Including Illegal Activity in the U.S. National Economic Accounts

By Rachel Soloveichik*

Abstract

The internationally agreed guidelines for national economic accounts, *System of National Accounts 2008* (hereafter referred to as *SNA 2008*) (United Nations Statistics Division 2008), explicitly recommend that illegal market activity should be included in the measured economy. This recommendation is not currently implemented by the U.S. Bureau of Economic Analysis (BEA) because of challenges inherent in identifying suitable source data and differences in conceptual traditions (Carson 1984a and 1984b). This paper explores how tracking illegal activity in the U.S. national economic accounts might impact measured nominal Gross Domestic Product (GDP), measured real GDP, measured productivity, and other economic statistics. In 2017, the level of nominal GDP rises by more than 1 percent when illegal activity is tracked in the U.S. National Income and Product Accounts (NIPAs). By category, illegal drugs add $111 billion to measured nominal GDP in 2017, illegal prostitution adds $10 billion, illegal gambling adds $4 billion, and theft from businesses adds $109 billion. Real GDP and productivity growth also change. Real illegal output grew faster than overall GDP during the 1970s. As a result, tracking illegal activity ameliorates the 1970s slowdown in measured productivity growth and partially ameliorates the post-2008 slowdown in measured productivity growth.

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Introduction

The internationally agreed guidelines for national economic accounts, *System of National Accounts 2008* (*SNA 2008*), recommend that illegal market activity should be included in measured output:

> *Transactions on unofficial markets that exist in parallel with official markets ... must also be included in the accounts, whether or not such markets are actually legal or illegal. (Section 6.42)*
>
> *Activities that may be illegal but productive in an economic sense include the manufacture and distribution of narcotics, illegal transportation in the form of smuggling of goods and of people, and services such as prostitution. (Section 6.44)*
>
> *Transactions in which illegal goods or services are bought and sold need to be recorded not simply to obtain comprehensive measures of production and consumption but also to prevent errors appearing elsewhere in the accounts. ... The failure to record illegal transactions may lead to significant errors within the accounts if the consequences of the activity are recorded in the financial account and the external accounts, say, but not in the production and income accounts (Section 6.45)*

The official guidelines for international transactions, *Balance of Payments and International Investment Position Manual* (International Monetary Fund 2009), also recommend that illegal market activity should be included in measured trade. The recommendation to include illegal market activity in the composition of Gross Domestic Product (GDP) and Balance of Payments (BoP) has been implemented in the European Union. The recent publication '*The Handbook on the Compilation of Statistics on Illegal Economic Activities in National Accounts and Balance of Payments*' (Eurostat 2018) provides country cases for Australia, Belgium, Colombia, Denmark, Finland, Italy, Luxembourg, the Netherlands, Serbia, Sweden, Ukraine and the United Kingdom. In addition, France and Canada recently included illegal drugs into their national economic accounts (Agence France-Presse 2018) (Barber-Duek et al. 2018). But, BEA does not currently include illegal market activity because of challenges in source data and different conceptual traditions (Carson 1984a and 1984b).

So far, most countries implementing the *SNA 2008* recommendations have chosen to focus on two illegal market activities: drugs and prostitution. The Eurostat handbook also discusses additional illegal market activities that countries might consider including in their national accounts in the future. This analysis only found reliable data for one of the additional activities mentioned—gambling—so that activity is included in this paper, but not the other additional activities mentioned in the *Handbook*. Going beyond the activities discussed in the Eurostat handbook, this analysis also found data on theft

from legal sector businesses. This paper explores how tracking all four illegal activities—drugs, prostitution, gambling, and theft—might impact the U.S. National Income and Product Accounts (NIPAs).

This paper is divided into seven sections. Section 1 describes the current and exploratory treatment of illegal activity in the United States. Sections 2, 3, 4, and 5 collect and present empirical data on illegal drugs, illegal prostitution, illegal gambling, and theft from businesses, respectively. Section 6 combines the empirical data collected in sections 2 to 5 to recalculate nominal Gross Domestic Income (GDI), nominal GDP, and real GDP when illegal activity is included in the NIPAs. Section 7 briefly discusses the impact of illegal activity on the joint production accounts of BEA and the Bureau of Labor Statistics (BLS). Finally, Appendix A lists the datasets used to construct the time series shown in sections 2 to 5 and Appendix B gives the nominal GDP share for illegal activity from 1929 onwards.

1. Current and Exploratory Treatment of Illegal Activity in the U.S.

Black Market Sector

Firms that produce illegal goods and services are often called black market firms because their activity frequently occurs under cover of darkness. In contrast, firms that produce legal goods without following all applicable regulations or without filing all required tax forms are called gray market firms. BEA already includes those gray market firms together with fully legal firms in the current NIPAs.

Black market firms generally do not report their income to the IRS and are generally not tracked in BEA's current estimates of business output, business value added, imports, or exports. One might think that BEA's adjustment for underreporting and misreporting of taxable income implicitly includes black market income. In fact, BEA's adjustment for underreporting and misreporting is based on IRS research that focuses on gray market firms (IRS 2005). The only black market firms that are captured in the IRS research are the ones that misreport their illegal income as legal income (Johns and Slemrod 2010). This misreporting is often called money laundering, and that term will be used in the remainder of the paper. This paper first expands the scope of GDP to include all black market activity and then adjusts legal sector activity downward to exclude the laundered black market activity.

Most European countries integrate some aspects of black market activity into their industry accounts. Drug dealing is combined with other retail sub-sectors, marijuana growing is combined with other agricultural sub-sectors, methamphetamine production is combined with other chemical sub-sectors,

and prostitution is combined with other personal services. BEA does not currently include black market output in those industries, so cross-country industry comparisons may be problematic.

Table 1. Impact of Black Market on GDP

Current Treatment in GDP	Adjusted GDP	Change to GDP
1. Black market firms that launder their activity, by reporting it as legal sector output, are tracked in the legal sector. 2. Retail margins on non-laundered illegal drugs are not in retail output. 3. Non-laundered illegal prostitution and gambling are not in services output. 4. Non-laundered intermediate inputs to black market production are tracked in personal consumption expenditures (PCE).	1. Black market firms that launder their output are shifted from the legal sector to the illegal sector. 2. Retail margins on non-laundered illegal drugs are tracked in retail. 3. Non-laundered illegal prostitution and gambling are tracked in the service sector. 4. Non-laundered intermediate input purchases are shifted from PCE to intermediate inputs.	Increases by the value added from illegal drug retailing, prostitution and gambling **less** the value added that is currently misreported as legal sector value added.

Table 2. Impact of Black Market on GDI

Current Treatment in GDI	Adjusted GDI	Change to GDI
1. Employee compensation and proprietors' income from black market firms that launder income are tracked in legal income. 2. Employee compensation and proprietors' income from black market firms that do not launder income are not tracked anywhere. 3. Capital income and taxes paid by black market firms are not tracked anywhere.	1. Employee compensation and proprietors' income from black market firms that launder their income are shifted from legal income to illegal income. 2. Employee compensation and proprietor' income from non-laundering firms are tracked in illegal income. 3. Capital income and taxes paid by black market firms are assumed to be negligible.	Increases by the employee compensation and proprietors' income associated with illegal drug retailing, prostitution and gambling **less** the income that is currently laundered.

Table 3. Impact of Black Market on BoP

Current Treatment in BoP	Adjusted BoP	Change to BoP
1. Imports of illegal wholesale drugs are excluded from trade in goods. 2. Imports of illegal online gambling are excluded from trade in services. 3. Exports of black market output excluded from trade in goods or services.	1. Imports of illegal wholesale drugs are included together with imports of legal goods. 2. Imports of illegal online gambling are included together with imports of legal services. 3. Exports of black market output are assumed to be negligible.	Total imports increase by the value of imported illegal drugs and imported illegal online gambling services.

Theft from Legal Sector Businesses

At first glance, theft does not appear to have any implications for measured GDP. After all, *SNA 2008* says that theft should not be treated as an economic transaction and should instead be captured in 'other flows' (Section 3.97-3.98). Unlike economic transactions, 'other flows' only appear in the 'other changes in the volume of assets account' and the 'revaluation account' (Section 3.50) and have no direct impact on measured GDP or GDI. If business financial statements followed the recommendation of Section 3.98 in *SNA 2008*, this paper would not need to study theft at all. However, business financial statements generally track physical theft as a component of cost of goods sold[1] and financial theft as a component of operating expenses. Hence, national accountants must adjust reported cost of goods sold and reported operating expenses to recover estimates consistent with *SNA 2008*.

A simple example can illustrate the issue. A retailer buys one hundred widgets for one dollar each and then records those widgets as $100 of inventory. The retailer suffers from a dishonest warehouse employee who steals 3 widgets for personal use. Section 3.98 of *SNA 2008* recommends recording the theft as a $3 'other flow' from the business sector to the household sector. By construction, this 'other flow' has no impact on change in private inventories, cost of goods sold, retail margin, business value

[1] Readers should note that businesses often use retail prices rather than inventory value in press releases about theft losses. In the extreme, many intellectual property firms report very high losses from piracy despite the zero inventory loss associated with illegal recopying. These press releases are not reflected in the financial statements.

added, or other components of GDP. If the theft had been very large, the store might have recorded it as an identified theft loss in their financial statement. BEA already adjusts reported inventory withdrawals for those identified theft losses (BEA 2019, chapter 7). But stores rarely identify $3 thefts in their financial statements. Instead, such a small theft is generally recorded as a $3 withdrawal from inventory[2] and pooled together with legitimate inventory withdrawals for resale or intermediate usage. As a result, the current NIPAs record a $3 theft as a $3 reduction in business value added.

