announced. In order to account for autocorrelation of the error term, equations 2 and 3 cluster standard errors at the municipality level (Bertrand et al., 2004).

4 Data

Health records: this research makes use of data from different sources. Data on health outcomes come from *Registros Individuales de Prestadores de Salud* (RIPS, per its Spanish acronym). RIPS data register the reported visits, hospitalizations and ER visits at the individual level from both public and private health providers across all of municipalities in Colombia, ranging from small clinics and laboratories to big hospitals. The provision of information to the centralized system (*Sistema Integrado de la Información de la Protección Social*, SISPRO) is required by Resolution 3374 of 2000, which mandates all health providers to report all procedures, costs, length of the visit and diagnostics to the Ministry of Health.

RIPS data codify diseases based on all levels of ICD-10.[18] I use municipality-based records provided by the Ministry of Health for the period 2009-2014 for the working-age population (18-65 years old), which allows me to observe health outcomes before and after the policy change. I am able to track the information on the overall number of hospitalizations and ER visits due to intoxication and harmful use of psychoactive substances (ICD-10 codes F10-F19) and all its coded sources: alcohol, hallucinogens, cannabinoids, cocaine, volatile solvents, multiple drugs, opiates, sedatives, tobacco and other stimulants.[19] In all cases, I compute the rate per 100,000 population.[20] Moreover, I observe the number of patients by condition and the number of services provided. It

[18]Listed by the World Trade Organization, ICD-10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems.

[19]To save space, the exact name of some variables was shortened. See table A1 for reference of each category definition based on ICD-10.

[20]All outcome variables are scaled by the municipality-level working-age population in any given year. Data come from population projections of the National Census in 2005.

allows me to evaluate effects on the intensive and extensive margins, respectively. Even though there could be some risk of misreporting given that I only observe actual ER visits and hospitalizations, RIPS data have been validated and used frequently in the literature as a source of health records in Colombia (Aristizabal-Mayor and Rosselli, 2016; Camacho and Mejía, 2017; Iregui-Bohórquez et al., 2019; Ordoñez, 2020).[21] Panel A of Table 1 shows descriptive statistics of substance abuse by source. For the period of analysis, the average level of substance abuse in patients is 4.84 per 100,000 people and 5.86 services per 100,000 people. Rates of abuse due to alcohol, multiple drugs and hallucinogens are the most common across municipalities on both patients and services provided. Figure 3 shows the rate of substance abuse for patients and services provided in the period of analysis. The increase has been dramatic: both rates of substance abuse were three times as high in 2014 as their levels in 2009.

Census and tariff data: I collect municipality-level data from Colombia's population census in 2005 using the Retrieval of Data for small areas by Microcomputer (REDATAM), a system supported by the population division of the Economic Commission for Latin America and the Caribbean. I calculate the initial levels of employment for the working-age population (men and women 18-65 years old) by industry at 2-digit SIC code for manufacturing and mining sectors in each municipality.[22] Most of the labor force (90.86%) works in the municipality where they live, so there should not be serious concern about attenuation bias due to measurement error.

Tariff data come from the World Integrated Trade Solution-World Trade Organization (WITS-WTO), which holds the import ad-valorem tariffs at 2-digit level for all industries in the desired time span.[23] I use the effectively applied tariffs for the time periods in our analysis. WITS-WTO tariffs data are derived from reports generated by the members of the WTO that normally apply to other countries under the most-favored nation's non-discriminatory principle (Mejía et al., 2018).

[21]Using RIPS also represents an advantage because it is available biannually since 2009, compared with other sources like the surveys available from the National Narcotics Administration, conducted in 1992, 1996 and 2008, and the National Suvey on Mental Health, conducted by the Ministry of Health in 1993, 1997, 2003 and 2015.

[22]I observe 27 sectors, excluding the non-tradeable sectors and agriculture.

[23]Data is available since 1996.

Employment data: for the exploration of mechanisms through the labor market, I use administrative data coming from *Planilla Integral de Liquidacion de Aportes* (PILA, as per its Spanish acronym). PILA data hold information on monthly wages, the number of employees, the number of establishments at the 4-digit level of SIC code Revision 3. These data allow me to track employment features for the formal sector, which accounts for around 60% of all workers. Just like RIPS, data coming from PILA are administered by SISPRO, so I have access to municipality-level information only. To avoid outliers due to the size of each municipality, the data that relates to employment and number of firms were re-scaled as rates per 100,000 people while data on monthly wages are kept as averages for each municipality-year cell. Since I can exactly match each variable to a corresponding SIC code, I perform all the analysis using the information for manufacturing and mining sectors only. The purpose of using these data is to test the relationship between employment and our treatment variable, so I will use equation 2 to model this mechanism.

Other data: finally, in order to account for baseline characteristics that could explain our health outcomes, I use the ready-to-use panel with an array of municipality characteristics put together by Universidad de los Andes (Acevedo and Bornacelly, 2014). It is the source of information to construct the vector of baseline characteristics for equations 2 and 3. The final dataset is comprised of 822 municipalities for each time period, which is the group of municipalities where nearly 70% of the working population lives.

5 Results

5.1 Baseline results

Table 2 presents the set of results for total substance abuse. Columns 1-4 each represent a different version of equation 2. Regressions include year and municipality fixed effects, baseline and time-varying controls, as discussed in section 3. All estimations cluster standard errors at the municipality level and report them in parenthesis. I present models for patients (intensive margin) and services (extensive margin) separately for each specification hereafter. I find a positive and statistically significant effect of trade liberalization on municipalities that were more exposed to the reform. Results for the most demanding specifications (columns 2 and 4) show that changes in one standard deviation of TVM increase the rate of substance abuse in patients and services by 0.86 and 1.13 after the reform, respectively. This means that following one standard deviation increase in TVM, the rate of substance abuse increased by 27% in patients and 30.5% in services with respect to the baseline mean value of the outcomes (2009 through 2010).

When looking at the different sources of the total substance abuse rate independently, Table 3 shows that trade liberalization increases the rate of substance abuse for almost all substances included in RIPS. The estimated coefficients are positive and statistically significant at conventional levels for alcohol and cocaine for both samples analyzed (columns 1 and 4 of Panel A and Panel B). With respect to the pre-intervention mean, the rate of abuse for alcohol increased 24.7% for patients and 28.2% for services, whereas for cocaine it increased 130.5% and 127%, respectively. Thus, our results in Table 2 are driven by increases in these two substances; drugs that tend to be of particularly high demand as indicated by Camacho González et al. (2016) using Colombia's most recent National Narcotics Directorate's surveys. Note, however, that unlike all the different sources in Table 3, only the coefficient for volatile solvents (column 5) is negative and not statistically different from zero. This could in part be explained because people might be substituting away from this type of drugs when affected by the income shock, more so for the population with lower income (Embleton et al., 2013; Masud and Khan, 2018).