Conceptually, the idea of adjusting business financial statements is not new. BEA already adjusts reported business inventories and inventory withdrawals for holding gains (BEA 2019, chapter 7), adjusts reported operating expenses for bad debts (BEA 2019, chapter 13), and adjusts reported depreciation for tax write-offs that do not match economic depreciation (BEA 2019, chapter 13). This paper explores broadening the existing theft adjustment so that BEA will track all theft as a current transfer rather than just theft that is specifically identified in business financial statements.[3] This broader adjustment is consistent with discussion in the handbook *Measuring the Non-Observed Economy* (OECD 2002). To be clear, tracking theft as a current transfer increases measured value added for the already tracked legal business sector without impacting the black market at all.

Table 4. Impact of Theft from Businesses on GDP

Current Treatment in GDP	Adjusted GDP	Change to GDP
1. Unidentified theft is included with costs of goods sold or intermediate inputs. 2. Insured identified theft is excluded from cost of goods sold, intermediate inputs and current transfers. 3. Uninsured identified theft is treated as a current transfer.	All theft from businesses is treated as a current transfer.	Increases by the value of unidentified theft (which had previously been tracked in cost of goods sold or intermediate inputs).

[2]Sections 6.46, 6.109, 6.147 and 6.148 of *SNA 2008* echo standard business accounting without noting the inconsistency with Section 3.98.

[3]Thanks are due to Robert Dunn from the UK Office of National Statistics for suggesting this methodology.

Table 5. Impact of Theft from Businesses on GDI

Current Treatment in GDI	Adjusted GDI	Change to GDI
1. Unidentified theft is included with the income deductions for cost of goods sold or intermediate inputs. 2. Insurance premiums for theft coverage are an income deduction. 3. Uninsured identified theft is treated as a current transfer.	All theft from businesses is treated as a current transfer.	Increases by the value of unidentified theft **plus** insurance premiums paid on theft coverage that had previously contributed to the statistical discrepancy.

2. Illegal Drugs

This paper studies six separate types of illegal drugs: 1) cocaine, 2) heroin and fentanyl, 3) marijuana, 4) methamphetamines, 5) miscellaneous drugs,[4] and 6) alcohol during Prohibition.[5] The paper does not study legal drugs that are misprescribed or misused because those drugs are already tracked in the NIPAs as health care. Similarly, purchases of legal alcohol and cigarettes are already tracked in the NIPAs as personal consumption. Accordingly, this paper is not sufficient to track harmful drug use. (Readers should note that the NIPA framework values activity based on the market price paid rather than the social cost. Accordingly, the tens of thousands of deaths caused by the recent opioid epidemic have no direct effect on measured GDP.)

Nominal Expenditures on Illegal Drugs

The primary data is taken from the report 'What America's Users Spend on Illegal Drugs: 2006-2016' (Executive Office of the President 2019). Figures 3.1, 3.3, 3.5, and 5.4 give the report's estimate of cash spending on cocaine, heroin, marijuana and methamphetamines. A separate section of the report

[4]This category includes illegally resold prescription drugs, hallucinogens like LSD, synthetic drugs and more. Each individual drug product is very small, so collecting data on individual drugs would have been too time consuming. The historical NIPAs may include some currently illegal drugs during the period that they were legal. Those formerly legal drugs typically had small legal product markets, so the impact on measured GDP is minimal.
[5]BEA's currently published NIPAs show zero expenditures on alcohol from 1929 to 1932. This precise zero omits the small amount of alcohol that U.S. residents were permitted to purchase for medicinal or religious purposes (Okrent 2010). In addition, legal home-produced wine is also in scope for GDP (*SNA 2008* Section 6.32c).

suggests that noncash transactions add 12.5 percent to drug consumption. Accordingly, the cash spending numbers are multiplied by 1.125 to get total cocaine, heroin, marijuana and methamphetamine spending. For data between 1988 and 2006, expenditure for cocaine, heroin, marijuana and methamphetamines is taken from Table 72 of the report 'National Drug Control Strategy: Data Supplement 2016' (Executive Office of the President 2016). Table 72 of that report also gives expenditures on miscellaneous illegal drugs from 1988 to 2000. For pre–1988 data, drug quantities and the average prices given in chart 2 are used as proxies to estimate nominal expenditures back to 1929.

For cocaine expenditures, the quantity index is based on the following sources. The UN estimated that total cocaine production grew from 164 metric tons in 1985 to 209 metric tons in 1989 (Abruzzese 1989). The Drug Enforcement Administration (DEA) estimated that cocaine imports grew from 40 metric tons in 1981 to 100 metric tons in 1985 (Volsky 1985). Another source estimates that cocaine imports grew from 16.5 metric tons in 1976 to 45 metric tons in 1982 (Hyland 2011). The quantity index uses a count of cocaine users (Rydell and Everingham 2005) to extrapolate quantities between 1962 and 1976 and interpolate quantities between years with data.[6] Before 1962, the paper uses drug seizure data collected by Gootenberg (2008) as a quantity index. The cocaine quantity index is then multiplied by the average prices that will be shown in chart 2 to calculate nominal expenditures.

For heroin expenditures, the quantity index is based on the following sources. A count of visits to the emergency room associated with heroin or morphine (Executive Office of the President 2002) is used as a quantity index from 1979 to 1988. Between 1973 and 1979, the paper uses heroin sale estimates from the Internal Revenue Service (1983). Between 1969 and 1973, the paper uses a news article tracking heroin users in the New York City region (Kerr 1986). Between 1960 and 1969, congressional record testimony estimating the quantity of heroin imported from Turkey is used (Cusack 1974). Finally, a historical review by Gerstein and Harwood (1992) is used to develop a judgmental quantity index back to 1929. Just like cocaine, the heroin quantity index is multiplied by a heroin price index that will be shown later to calculate nominal expenditures.

For marijuana expenditures, the quantity index is based on the following sources. The National Survey of Drug Abuse gives an estimate of total marijuana users back to 1972 (US Department of Health and Human Services 1995). Between 1967 and 1972, college survey data collected by Gallup is used (New

[6] The same paper also estimates consumption from 1972 onward. However, their model assumes that the annual quantity used by frequent users has remained steady over time. This paper relaxes that assumption.

York Times 1972). Between 1954 and 1967, California marijuana arrest data (Brecher 1973) is used as a proxy for usage across the entire nation. Finally, heroin expenditures are used as a proxy for marijuana expenditures before 1954. Just like cocaine and heroin, the marijuana quantity index is multiplied by a marijuana price index that will be shown later to calculate nominal expenditures.

For methamphetamines expenditures, the quantity index is based on laboratory seizures by the DEA from 1977 to 1988 (Drug Intelligence Report 1994). The quantity index is then multiplied by prices to get nominal expenditures on methamphetamines. Before 1977, methamphetamine consumption was small and not tracked reliably. Based on academic literature suggesting that methamphetamine has similar physiological effects as cocaine and it is sometimes mixed with cocaine (Sobic 2004), this paper assumes that historical methamphetamine expenditures track historical cocaine expenditures.

For miscellaneous drug expenditures, the expenditures series reported in 'National Drug Control Strategy: Data Supplement 2016' (Executive Office of the President 2016) only covers 1988 to 1998. The usage share of miscellaneous drugs reported in the survey 'Monitoring the Future' (Miech et al. 2019) is used as a proxy for the spending share of miscellaneous drugs from 1998 to 2003 and 1975 to 1988. After 2003, the federal conviction share of miscellaneous drug dealers is used as a proxy for the spending share of miscellaneous drugs (U.S. Sentencing Commission 2003-2017). Before 1975, total spending on the other four drug categories is used as an extrapolator for miscellaneous drug spending.

For alcohol expenditures during Prohibition, quantities are based on the academic literature. Miron and Zweibel (1991) show that liver cirrhosis deaths did not increase significantly when Prohibition was repealed in late 1933—suggesting that alcohol consumption was almost unchanged by repeal. BEA's currently published NIPA tables show that the ratio of alcohol spending to food at home spending was 22 percent in 1936. This analysis assumes that illegal alcohol spending was also 22 percent of food spending during Prohibition. After 1935,[7] underground alcohol production may have continued—but the underground alcohol production was now merely unlicensed gray market activity and should be captured in BEA's standard adjustments for underreporting and misreporting.

[7]While alcohol was legalized at the national level in late 1933, legal producers needed some time to restart production and illegal producers needed some time to use up inventory. This paper assumes a transition period. Readers should note that the estimates of illegal alcohol during Prohibition are higher than the Economic Research Service (ERS) estimates of alcohol for the same time period. The main driver of this difference is a lower ERS estimate for legal alcohol. See https://www.ers.usda.gov/data-products/food-expenditures.aspx.

Chart 1: Nominal Expenditures on Illegal Drugs as a Share of Personal Consumption Expenditures (PCE)

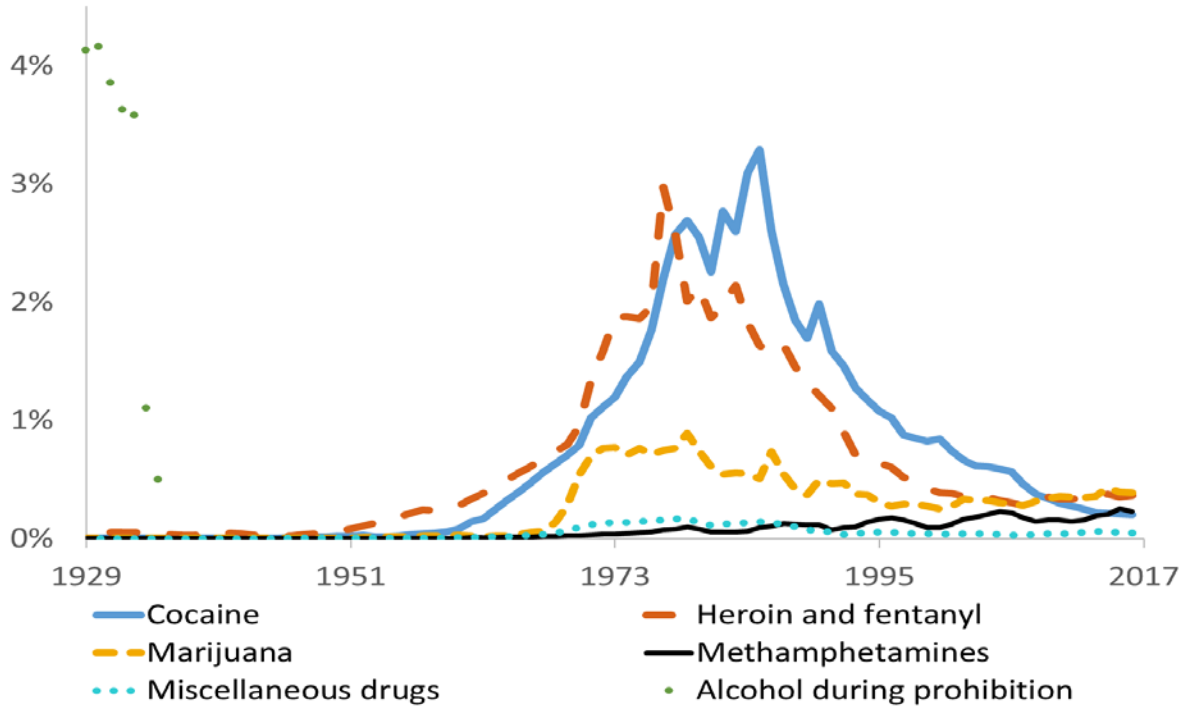


Chart 1 shows that expenditures on many different illegal drugs grew rapidly after 1965 and peaked around 1980. In total, this paper calculates that illegal drugs accounted for 5 percent of total PCE in 1980. This high expenditure share is consistent with contemporaneous reports. For example, a Washington Post article estimated that Americans bought $35 billion of cocaine (O'Toole 1981).

Retail Prices for Illegal Drugs

The primary data is taken from 'What America's Users Spend on Illegal Drugs: 2006-2016' (Executive Office of the President 2019). Figure 4.1 gives purity-adjusted average prices for cocaine, heroin, and methamphetamines. The report does not give an explicit price index for marijuana, but it provides an estimate of consumption in grams (Figure 6.1), which can be combined with nominal spending (Figure 5.4) to calculate an average cost per gram. The marijuana cost per gram is then adjusted by the average tetrahydrocannabinol (THC) share reported by Chandra et al. (2019) to derive a potency-adjusted price

index.[8] Before 2006, purity-adjusted average prices for cocaine, heroin, and methamphetamines from 'National Drug Control Strategy: Data Supplement 2016' were used (tables 73-75). Potency-adjusted marijuana prices are calculated from the unadjusted prices in table 76 and the average THC share in table 77 and elsewhere (ElSohly et al. 1984 and 2000). Price data for miscellaneous drugs was not found, so miscellaneous drug prices are assumed to track average prices of the four estimated drugs. Data was not yet available on 2017 drug prices, so the paper imputes them based on trends.

Next, the average heroin price series is adjusted for the recent fentanyl epidemic. Fentanyl is a legal prescription product with similar physical effects as heroin that is targeted towards patients with very severe pain. Before 2013, illegal fentanyl production was very rare and only a few legal prescriptions were diverted. After 2013, illicit labs in China started producing fentanyl in bulk and many heroin dealers have switched from heroin to fentanyl (DEA 2018a). Fentanyl doses are approximately 8 times more potent than heroin doses (Davis 2017)[9] and the National Forensic Laboratory System reports that the share of tested specimens containing fentanyl grew from less than one percent of specimens in 2013 to more than one third of specimens in 2017 (DEA 2018b). Hence, the paper estimates that the average illegal heroin or fentanyl dose tripled in potency between 2013 and 2017.

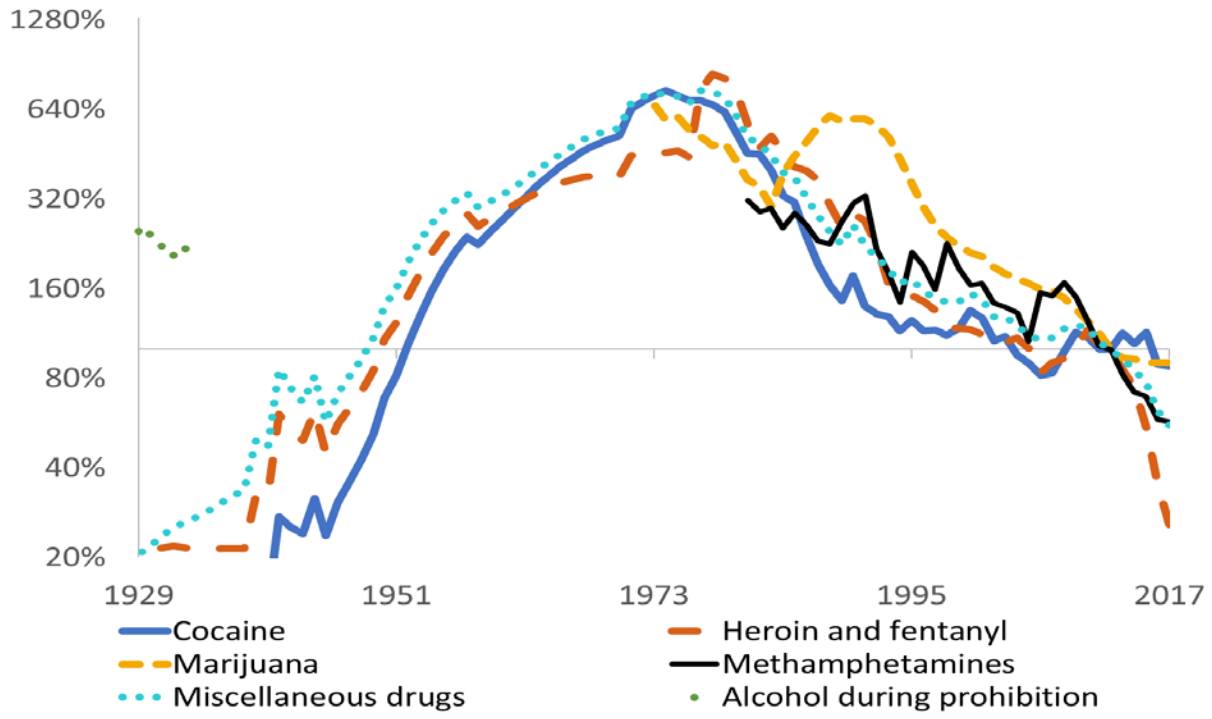
Between 1972 and 1981, average price data is taken from the academic literature. An annual price series published by the RAND Institute is used for cocaine (Rydell and Everingham 2005). For heroin, this analysis generates a price series by combining academic research tracking national prices between 1975 and 1980 (Lindgren and Grossman 2005), IRS data tracking national prices between 1973 and 1974 (IRS 1983) and academic research tracking heroin prices in Manhattan between 1970 and 1972 (Leveson 1980). For marijuana, the price series is formed by combining academic research tracking national marijuana prices between 1975 and 1980 (Lindgren and Grossman 2005), IRS data for national marijuana prices between 1973 and 1974 (IRS 1983), and a government report giving national marijuana prices in 1965 (Katzenbach 1967). Methamphetamine price data is not available before 1981, so cocaine prices are used as an extrapolator. The price series described above are all purity-adjusted.

[8]THC is the main psychoactive chemical in marijuana, and most users target a fixed level of THC consumption. Readers should note that most other countries do not adjust for THC content, so the US index might not track international indexes. The time series is smoothed across five years to minimize volatility.

[9] Davis (2017) does not give that number explicitly. Instead, it reports that fentanyl is approximately 50 times more powerful than heroin, retail fentanyl doses are approximately 5 percent pure and retail heroin doses are approximately 30 percent pure. This paper calculates an 8.33 (50*5/30) higher potency for fentanyl. Dealers and users also mix the two chemicals to get a dose with a potency between heroin and fentanyl.

Before 1972, government statisticians devoted fewer resources to measuring purity-adjusted average prices. The heroin price index is based on academic research tracking heroin prices in Chicago from 1938 to 1969 (Hughes et al. 1972) and the consumer price index between 1929 and 1938. The only historical cocaine price data available was for 1928 (Musto 1991) and the only marijuana price data available was for 1929 and 1938 (Brecher 1973). In years when no other data is available, heroin prices are used as an interpolator for cocaine prices and marijuana prices. For illegal alcohol during Prohibition, BEA's price index for food at home is used as an extrapolator.

Chart 2: Purity-Adjusted Average Illegal Drug Prices, Relative to PCE Prices



The huge drops in relative drug prices between 1980 and 1990 may appear implausible at first glance. While such price drops are highly unusual, they are not impossible. The price declines shown in chart 2 are based directly on data in 'National Drug Control Strategy: Data Supplement 2016' (Executive Office of the President 2016) and other official sources. Furthermore, previous academic research (Caulkins 1994) and news articles (Dermota 2007) documented large drug price declines in the 1980s.