One of the main assumptions of the empirical analysis is that prior to the enactment of tariff cuts, the dynamics of the outcomes were common across municipalities, and as a response to subsequent tariff cuts we would expect effects after the Colombian economy became more liberalized. Following model 3, Panel A of Figure 4 shows the estimates of the dynamic model for patients while Panel B estimates the same model for services. Both models control for the full set of covariates. There is evidence of close-to-zero effects prior to 2010, but there are statistically significant results in 2013 and 2014 for patients and significant results in 2013 for services. Further, Figures 5 and 6 suggest that there are dynamic effects following the reform on the samples of patients and services for alcohol, cocaine and opiates. Altogether it supports the use of model 2 as our baseline specification and suggests that, even though the process of liberalization hit rapidly the economic sectors under analysis (specially manufacturing), it took at least two years to see changes in total substance abuse to be materialized.

5.2 Robustness

In this section I run a series of robustness checks to validate the consistency and sensitivity of my main estimates (Table 2 Columns 1 and 4). Table A2 presents the results. I begin by estimating the same models as in equation 2 but now I include $Department \times Year$ fixed effects.[24] In addition to adding municipality fixed effects, by including these highly dimensional fixed effects, I am controlling for time shocks that happen at the department level on a given year.[25] I find that the estimates are unaffected by this inclusion (Table A2, Column 1) in terms of direction of the coefficient and its precision.

From equation 1, I aim at capturing the industrial composition of each municipality and the evolution of tariffs prior to the reform. I test whether my estimates are driven by a particular year in the definition of TVM through the sectoral evolution of tariffs (1996-2005). Thus, I re-define TVM using tariff data only for 2005 (see equation 1). Column 2 shows that the results are mostly unaffected by this change, which is naturally expected given the low variation in tariffs while Colombia was part of the CET (see Figure 1, Panels A and B).

One plausible concern is that my results could have also been driven by areas in which supply of drugs is more easily distributed. I run model 2 excluding from

[24]I estimate the following specification using OLS: $Y_{m,d.t} = \alpha + \mu_m + \lambda_{d,t} + z_{mt} + \beta_1 (TVM_m \times Post_t) + \sum_{\tau \in X_m} \gamma' (\tau \times Post_t) + \epsilon_{m,t}$.

[25]Colombia is comprised of 32 departments, an administrative unit similar to states

the analysis all municipalities where coca cultivation was present prior to the reform (2005). The results are robust to this exclusion as shown in Column 3. Moreover, the significance of the estimated effects do not disappear when only leaving the extremes in the distribution of TVM (dropping percentiles 30 through 70) on both the data for services and patients (Column 4).[26]

I run two additional exercises to further validate the causal interpretation of my estimates. First, I run equation 2 on a set of outcomes that plausibly could have not responded to short-term income shocks and distress: patients (services) with mental impairment and patients (services) of mental conditions present in childhood and teenage years. All these alternative outcome variables were scaled by population. I argue that these alternative outcomes should not be affected by the reform because its diagnosis has to do with long-term conditions that are either congenital or appear early in life, hence not related to negative income shocks.[27] The results for this falsification test are shown in Columns 1-4 of Table A3. I found no effects on the extensive or intensive margins for these conditions.

Second, I employ a non-parametric permutation test on the main estimates. In the spirit of Carrillo (2020) and Chetty et al. (2009), I randomize the cross-sectional composition of TVM 1,000 times and estimate equation 2 on every iteration. The share of estimates that are larger than the "true" estimates (Table 2, Columns 2 and 4) act as p-values for the hypothesis $\beta = 0$. The rationale of this test is as follows: if the reform had a significant effect on the rate of substance abuse in Colombia, then my estimates should fall in the right tail of the empirical distribution. Figure 7, Panels A and B shows the results for the data on patients and services, respectively. In all cases, the estimated β are located in the right tail of the empirical distribution with a p-value lower than 5%. Thus, I can be more confident that my results were driven by the reform and not by chance.

[26]This result is supplementary, as dropping a significant part of the sample takes away important variation for the analysis.

[27]These outcomes are observed in RIPS for the of working-age population.

5.3 Mechanism and heterogeneous effects

Labor as a possible mechanism: it has been documented in the literature that one possible mechanism through which substance abuse could increase is via labor market disruptions. As argued by Ruhm (2015), lower expectations and higher uncertainty in the labor market potentially leads to anxiety, thus to higher substance abuse. Using administrative data coming from PILA, I estimate equation 2. The results shown in Table 4 help to corroborate that trade liberalization induces costs to the economy (in the short run) reflected in lower employment, wages, and firm performance. I find that one standard unit increase in TVM leads to an average decrease in employment, number of firms and wages (in logs) of 16%, 19% and 0.4% with respect to their baseline values, respectively.

Heterogeneity: I explore a set of heterogenous effects by splitting the data on patients and services into age groups and by sex.[28] Table 5 reports the results using equation 2 by age group (Columns 1-4) and by sex (Columns 5-6). I find a suggestive gradient with age that is particularly significant at conventional levels for individuals between 35 and 44 years old and for those older than 45. Despair effects due to a negative income shock could be affecting more pronouncedly high-bearing risk groups in the population: those with more experience and tenure than those in younger cohorts who can smooth their consumption by, for example, living with their parents or relatives when the shock hits them. Particularly, for the case of Colombia Bonilla and Munoz (2019) find that on average high-skilled individuals working in manufacturing are more prone to employment and income loss relative to other groups, as a response to the United States-FTA.

The effects found by gender are more pronounced and statistically more precisely estimated for females than for males on both patients and services. On one hand, the literature documents that men are on average more affected in terms of employment and income due to negative income shocks (Ben Yahmed and Bombarda, 2020). How-

[28] Ideally we would have wanted to estimate interaction terms within each sample, however, due to the format RIPS is delivered it was not possible

ever, there is also evidence of negative spillovers to other family members. For instance, women tend to suffer from mental illness as a response to job losses of their partner and other intra-household complications like poor communication and domestic violence (Colantone et al., 2019; Chong and Velásquez, 2022; Erten and Keskin, 2021).