In fact, the purity-adjusted prices shown in chart 2 actually underestimate the true historical price declines for illegal drugs. The government price data largely tracks drug purchases that were carried out

or almost carried out. However, many potential drug users report that drugs are not available (Miech et al. 2019). Price measurement theory generally suggests that unavailable goods should be modeled as having a high shadow price (Diewert and Feenstra 2019). This theory is most commonly used to analyze newly invented goods, but it also applies to existing goods that are newly introduced to a market (Diewert et al. 2019). This paper assumes that unavailable drugs have a shadow price triple the sales price for available drugs in the same year and category.[10]

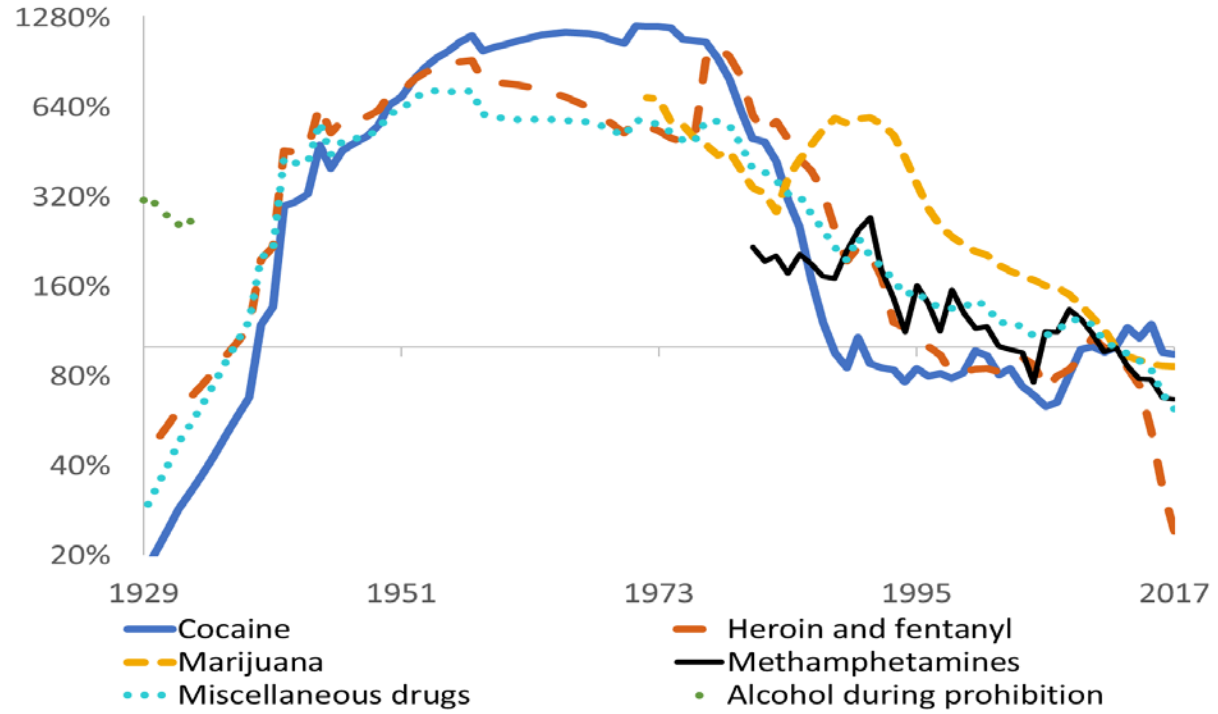
The primary data on drug availability is taken from the survey 'Monitoring the Future'. That survey started out with high schoolers in 1975 and gradually expanded to cover the adult population (Miech et al. 2019 and Schulenberg et al. 2019). This survey data is then supplemented with academic research on crack cocaine (Fryer et al. 2013),[11] academic research on drug availability in the early 1970s (Grizzle 1974) and qualitative research on historical drug availability (Office of the Chief of Engineers 1972). Drug prices are also adjusted for legal status. Licensed marijuana is generally sold at a price premium of approximately 25 percent (Priceonomics 2016) and illegal alcohol during Prohibition was frequently lower quality (Fortune 1933). Therefore, the price indexes for marijuana and alcohol require adjustment to account for their changing legal status.

Readers should note that neither chart 2 nor chart 3 is likely to match the price index that BLS might have reported if it tracked illegal drugs in its consumer price index. On the one hand, BLS's published price indexes do not impute a high shadow price for unavailable goods (Bradley 2003). As a result, the price declines that will be shown in chart 3 may overestimate the price declines that BLS might have reported. On the other hand, BLS's published price indexes generally track prices for the exact same product at a specific outlet over time. These matched model price indexes often show faster price declines than average retail prices (Gordon 2009). As a result, the price declines that were shown in chart 2 may underestimate the price declines that BLS might have reported. The construction of price indexes for illegal drugs consistent with BLS's existing price indexes is a topic for future research.

[10] Price index theory suggests that the precise shadow price depends on elasticity of demand and the functional form of the demand curve. Unfortunately, the available data was not sufficient to calculate a precise shadow price. The shadow price assumed in this paper is based on the author's expert judgment.

[11] Crack and powder cocaine are very similar chemically – but crack is easier to smoke and easier to sell in small doses. As a result, crack is often consumed by different demographics than powder cocaine. Because crack is similar to cocaine, the shadow price for unavailable crack is assumed to be one and a half times the cocaine price.

Chart 3: Purity and Availability-Adjusted Prices for Drugs, Relative to PCE Prices



Availability-adjusted prices show a different price history than the purchase prices shown in chart 2. During the 1960s and 1970s drug availability rose steadily. This availability increase is almost sufficient to cancel out the increasing average price paid by drug purchasers. As a result, availability-adjusted drug prices are nearly steady from 1950 to 1980. Furthermore, the increase in drug availability during the 1980s reinforced plummeting average prices. The remainder of this paper will use the price series in chart 3 to recalculate GDP prices, real GDP and total factor productivity (TFP).

Intermediate Inputs for Illegal Drugs

Cocaine and heroin are imported, so there are no intermediate inputs used in manufacturing. Furthermore, minimal intermediate inputs are required to transform powder cocaine into crack, dilute heroin or package drugs for retail sale (Caulkins et al. 1998). Similarly, resold prescription drugs do not require intermediate inputs for manufacturing and minimal intermediate inputs for packaging.[12] The

[12] Resold prescription drugs are a cost of goods sold rather than an intermediate input. Nevertheless, they are still subtracted from personal consumption expenditures on prescription drugs just as if they were used as an input.

remainder of miscellaneous drugs are assumed to be produced outside the United States. For simplicity, it is assumed that there are no intermediate inputs for those three drug categories.

The situation with other drug categories is more complex. Low quality marijuana is generally imported, but high quality marijuana is frequently produced in the United States. One analysis of the marijuana market estimated that the domestic share of marijuana grew from 15 percent in 2000 to 50 percent in 2015 (Robinson, Cattan, and Bain 2015). Conversely, one analysis of the methamphetamine market estimated that the domestic share of methamphetamine rose from 10 percent in 1990 to 50 percent in 2000, remained stable for a decade, and then fell back to 10 percent once the precursor chemicals were restricted in the United States (Hinkes-Jones 2011). Finally, the paper assumes that 85 percent of illegal alcohol during Prohibition was produced domestically.

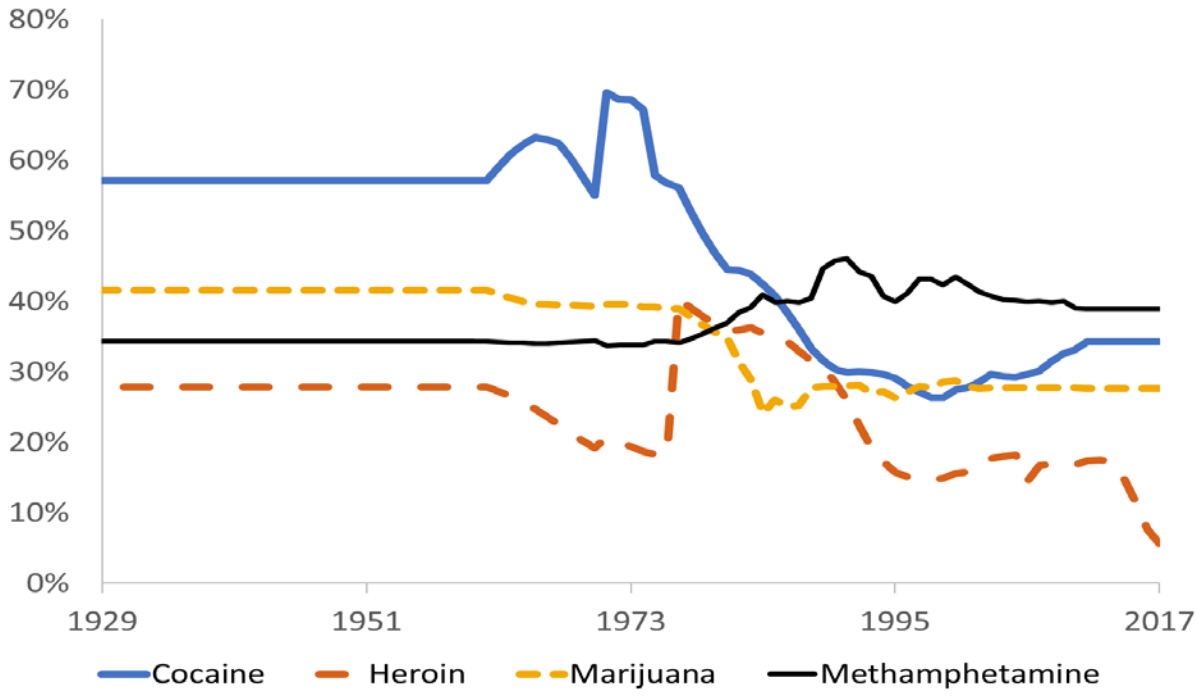
Data on the precise intermediate inputs used for domestic drug production were not available. However, the academic literature suggests that marijuana, methamphetamine and illegal alcohol are generally produced inside of residential housing (Caulkins 2010, Weisheit 2008 and Okrent 2010). For now, it is assumed that housing services account for half of the intermediate inputs to marijuana, methamphetamine and illegal alcohol. The remaining half of intermediate inputs are assumed to be: electricity to power the grow lights for marijuana (Caulkins 2010), over-the-counter medications containing ephedrine and pseudoephedrine for methamphetamines (Weisheit 2008), and liquids with sugar or starches for alcohol (Okrent 2010). This preliminary exploration uses BEA price indexes for housing services, electricity, legal medicines, and food-at-home to deflate the inputs described above.

Nominal Imports of Illegal Drugs and Prices for Imported Drugs

The academic literature is clear that drug dealers in the United States charge a large markup over import costs (Executive Office of the President 2016). As a result, most of the PCE shown in chart 1 represents domestically produced retail margin. However, there is disagreement over the precise value of imports relative to domestic consumption. In this preliminary exploration, the paper relies on a 2001 report by Abt Associates that gives average prices for four major quantity levels. It is assumed that prices at the smallest quantity level represent retail prices and prices at the second largest quantity level represent import prices soon after drugs enter the U.S. market. The difference between retail prices and import prices is assumed to be the domestically produced retail margin.

The 2001 Abt Associates report only tracks import prices from 1981 to 2000. Between 2000 and 2012, average wholesale prices from 'National Drug Control Strategy: Data Supplement 2016' are used as a proxy for import prices. Before 1981, a RAND report tracking cocaine markups in New York City (Caulkins 1994) was used to estimate import prices for cocaine, heroin, and methamphetamine back to 1977. Wholesale price data was not available before 1977 or after 2012, so retail prices for each drug category are used as extrapolators for the import prices of that drug category.[13] Wholesale price data for miscellaneous drugs and alcohol during Prohibition was also unavailable. For now, the average retail markup on the four major drug categories is used as a proxy for the retail markup on those categories.

Chart 4: Ratio of Nominal Import Prices to Nominal Retail Prices



The ratio of import prices to retail prices fell steadily from 1975 to 1995 and then approximately stabilized. Most of this decrease can be explained by the decrease in import prices. In contrast, the absolute retail margin per pure gram has been more stable over time. These results are preliminary.

[13] Each pound of imported fentanyl sells at a similar price as each pound of imported heroin (Vestal 2019). But, fentanyl is much more potent and sells at a higher retail price per pure gram. Hence, the ratio of heroin import prices to heroin retail prices must be adjusted for the recent growth in fentanyl. Before 1961, the retail price data is not a reliable extrapolator, so a constant markup is assumed instead.

Money Laundering of Illegal Drug Income

The NIPAs already track a small portion of the drug industry described earlier. Historically, the IRS estimated that 9 percent of cocaine and heroin dealers laundered their income (IRS 1983). This paper assumes that the 9 percent laundering rate on cocaine and heroin is fixed over time, and that same laundering rate applies to methamphetamine, miscellaneous drugs and alcohol during Prohibition. The paper also assumes that the 4 percent laundering rate for illegal marijuana dealers given by the IRS (1983) is fixed over time. Finally, the paper assumes that all legal marijuana dealers report their income fully. Data on the specific industries in which drug dealers report their laundered money is not available. However, the academic literature suggests that restaurants are frequently used to launder drug profits (O'Neill 2011). For simplicity, this paper assumes that all laundered drug income and legal marijuana income are currently reported as restaurant value added. Hence, adjusting for laundered drugs and legal marijuana reduces measured restaurant sector output by $13 billion in 2017.[14]

Unfortunately, data on laundered drug imports was not available. The academic literature suggests that drug importers may misreport their transactions in almost any category (O'Neill 2011). Furthermore, both criminal organizations and legitimate corporations frequently misreport international transactions for other reasons than laundering drug imports. Statistical agencies are already researching topics related to trade mismeasurement such as bilateral asymmetries (Howell, Obrzut, and Nowak 2017) and profit-shifting by multinational enterprises (Bruner, Rassier, and Ruhl 2018). It is assumed that laundered drug deals are already a component of broader trade mismeasurement. Hence, it is not necessary to specifically adjust the already measured import statistics for possible misreporting of drug trafficking by black market firms.

3. Prostitution

Readers should note that including prostitution in the GDP accounts is somewhat controversial because some prostitution is not a consensual transaction. Footnote 22 of Eurostat's handbook for illegal activities (2018) recommends that forced prostitution be excluded from GDP. France excludes street

[14]To maintain consistency, laundered inputs are removed from the restaurant sector together with laundered output. Many states are now experimenting with legalizing marijuana. These legal changes may impact future reporting for those states, but few firms are likely to revise past reports. The industry category chosen by 'legal' marijuana dealers and their impact on measured personal consumption expenditures in the NIPAs is a topic for future study.

prostitution from their GDP accounts because France believes that those prostitutes are often forced into sex work (Agence France-Presse 2018). Unfortunately, the constraints of the U.S. source data made it impossible to separate out forced prostitution from voluntary prostitution. Chart 5 shows all prostitution expenditures together. For comparison purposes, chart 5 also shows legal erotic activity.[15]

Nominal Expenditures on Illegal Prostitution

The primary data on illegal prostitution is taken from the same study used earlier for heroin (IRS 1983). That study estimates unreported income from **female** prostitution for 1973, 1976 and 1979. Historical data on male prostitution is not available—but one recent study estimates that males accounted for approximately 20 percent of prostitutes in the 2000s (Dank et al. 2014).[16] It is assumed that males account for a fixed 20 percent of prostitutes over time and prostitutes spend a fixed 25 percent of their gross revenue on intermediate inputs. Therefore, the IRS income estimates are multiplied by 1.67 to get a benchmark of total expenditures on prostitution of $10.3 billion in 1979.

The annual number of female arrests for "prostitution and commercialized vice" is used as a proxy for the number of prostitutes working illegally (Department of Justice, 1929-2017). Arrests are smoothed across five years to minimize volatility.[17] The arrest data is then multiplied by estimated wages to calculate nominal earnings per prostitute,[18] and those calculated earnings are used as a proxy for expenditures on illegal prostitution from 1929 to 2017. This formula produces estimates for prostitution expenditures in 1929 that match reasonably well with studies published in the early 1920s (Woolston 1921) and estimates for prostitution expenditures in 2003 that are only a little higher than those suggested by an 8-city Urban Institute study (Dank et al. 2014).[19]

[15] To be clear, legal erotic activity is already tracked in the NIPAs and this paper does not propose to change its treatment. However, BEA does not yet have a PCE line or a price deflator specifically tracking it.
[16] Many prostitutes self-identify as transsexual. Historically, these individuals were coded in the arrest data based on their sex at birth. This paper follows that treatment. The paper focuses on female arrests because approximately half of the males arrested are customers. In addition, some early laws recorded male prostitution as another crime.
[17] Readers should note that arrests are an imperfect proxy for prostitution employment. Many police officers tacitly permit discreet prostitution, and only arrest prostitutes who break social norms such as soliciting in forbidden areas.
[18]Unfortunately, labor costs for illegal prostitution are not readily observable. This paper uses data from the Quarterly Census of Employment and Wages (QCEW) giving weekly earnings for workers in 'other personal services' (NAICS 812990) as a proxy back to 1990. Before 1990, the paper uses BEA's pre-existing estimates of labor compensation and employment (tables 6.2A-C and 6.5A-C) in the personal services industry.
[19] Readers should note that the United Kingdom uses total male population as a proxy for prostitution quantities (Abramsky and Drew 2014). This formula produces a more stable estimate of prostitution expenditures than the academic literature suggests for the United States. This paper will not pursue this approach further.

Chart 5: Nominal Expenditures on Prostitution as a Share of PCE

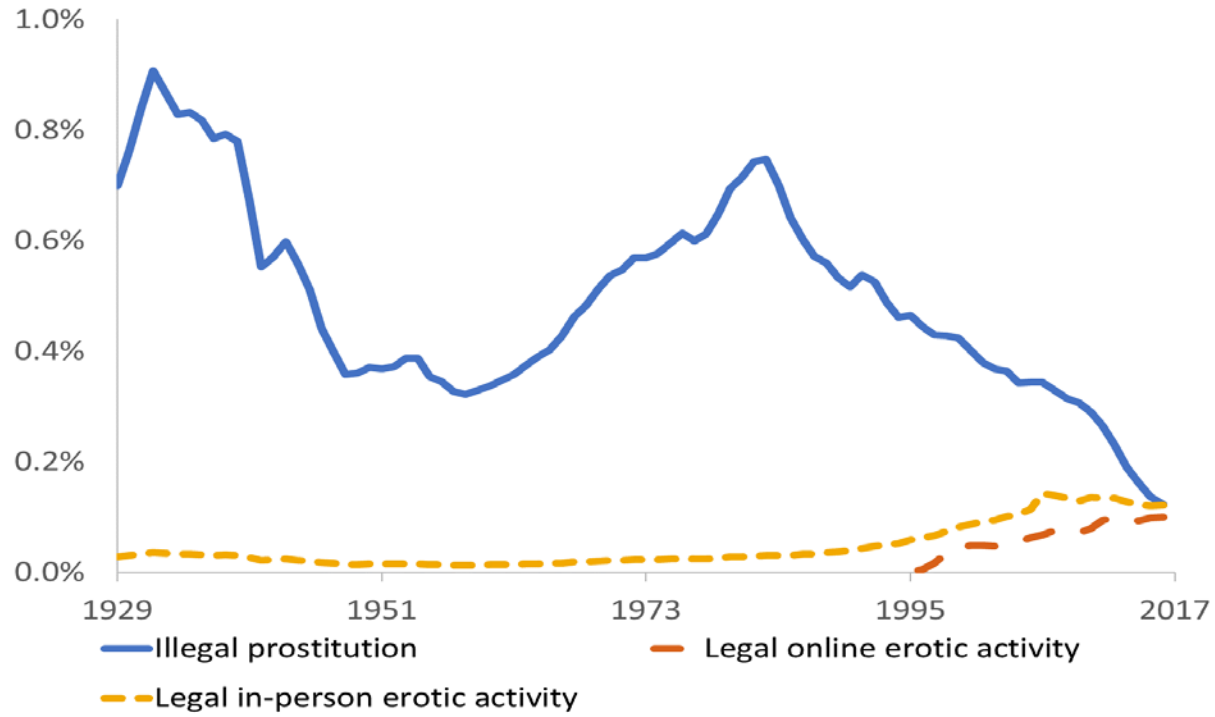


Chart 5 shows that illegal prostitution had two major peaks: during the early 1930s and the late 1970s. Interestingly, chart 1 shows the same peak for illegal drugs. Perhaps the industries are correlated? Chart 5 also shows that illegal prostitution consistently accounts for a much smaller share of PCE than illegal drugs, and it has been growing slower since 1980. As a result, including illegal prostitution in the NIPAs has a much smaller impact than including illegal drugs in the NIPAs.