6 Conclusions

This study provides evidence that trade liberalization affects short-term substance abuse in Colombia. Following the 2010 structural tariff reform, municipalities more exposed to international trade experienced larger increases in total substance abuse, measured both by patients and services provided. These effects are largely driven by alcohol and cocaine use, particularly among middle-aged and older adults and women. The findings are consistent with literature linking import competition to stress and labor market disruptions, as trade exposure is associated with declines in formal employment, firm creation, and average wages. Spillover effects on household members may also contribute to increased substance abuse.

One limitation is that the treatment variable may also capture the effects of changes in input tariffs. The reform lowered tariffs on intermediate goods and capital, potentially mitigating local employment losses in some sectors (Edmonds et al., 2010). Data limitations prevent a direct assessment, but the robustness of the main results suggests that the estimated effects are not substantially affected.

These findings highlight that the benefits of trade reforms can be offset by significant social costs, necessitating integrated policy responses. To mitigate these adverse effects, policymakers should consider pairing trade liberalization with strengthened health and labor market interventions. On the demand side, targeted mental health and substance abuse programs are crucial in regions vulnerable to trade shocks, especially given that 4.5% of 18-44 year olds report mental health issues, but only 38.5% of those reporting mental health issues seek professional help (Minsalud, 2015). On the supply side, while our focus is on consumption, it is recognized that economic distress may also increase incentives for illicit drug production and trafficking. In fact, Colombia remains a major producer of narcotics, with 64% of global cocaine production in 2019 (UNODC, 2021). This underscores the need for comprehensive rural development and alternative livelihood programs.

Future research should explore the mechanisms through which trade and income shocks affect substance abuse in developing countries. By documenting a clear link between trade liberalization and substance abuse at the municipality level, this study highlights the unintended social costs of trade reforms and provides evidence to inform policies that can mitigate their impact on vulnerable populations.

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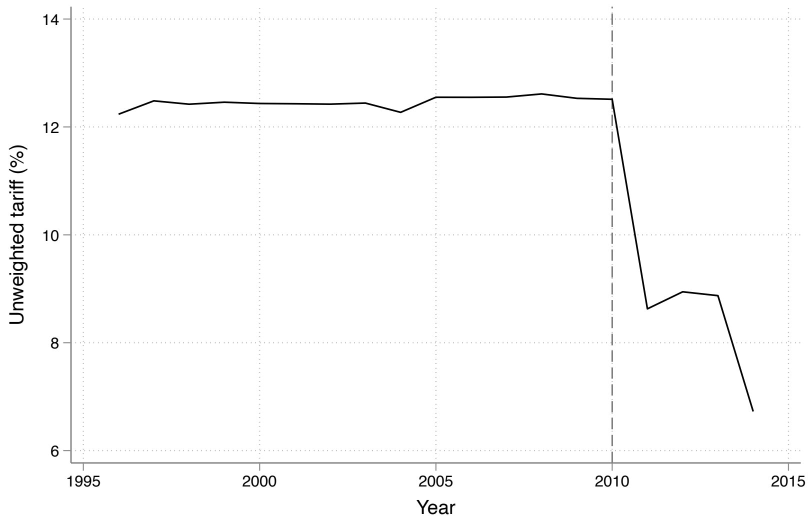
Figures and tables