Prices for Prostitution

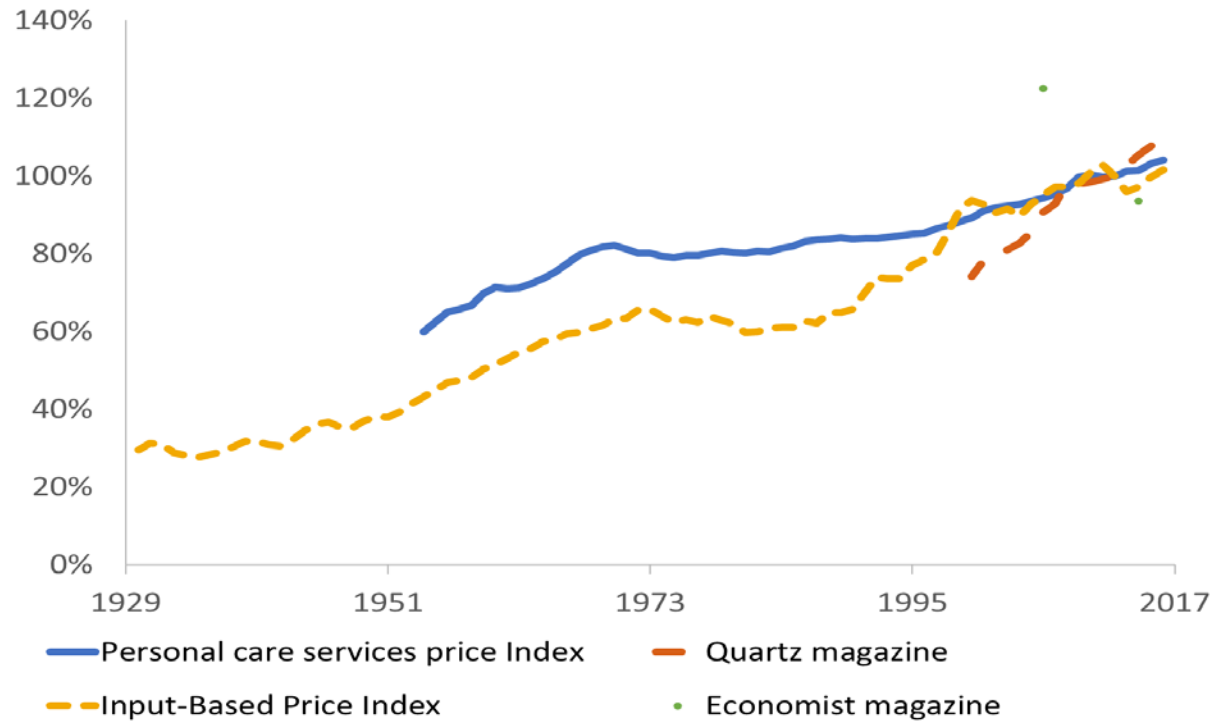
It is difficult to construct a reliable price index for prostitution. One major issue is that prices often depend on the exact services provided, client characteristics and other variables. For now, BEA's pre-existing price index for personal care services is used in these calculations (table 2.4.4U, line 304). That price index is available back to 1959. Before 1959, input costs are used as an extrapolator.[20] Data on illegal prostitution availability was not located, so the price index is not adjusted for availability.

[20] This paper constructs a geometric average with a 75 percent weight for labor, a 12.5 percent weight for clothing and a 12.5 percent weight for housing services. All the price series are taken from existing BEA data.

It might seem that new technologies like antibiotics and contraceptives would increase prostitution labor productivity. However, prostitutes still face many issues that technology has not yet solved. Both physical abuse and sexual abuse are extremely common (Farley and Barkan 1998). Precise data on historical prostitution prices is not available but scattered historical price quotes show prostitution prices growing faster than wages historically (IRS 1983, California 1953, Ken Magazine 1938). These scattered price quotes are not reliable enough to construct an index on their own, but they certainly do not suggest dramatic increases in labor productivity over time. Accordingly, the price deflators described earlier will not be adjusted for productivity changes.

Readers should note that the price index calculated in this paper matches neither a price index reported by Quartz Magazine (Schrager 2017) nor a price index reported by Economic Magazine (J.D. 2014). Neither article provided enough methodology description to explain the vastly different results. Accordingly, this preliminary paper will not use either price index.

Chart 6: Prostitution Prices, Relative to PCE Prices



Intermediate Inputs for Prostitution

Data on intermediate inputs to prostitution services is not available. For now, it is assumed that illegal prostitutes spend 12.5 percent of their revenue on clothing and 12.5 percent on housing services. This paper adjusts PCE housing and PCE clothing to remove those intermediate inputs.

Imports and Exports of Prostitution

Data on imports and exports is not available. For now, it is assumed that there is no net trade.

Money Laundering of Illegal Prostitution Income

The IRS estimated that few prostitutes laundered income in the 1970s (IRS 1983). This paper assumes that an adjustment for laundering income is not necessary for the entire 1929 to 2017 period.

4. Gambling

Standard business accounting records the output of legal gambling providers as the difference between gaming wins and gaming losses (Greenlees 1988). For example, a gambler who buys $100 of lottery tickets and wins $50 in prizes is recorded as receiving $50 of gambling services. *SNA 2008* uses different terminology to describe gambling transactions, but the fundamental accounting rules are very similar (Section 8.136). This paper follows the *SNA 2008* accounting rules for black market gambling as well.

Nominal Expenditures on Illegal Gambling

The primary data is taken from a California survey tracking gambling prevalence and gambling losses (Volberg, Nysse-Carris, and Gerstein 2006). In total, the survey respondents reported $4.7 million of losses from legal in-person gambling, $0.3 million from illegal in-person gambling, and $0.4 million from illegal online gambling.[21] For the same year, BEA's pre-existing statistics report $105 billion of legal

[21] The survey does not ask about legality directly but rather the type of game. The paper assumes that casino, track, lottery, bingo and cardroom gambling are legal—but private games and Internet gambling are illegal.

gambling expenditures nationwide. Accordingly, the paper calculates that Americans spent $7 billion on illegal in-person gambling (105*0.3/4.7) and $9 billion on illegal online gambling (105*0.4/4.7) in 2006.

The California survey estimates larger online gambling losses than other sources. One industry analysis estimated that the U.S. offshore gambling market was $6 billion in 2006 (Spectrum Gaming 2010). The additional $3 billion of illegal online gambling may represent revenue for the few skilled Americans who are able to earn money by playing online poker. In other words, amateur online players lose more than the standard house edge because they were sometimes matched against professional online gamblers. These additional losses are treated as domestically produced online gambling services.

Gambling arrests are used as a labor quantity index for the illegal in-person gambling industry (Department of Justice, 1929-2017). The labor quantity index is then multiplied by average wages in the accommodation sector[22] to estimate nominal in-person gambling output from 1929 to 2017. Just like illegal prostitution, arrests are an imperfect proxy for employment in the illegal gambling industry. Nevertheless, arrest trends generally track trends reported in the academic literature. Furthermore, this methodology calculates that Americans spent $6.5 billion on illegal gambling in 1965, very close to the $7 billion estimated by the President's Commission on Crime (Katzenbach 1967).[23]

Industry estimates of offshore gambling from Spectrum Gaming group are used to track imported online gambling services and used as a proxy for domestically produced online gambling from 2003 to 2010 (Spectrum Gaming 2010). A report tracking online gambling expenditures in California is used as a proxy from 2010 to 2013 (Capitol Matrix 2014). After 2013, this paper uses global online gambling as a proxy (Platzer 2016). Between 1999 and 2003, an online industry analysis created for WTO is used (Antigua 2006). Before 1999, online advertising is used as a proxy for online gambling (Nakamura, Samuels, and Soloveichik 2018).

[22] These average wages are taken from the QCEW data and BEA data described earlier in the prostitution section.
[23] An alternative report gives a much higher value for illegal gambling during the 1960s (King 1969) and the IRS gives a much lower value for illegal gambling during the 1970s (IRS 1983).

Chart 7: Gambling Losses as a Share of PCE

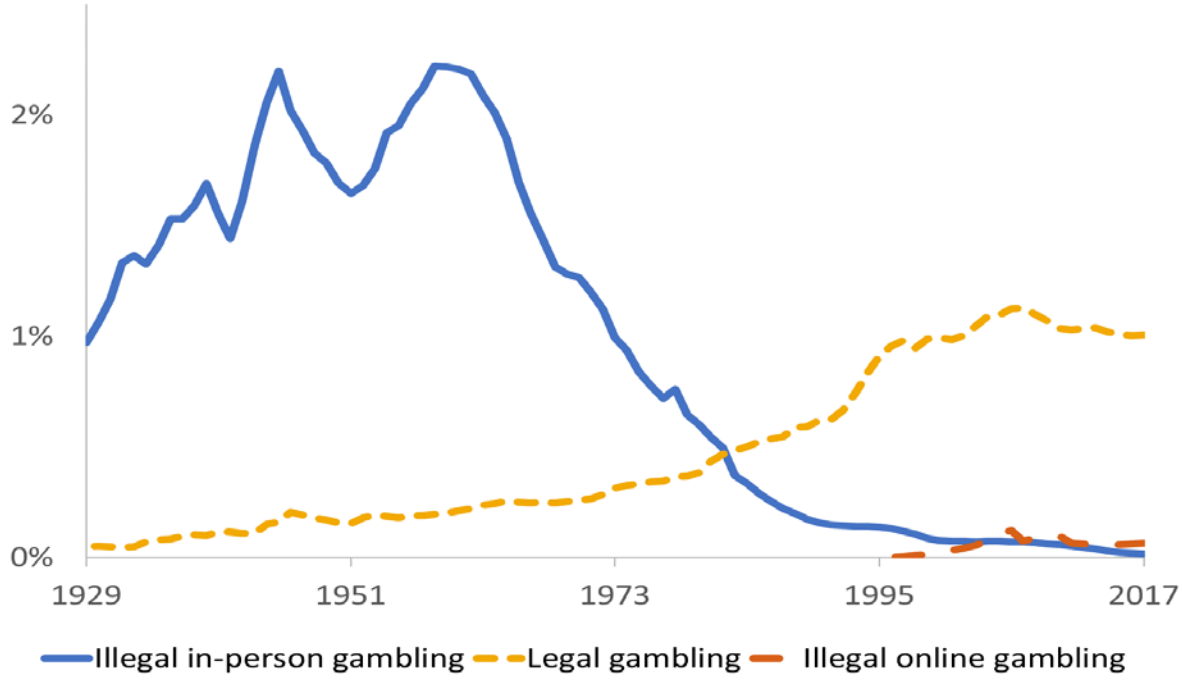


Chart 7 shows that illegal gambling has grown much slower than overall PCE. A portion of the slow growth can be explained by customers shifting towards legal gambling, but total gambling appears to have accounted for a larger share of personal consumption expenditures before 1970.

Prices for Gambling

Measuring prices for gambling services is hard. First, BLS considers gambling losses to be out of scope for the consumer market basket, and therefore does not produce a consumer price index for gambling (2018). According to pages 5–24 of the 2019 NIPA Handbook, BEA currently uses the CPI-All Items price as a deflator for legal gambling services.[24] Finally, BLS's Producer Price Index for casino hotel gaming uses the average winning percentage as its price index.[25] The gambling price index is very sensitive to the methodology used to measure gambling prices. Going forward, BEA could develop a conceptual framework for tracking prices of both legal and illegal gambling services consistently.

[24] BEA's published price index for gambling largely tracks the CPI back to the 1940s but grew faster than the CPI from 1929 to 1946. Documentation on BEA's sources used as a deflator then is not readily available.
[25] Description based on a BLS document kindly shared by Sarah Eian at BLS.

The in-person gambling price index in this paper tracks daily casino revenue per visitor.[26] Based on the Las Vegas Visitor Profile, it is calculated that casinos earned net gambling revenue of about $95 per visitor per day (Las Vegas Convention and Visitors Authority 2012). This is roughly comparable to the daily cost of visiting amusement parks, sporting events and other entertainment locations. Between 1970 and 2016, smoothed daily gambling costs were used as a price index.[27] Before 1970, the labor cost data described earlier is used as a proxy for output prices. The same in-person gambling price index is used to deflate the domestically produced online gambling services described earlier.

Imported online gambling services from foreign websites are deflated based on digital content costs calculated earlier (Nakamura, Samuels, and Soloveichik 2018). Digital content costs fell very rapidly over the past two decades, so the paper calculates rapid quality improvement and declining quality adjusted prices for the online gambling industry. This result seems plausible. For example, sports bettors are now able to observe odds in real time and place bets whenever they want.

The paper then adjusts these two gambling price indexes for legal changes over time. It may be true that illegal gambling is widespread and not particularly stigmatized. Nevertheless, the illegality does create moderate quality problems that probably diminish willingness-to-pay. In particular, the Bolita numbers game offers an experience very similar to the legal lottery but has a house edge of 20 percent less than the lottery (Trench 2015). In 1929, the clear majority of gambling services was illegal, so the quality adjustment raises prices approximately 25 percent. Data on illegal gambling availability was not located, so the price index is not adjusted for availability.

[26] Thanks are due to Joshua Abramsky and Gareth Powells at the UK Office of National Statistics for their conceptual advice. Readers should note that reported hours of gambling per day trend downward over time and fall very sharply recently. As a result, daily gambling prices have risen slower than hourly gambling prices.
[27] The Las Vegas Convention and Visitors Authority publishes estimates of total gambling revenue and total visitors back to 1970. Since 1975, they have also surveyed visitors to estimate length of stay and gambling participation. The author has not yet been able to obtain all surveys. Revenue per visitor is used as a proxy in missing years.

Chart 8: Gambling Prices, Relative to PCE Prices

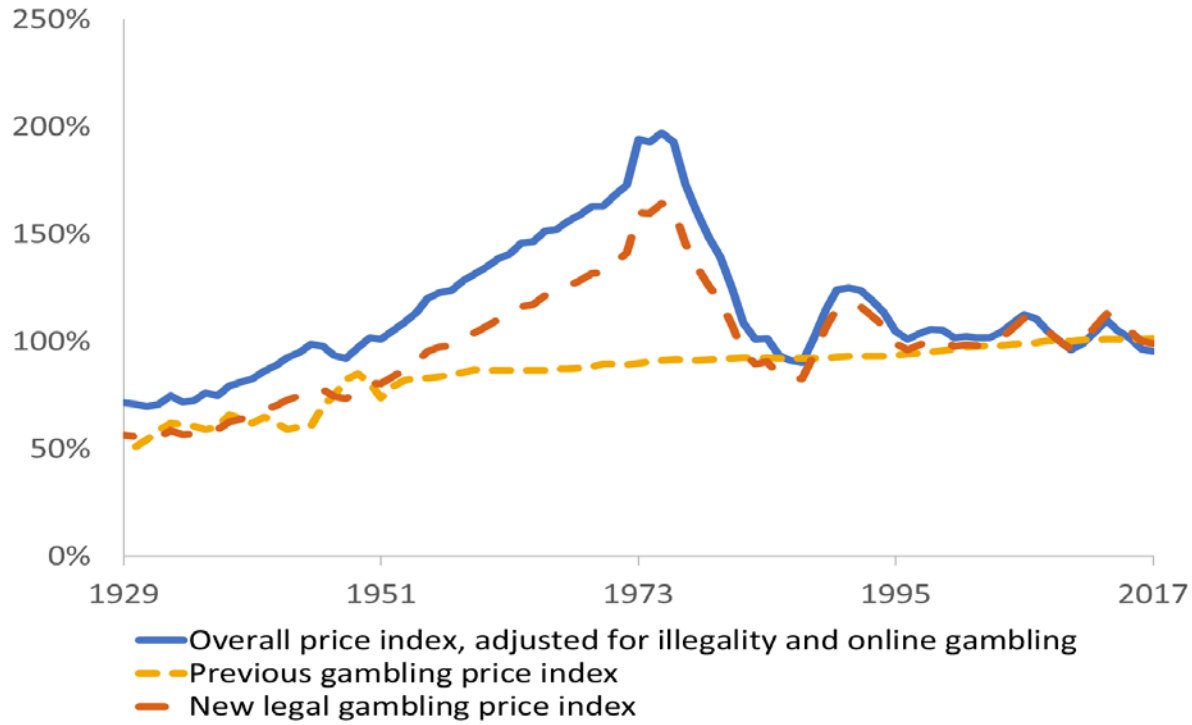


Chart 8 shows that the gambling price index rises a little faster than overall PCE prices in the long run. As a result, including illegal gambling in the measured economy slightly raises aggregate inflation.

Intermediate Inputs for Gambling

Data on the intermediate inputs used by illegal gambling providers is not available. The academic literature suggests that the main non-labor cost is space for the bookie to meet gamblers and record bets. For now, it is assumed that space rental costs are fixed at 25 percent of total illegal gambling output. This paper adjusts PCE housing to remove those intermediate inputs from PCE.

Imports and Exports of Gambling Services

The Internet has allowed Americans to easily import online gambling services from global websites. For now, it is assumed that all online gambling services are imported except for the portion of online poker that is provided by domestic professionals who play amateurs and win consistently. Data on imports or exports of illegal in-person gambling is not available. For now, it is assumed that gambling tourists typically visit locations with legal gambling and therefore imports and exports are both minimal.

Money Laundering of Illegal Gambling Income

Data on the share of illegal gamblers laundering income was not available. For now, the paper assumes that laundering is minimal throughout the entire 1929 to 2017 period, so no adjustment is necessary.

5. Theft from Businesses

This category covers all goods or money taken by individuals from businesses without legal authorization.[28] Goods are assumed to be stolen after they are produced or put into inventory but before a sale is recorded. In contrast, money is assumed to be stolen either before it is used to purchase inputs or after a sale is recorded. This timing difference has little impact on the loss from theft, but it does change how theft is recorded. Businesses generally track stolen goods in cost of goods sold and stolen money in operating expenses. The Uniform Crime Report generally records stolen goods as larceny and records stolen money as fraud or embezzlement (Department of Justice 1929-2017). Empirically, it is easier to track these types of theft separately and then add them to get total theft loss.