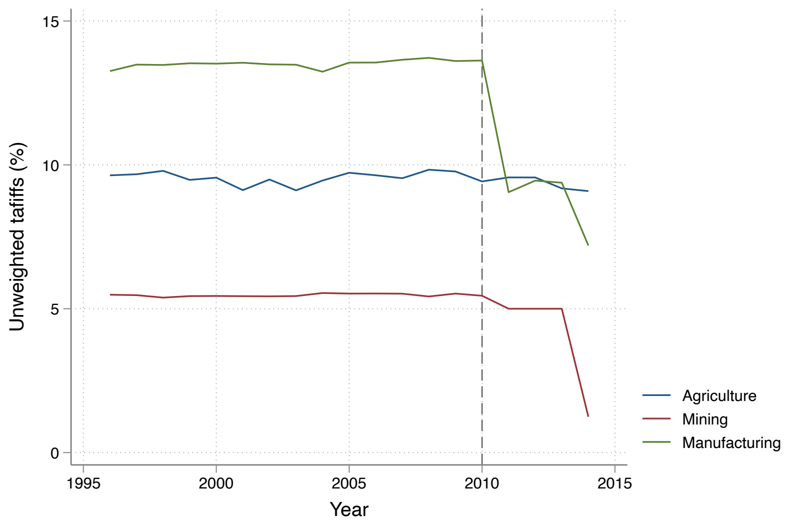
Figures

Figure 1: Evolution of tariffs

(a) Evolution of tariffs -all sectors

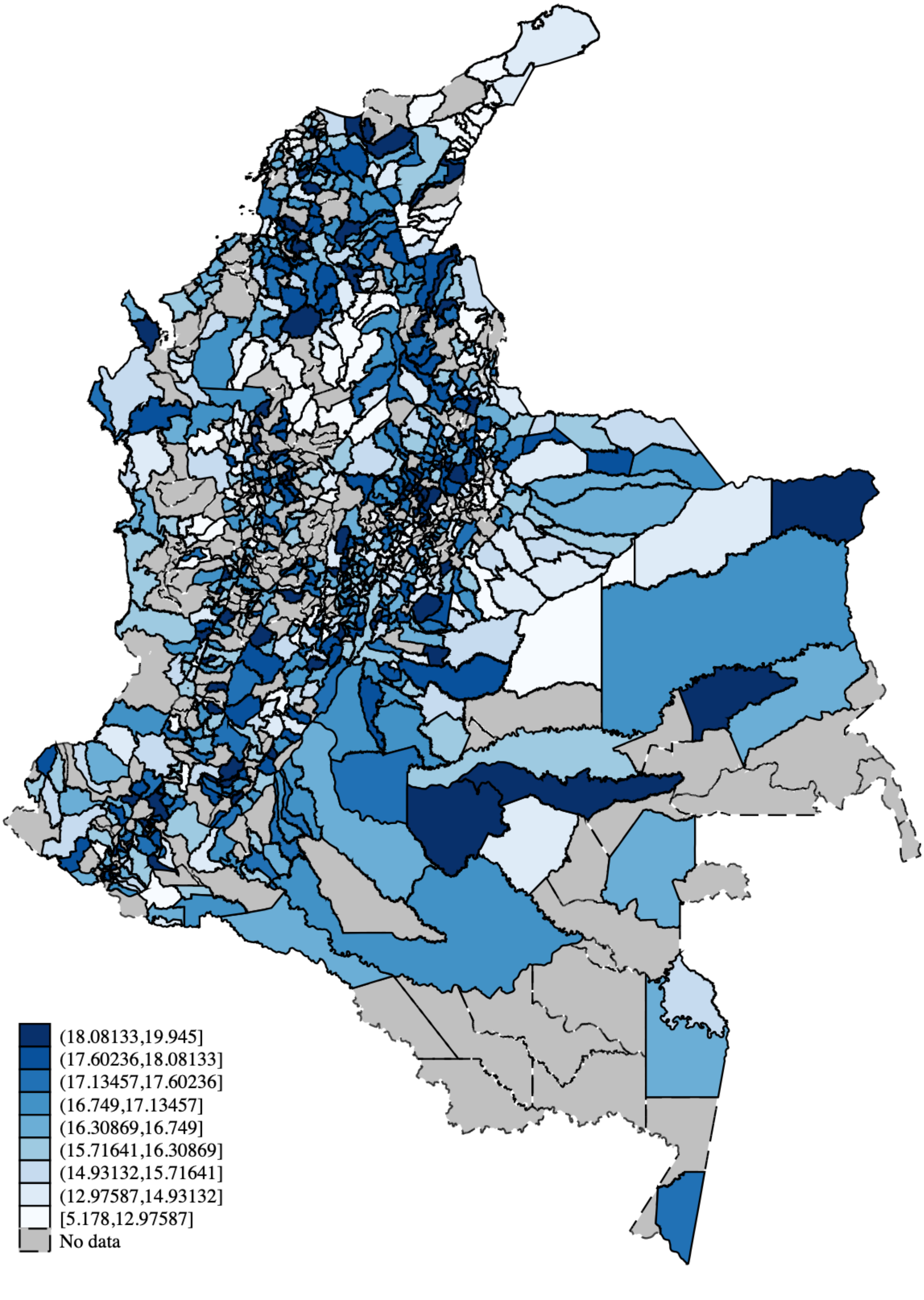


(b) Evolution of tariffs by economic sector



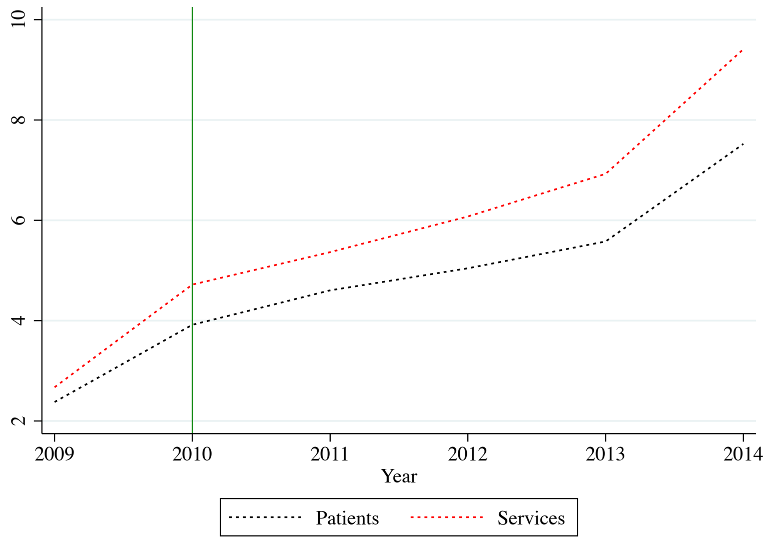
Note: Panel a shows the unweighted average of all tariffs across time. Panel b shows the unweighted mean of tariffs from 1-digit ISIC codes for selected economic sectors: agriculture, manufacturing and mining. Red dashed lines show when tariff cuts took place. Data source: WTO-WITS database.

Figure 2: Cross sectional variation of tariff vulnerability measure, 2005



Note: Own calculation using WTO-WITS data and the national population census. Darker (lighter) regions indicate higher (lower) tariff vulnerability.

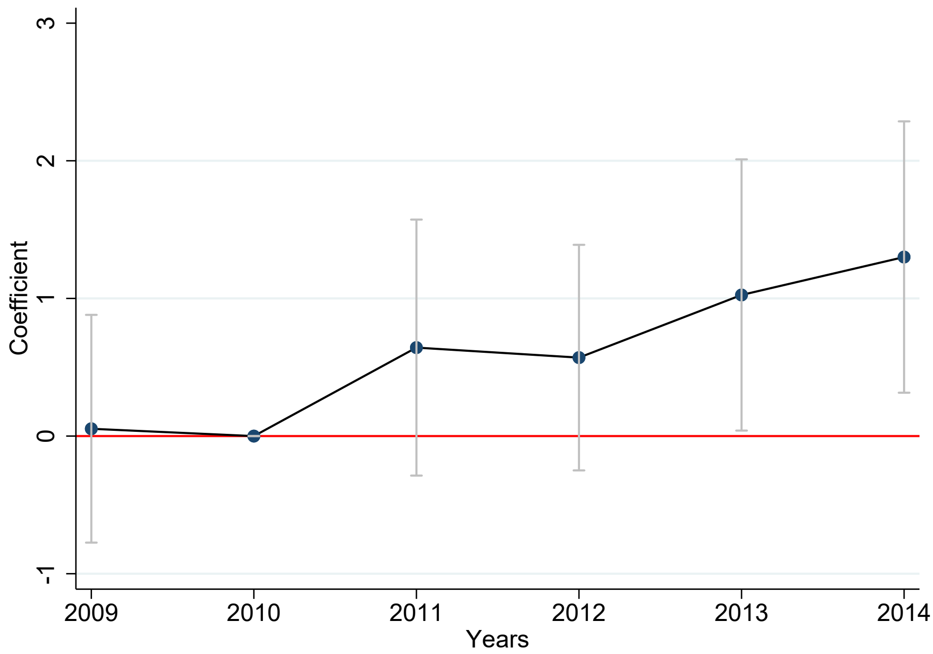
Figure 3: Evolution of mean hospitalizations due to substance abuse per 100,000 population



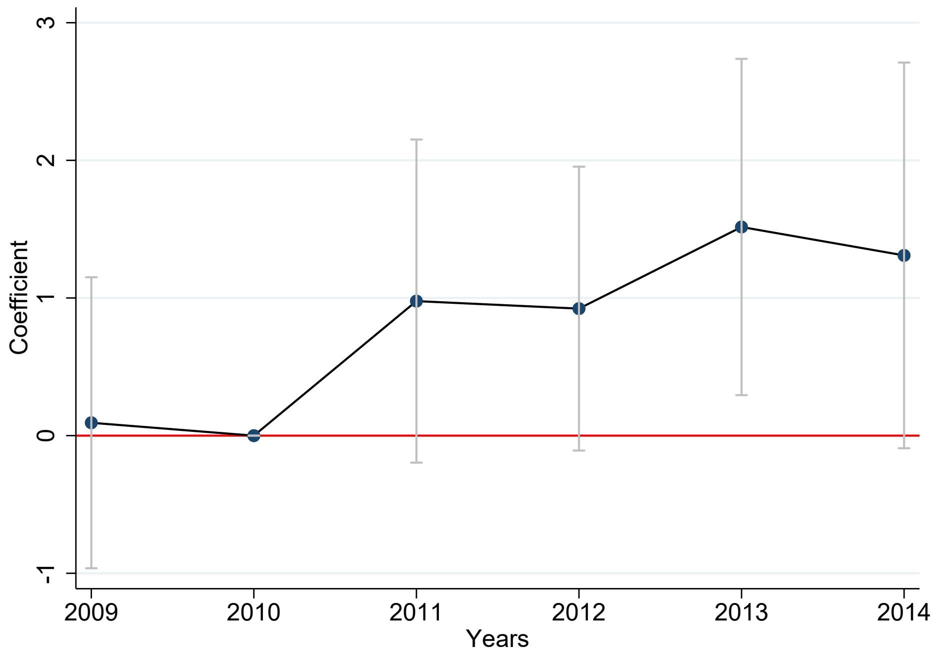
Note: Own calculation using RIPS data. Green line shows when tariff cuts took place.

Figure 4: Dynamic estimates of the effect of trade liberalization on total substance abuse

(a) With baseline controls -patients

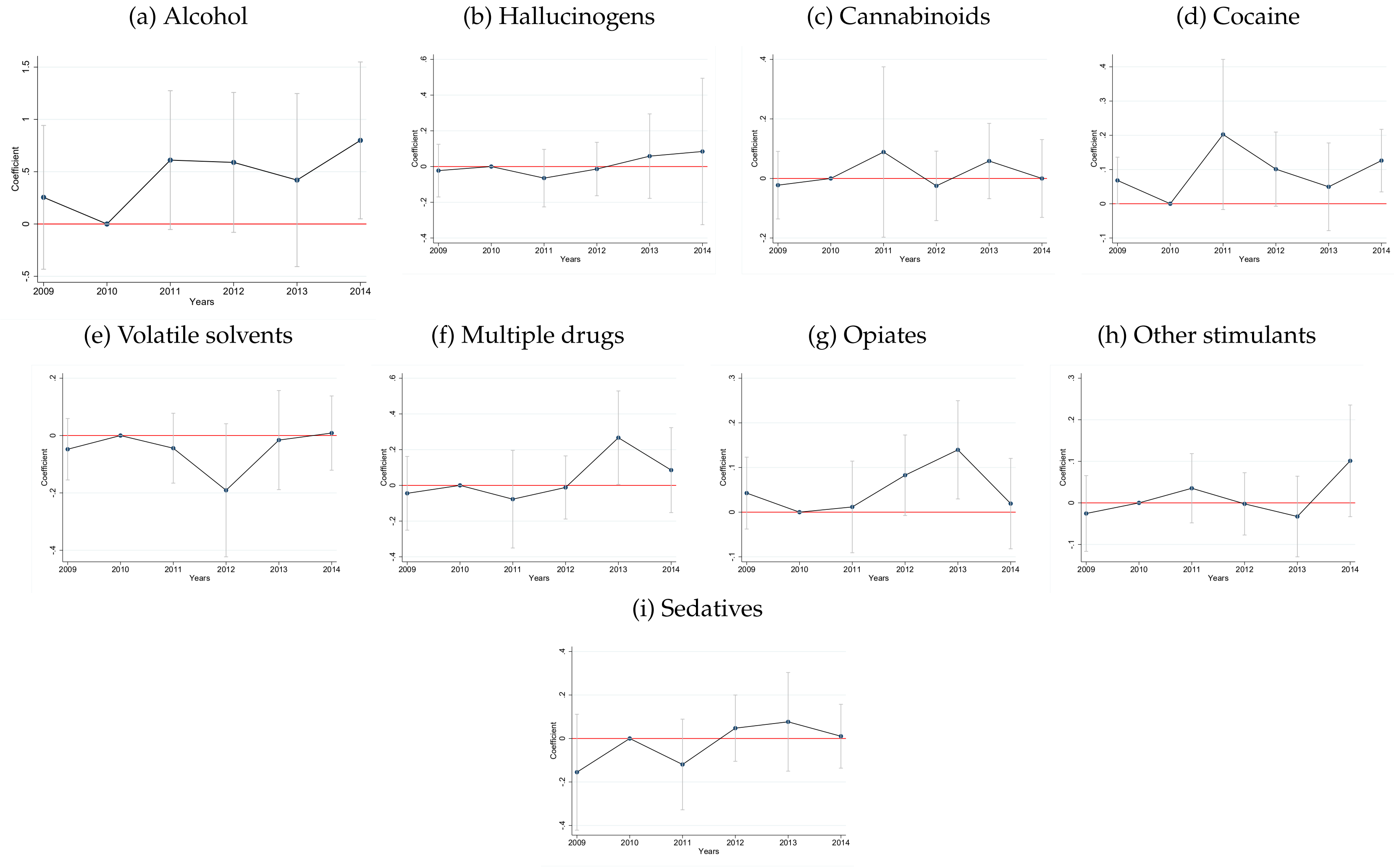


(b) With baseline controls -services



Note: Panels A and B show the estimated coefficients from equation 3. The baseline year is 2010. Baseline controls interacted with year dummies include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Whiskers show 95% confidence intervals.

Figure 5: Dynamic estimates of the effect of trade liberalization on total substance abuse by substance type in the sample of patients



(a) Alcohol

(b) Hallucinogens

(c) Cannabinoids

(d) Cocaine

(e) Volatile solvents

(f) Multiple drugs

(g) Opiates

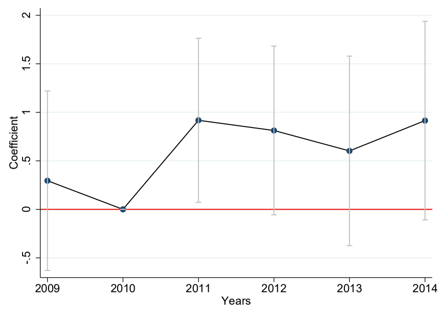
(h) Other stimulants

(i) Sedatives

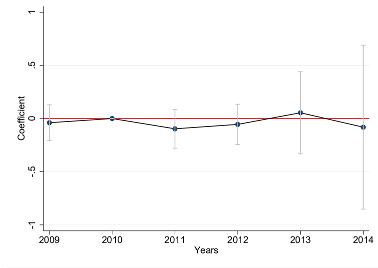
Note: Figure shows the estimated coefficients from equation 3. The baseline year is 2010. Baseline controls interacted with year dummies include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Whiskers show 95% confidence intervals.

Figure 6: Dynamic estimates of the effect of trade liberalization on total substance abuse by substance type in the sample of services

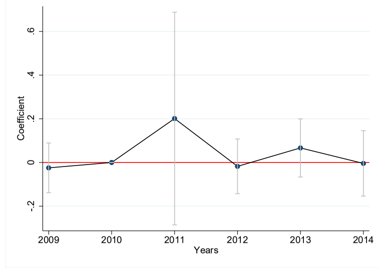
(a) Alcohol



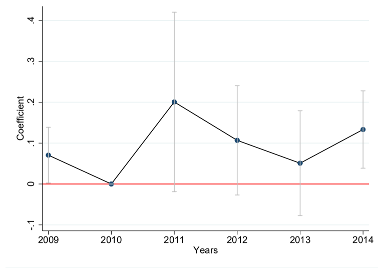
(b) Hallucinogens



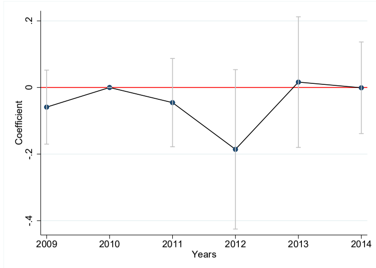
(c) Cannabinoids



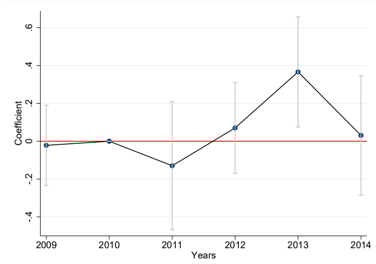
(d) Cocaine



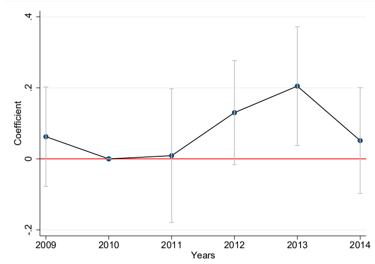
(e) Volatile solvents



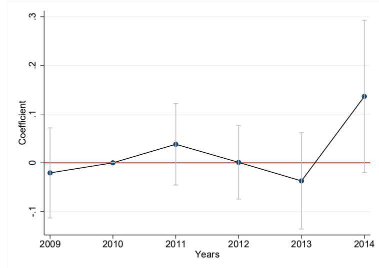
(f) Multiple drugs



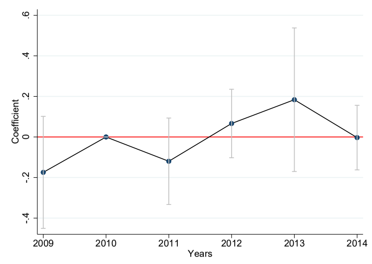
(g) Opiates



(h) Other stimulants



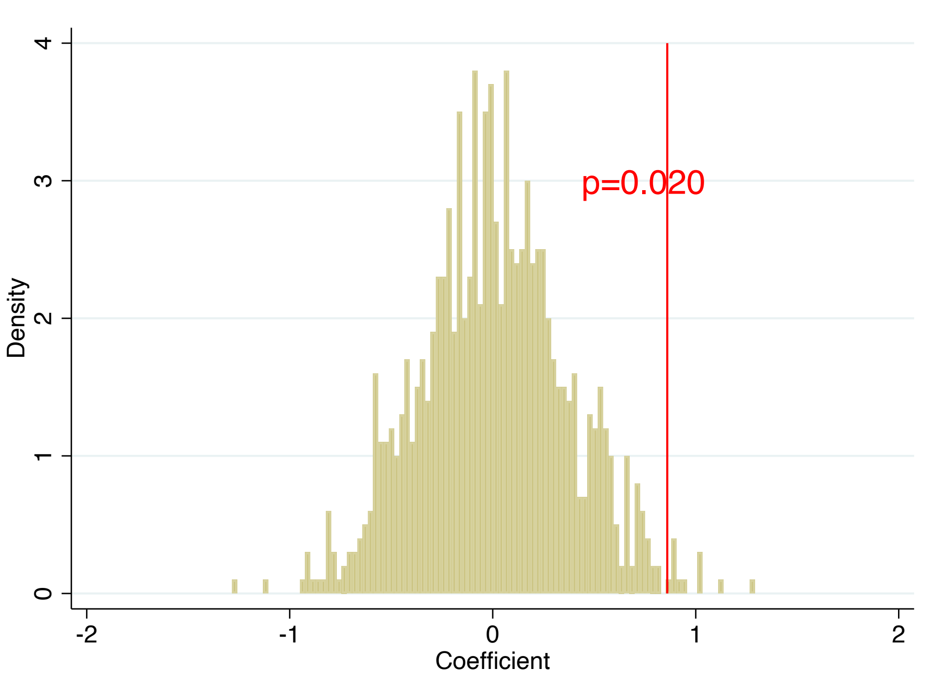
(i) Sedatives



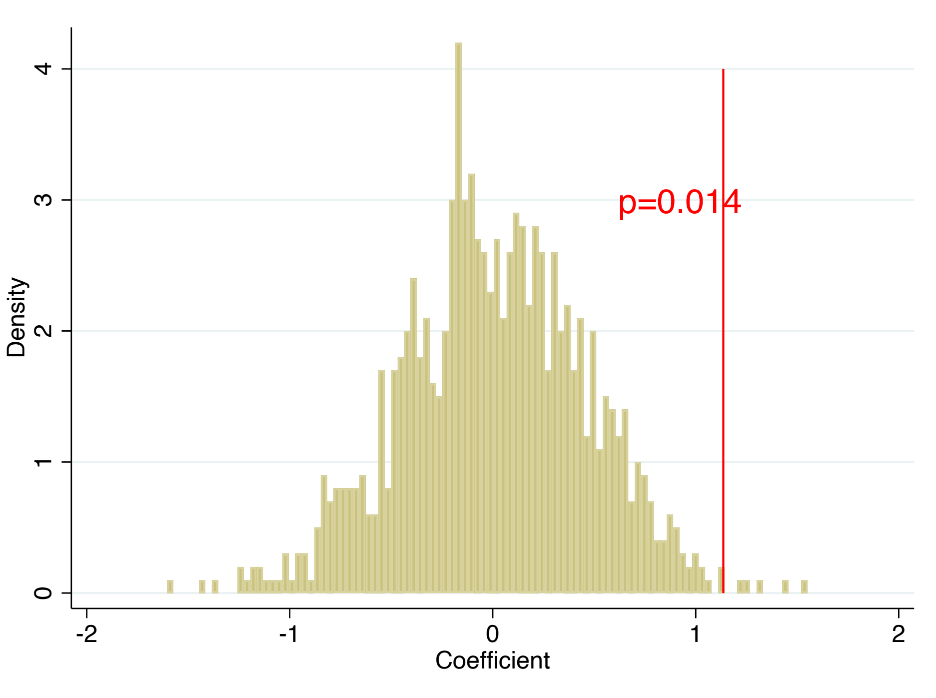
Note: Figure shows the estimated coefficients from equation 3. The baseline year is 2010. Baseline controls interacted with year dummies include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Whiskers show 95% confidence intervals.

Figure 7: Permutation tests

(a) Patients



(b) Services



Note: Figures show the empirical distribution of placebo coefficients. I randomly resampled TVM across different municipalities and run the main specification 1,000 times. The share of the 1,000 absolute placebo coefficients that are larger than the absolute "true" coefficient is the p-value for the hypothesis that β=0. Vertical lines show the estimated baseline coefficients for patients and services, respectively.

Tables

Table 1: Municipality-level summary statistics

	Mean	SD	Min	Max	N
Panel A. Outcome variables (Rate per 100,000)					
Total substance abuse (patients)	4.84	13.88	0.00	238.18	4,932
Total substance abuse (services)	5.86	18.08	0.00	265.57	4,932
Alcohol (patients)	2.31	11.21	0.00	238.18	4,932
Alcohol (services)	2.76	14.43	0.00	265.57	4,932
Hallucinogens (patients)	0.53	3.16	0.00	53.73	4,932
Hallucinogens (services)	0.69	4.77	0.00	128.21	4,932
Cannabinoids (patients)	0.18	2.62	0.00	118.91	4,932
Cannabinoids (services)	0.22	3.98	0.00	237.81	4,932
Cocaine (patients)	0.16	1.72	0.00	82.99	4,932
Cocaine (services)	0.17	1.81	0.00	82.99	4,932
Volatile solvents (patients)	0.34	2.43	0.00	55.83	4,932
Volatile solvents (services)	0.38	2.91	0.00	88.99	4,932
Multiple drugs (patients)	0.73	3.54	0.00	88.65	4,932
Multiple drugs (services)	0.92	4.97	0.00	177.30	4,932
Opiates (patients)	0.11	1.20	0.00	39.79	4,932
Opiates (services)	0.14	1.85	0.00	79.59	4,932
Other stimulants (patients)	0.10	1.16	0.00	32.35	4,932
Other stimulants (services)	0.11	1.40	0.00	49.09	4,932
Sedatives (patients)	0.35	2.43	0.00	61.65	4,932
Sedatives (services)	0.42	3.13	0.00	123.30	4,932
Tobacco (patients)	0.02	0.85	0.00	56.40	4,932
Tobacco (services)	0.04	1.64	0.00	112.80	4,932
Panel B. Controls from initial conditions					
Unmet basic needs (index)	45.77	19.99	5.43	100.00	4,932
Homicides (pop/100k hab)	41.27	54.27	0.00	532.75	4,932
Share of public investment in health	0.38	0.14	0.00	0.77	4,896
Share of public investment in education	0.10	0.08	0.00	0.61	4,896
Share of employment in manufacturing	0.05	0.05	0.00	0.45	4,932
Share of population 18-24 years old	0.11	0.02	0.06	0.38	4,932
Panel C. Employment data					
Employment (pop/100k hab)	1,289.50	3,371.99	3.17	44,444.44	3,427
Number of establishments (pop/100k hab)	95.49	189.18	0.00	2,180.69	3,427
Log of monthly wages	10.00	1.30	4.64	14.34	3,427

Note: panel A shows the summary statistics for the rate of hospitalizations and ER visits due to substance abuse (by source) for the working-age population (18-65 years old) per 100,000 inhabitants for the period 2009-2014. Panel B shows controls for initial conditions measured in 2005, from Panel CEDE and the national population census. Panel C shows the rate of employment and establishments per 100,000 people and the average monthly wages from PILA.

Table 2: Effect of trade liberalization on the rate of substance abuse

	Patients		Services	
	(1)	(2)	(3)	(4)
$TVM \times Post$	0.6421**	0.8597***	0.8118**	1.1358***
	(0.2741)	(0.2694)	(0.3582)	(0.3510)
Observations	4932	4896	4932	4896
Municipalities	822	816	822	816
Year FE	Yes	Yes	Yes	Yes
Baseline controls	No	Yes	No	Yes
Municipality FE	Yes	Yes	Yes	Yes
Mean dependent variable	3.148	3.164	3.696	3.716
SD dependent variable	13.00	13.05	15.77	15.83
R^2	0.457	0.460	0.431	0.435

Note: the dependent variable is the total rate of hospitalizations and ER visits due to substance abuse per 100,000 inhabitants for the working age population (18-65 years old). When specified, regressions control for time, department/year and municipality fixed effects. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Clustered standard errors at the municipality level are reported in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 3: Effect of trade liberalization on the rate of substance abuse by substance source

	(1) Alcohol	(2) Hallucinogens	(3) Cannabinoids	(4) Cocaine	(5) Volatile solvents	(6) Multiple drugs	(7) Opiates	(8) Other stimulants	(9) Sedatives
Panel A. Patients									
$TVM \times Post$	0.4770**	0.0274	0.0419	0.0856**	-0.0366	0.0882	0.0420	0.0380	0.0814
	(0.1957)	(0.0906)	(0.0539)	(0.0418)	(0.0464)	(0.0782)	(0.0279)	(0.0275)	(0.0827)
Observations	4896	4896	4896	4896	4896	4896	4896	4896	4896
Municipalities	816	816	816	816	816	816	816	816	816
Mean dependent variable	1.931	0.201	0.0747	0.0656	0.202	0.314	0.0823	0.0662	0.219
SD dependent variable	11.67	1.743	1.155	0.976	1.559	2.233	1.080	1.081	2.218
Panel B. Services									
$TVM \times Post$	0.6639***	-0.0249	0.0737	0.0875**	-0.0244	0.0957	0.0677	0.0448	0.1193
	(0.2513)	(0.1551)	(0.0847)	(0.0429)	(0.0508)	(0.0885)	(0.0449)	(0.0296)	(0.0934)
Observations	4896	4896	4896	4896	4896	4896	4896	4896	4896
Municipalities	816	816	816	816	816	816	816	816	816
Mean dependent variable	2.347	0.234	0.0796	0.0689	0.218	0.344	0.105	0.0715	0.241
SD dependent variable	14.37	1.952	1.203	0.995	1.691	2.410	1.593	1.129	2.346

Note: the dependent variables are the rates of substance abuse from the different sources per 100,000 inhabitants for the working age population (18-65 years old). All regressions control for time and municipality fixed effects. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Clustered standard errors at the municipality level are reported in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 4: Effect of trade liberalization on municipality-level labor outcomes

	(1) Employment	(2) Number of establishments	(3) Log of monthly wages
$TVM \times Post$	-200.3844***	-16.4627***	-0.0386**
	(62.9797)	(4.2689)	(0.0196)
Constant	828.4437***	124.6920***	10.0173***
	(152.0337)	(24.2062)	(0.0901)
Observations	3350	3350	3350
Municipalities	646	646	646
Year FE	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Mean dependent variable	1238.2	86.60	9.782
R^2	0.952	0.946	0.914

Note: the dependent variables in columns 1-2 are the rate of the number of employed and the number of establishments per 100,000 people. The dependent variable in column 3 is the logarithm of the mean of monthly wages. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Clustered standard errors at the municipality level are reported in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.10.

Table 5: Effect of trade liberalization on the rate of substance abuse by age and sex

	Age				Sex	
	(1) 18-24	(2) 25-34	(3) 35-44	(4) Over 45	(5) Male	(6) Female
Panel A. Patients						
$TVM \times Post$	0.4430	0.4007	1.8709***	0.8330**	0.7779*	0.8786***
	(0.3974)	(0.6072)	(0.6266)	(0.4197)	(0.4422)	(0.2833)
Observations	4896	4896	4896	4896	4896	4896
Municipalities	816	816	816	816	816	816
Mean dependent variable	1.985	7.703	6.212	3.628	6.333	3.386
SD dependent variable	12.83	28.90	27.68	15.79	22.46	12.46
Panel B. Services						
$TVM \times Post$	0.3419	0.6895	2.6279***	1.0718**	1.1044*	1.1549***
	(0.4902)	(0.7200)	(0.8382)	(0.5051)	(0.5706)	(0.3836)
Observations	4896	4896	4896	4896	4896	4896
Municipalities	816	816	816	816	816	816
Mean dependent variable	2.498	9.266	7.623	4.444	7.814	4.076
SD dependent variable	17.59	37.08	36.19	21.81	29.32	17.04

Note: the dependent variable is the total rate of hospitalizations and ER visits due to substance abuse per 100,000 inhabitants for the working age population (18-65 years old) by age group and sex. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Clustered standard errors at the municipality level are reported in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.10.

Table A1: ICD classification code and substance name

ICD code	Substance name
F100-F101	Alcohol
F110-F111	Opiates
F120-F121	Cannabinoids
F130-F131	Sedatives or hypnotics
F140-F141	Cocaine
F150-F151	Other stimulants, including caffeine
F160-F161	Hallucinogens
F170-F171	Tobacco
F180-F181	Volatile solvents
F190-F191	Multiple drugs and use of other psychoactive substances

Note: each of the substances listed belong to the general category of the ICD "F10-F19. Mental and behavioral disorders due to the use of psychoactive substances: acute intoxication and harmful use". Total substance abuse is calculated by summing each category and scaling it by population size.

Table A2: Robustness checks on main specification

	(1)	(2)	(3)	(4)
	$Dept \times Year$ FE	2005 tariffs	No coca	W/o pctiles 30-70
Panel A. Patients				
$TVM \times Post$	0.6810**	0.7946***	0.8625***	4.9620**
	(0.3022)	(0.2597)	(0.3043)	(1.9597)
Observations	4878	4896	4122	2448
Municipalities	813	816	687	408
Mean dependent variable	3.148	3.164	3.271	2.956
SD dependent variable	13.06	13.05	13.71	13.09
R^2	0.481	0.460	0.459	0.516
Panel B. Services				
$TVM \times Post$	0.8183**	1.0443***	1.1739***	6.1744**
	(0.4016)	(0.3347)	(0.4037)	(2.5358)
Observations	4878	4896	4122	2448
Municipalities	813	816	687	408
Mean dependent variable	3.694	3.716	3.900	3.273
SD dependent variable	15.85	15.83	16.79	13.94
R^2	0.457	0.435	0.434	0.483

Note: the dependent variables are the rates of substance abuse from the different sources per 100,000 inhabitants for the working age population (18-65 years old) for patients and services, respectively. Column 1 includes $Dept \times Year$ and municipality fixed effects. Column 2 measures the TVM using only tariffs for the relevant sectors for the main specification in 2005. Column 3 excludes municipalities with coca in 2005. Column 4 estimates the baseline model without percentiles 30 through 70. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. Clustered standard errors at the municipality level are reported in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.10.

Table A3: Effect of trade liberalization on other health conditions

	Patients		Services	
	(1)	(2)	(3)	(4)
$TVM \times Post$	-0.2863	0.0715	-4.1035	0.1351
	(0.5996)	(0.0968)	(4.8640)	(0.1198)
Observations	4896	4896	4896	4896
Year FE	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Department/year FE	No	No	No	No
Mean dependent variable	2.089	0.751	9.506	0.941
SD dependent variable	42.283	3.891	322.613	5.114
R^2	0.392	0.236	0.443	0.247

Note: the dependent variable in models 1 and 3 are the the number of cases of mental impairment (scaled by 100,000 population) . The dependent variable for models 2 and 4 is the number of cases of mental conditions present in childhood and teenage years. Baseline controls interacted with $Post_t$ include: unmet basic needs index, homicides rate (rate per 100,000 population), the share of public investment in health and education, the share of people 18-24 years old, the share of employment in the manufacturing sector and weighted external tariffs from key trading partners. All regressions compute clustered standard errors at the municipality level. Significance: *** p<0.01, ** p<0.05, * p<0.10.