Thefts are partially tracked in the NIPAs. BEA already tracks a small portion of thefts in 'other business current transfers' (table 7.7, line 13).[29] This paper is careful to avoid double-counting those thefts. In the NIPAs, measured intermediate inputs exclude insured theft losses but measured business deductions implicitly include insured theft losses through the deduction for insurance premiums. In other words, insured thefts are counted in GDP but not GDI. This disparate treatment may contribute to the statistical discrepancy between GDP and GDI.

Nominal Value of Stolen Goods

The primary data is taken from the National Retail Security Survey (National Retail Federation, or NRF, 1991-2017). The NRF survey tracks both overall inventory shrinkage and splits that shrinkage between four specific separate causes: 1) customer shoplifting; 2) employee theft; 3) vendor fraud; and 4)

[28] Business owners sometimes take goods, services or money for personal use without recording the transactions properly. These transactions are generally considered tax evasion rather than theft, and so they are implicitly accounted for in BEA's existing adjustments for underreporting and misreporting of proprietors' income. The paper also does not analyze thefts by individuals from governments or non-profits, thefts by governments or non-profits from individuals, or thefts by businesses from individuals because the conceptual treatment of those thefts is unclear. Thefts between entities in the same sector are not tracked because they do not impact the NIPAs.

[29] Howard Krakower was kind enough to share BEA's internal data on tracked cash disappearances back to 1946. Before then, total cash disappearance is used as a proxy to extrapolate tracked disappearances.

administrative error. It is assumed that customer shoplifting and employee theft both involve thefts of physical goods, so they are tracked in this section. On the other hand, vendor fraud are not tracked in this section because it is assumed to be involve stolen money and administrative error is not tracked because it is assumed to involve unrecorded spoilage, which is not illegal. The NRF values stolen items at retail prices, so it overestimates the true inventory loss from theft. This paper removes estimated retail markups to calculate an inventory loss from theft.

Tracking retail shrinkage before 1991 is more difficult. The paper uses data from the National Merchants Retail Association (NMRA) and other sources (McNair 1948-1957, Isaacson 1960-1969, Abt Associates 1984, and Retailing Today 1988). Shrinkage reports for all years were not readily available, so smoothing techniques are used to interpolate and extrapolate retail shrinkage from 1929 to 2017.

Unfortunately, reliable time-series data on stolen goods from non-retail firms is not available. Most non-retail businesses keep less detailed inventory records and therefore have difficulty distinguishing between theft and legitimate usage. However, both industry literature and academic research are clear that theft is a common problem in non-retail firms (Pierce, Snow and McAfee 2015). For now, the paper uses a benchmark report that estimates theft for retail and food services, wholesale, transportation, manufacturing, and the rest of the economy (Department of Commerce 1975). For all other years in the sample the following extrapolators are used: retail theft, employee compensation, and employee demographics by industry in the Current Population Survey.

Readers should note that stolen goods are often resold and therefore may eventually earn a retail margin. If the reseller is filing income taxes properly, then those retail margins should be captured in taxable income. If the reseller is a small business not filing income taxes properly, then the retail margins may be captured in BEA's existing adjustments for underreporting and misreporting of income. Only non-business resellers, such as store employees who personally sell stolen items, may have their margins missed in the existing NIPAs. Data on the revenue earned by non-business resellers is not readily available, so the paper omits this potential value added from its analysis for simplicity.

Chart 9: Nominal Stolen Goods and Services, as a Share of PCE

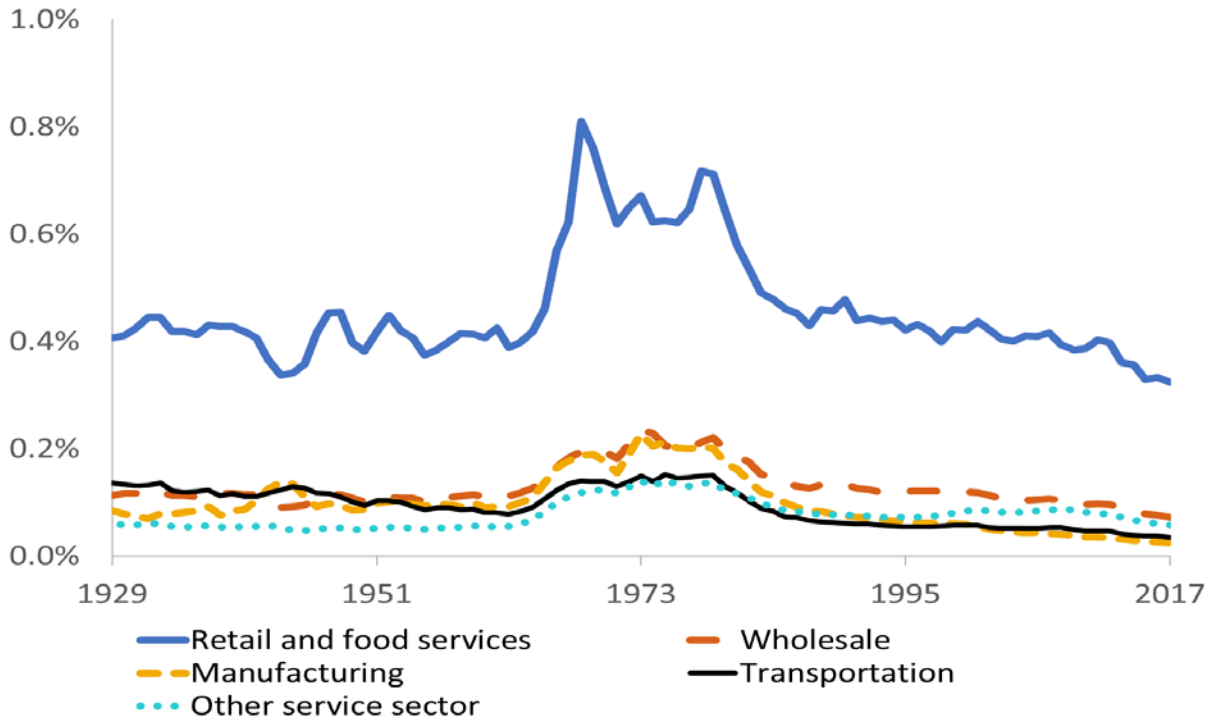


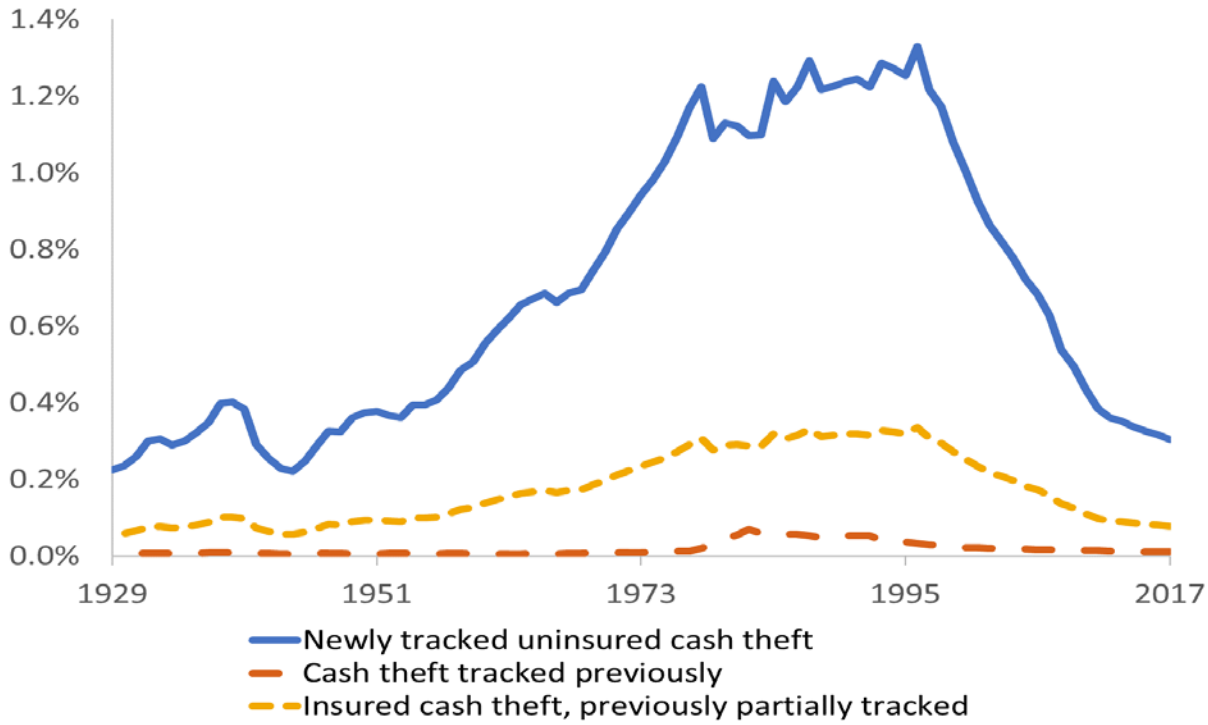
Chart 9 shows that theft of goods increased dramatically during the late 1960s and then fell gradually. This matches the general trends in crime over time.

Nominal Value of Stolen Money

The primary data on physical cash theft and inappropriate bills is taken from a 1975 report by the American Management Association (Cunningham, Gross, and Nugent 1978). That study reports that in 1975, businesses lost $3.5–$10 billion from kickbacks, $4 billion from embezzlement, and $2–$2.5 billion from insurance fraud. In total, businesses lost $14 billion to fraud and embezzlement in 1975.

Unfortunately, historical time-series data on stolen money is not available. For now, fraud and embezzlement arrests are used as a proxy for the number of people stealing cash. Interestingly, arrests for fraud and embezzlement peak about two decades after inventory theft peaked. This may suggest a shift in activities by criminals over time. Perhaps young criminals start out their career stealing goods and then move to more lucrative fraud over time? The paper then uses average wages in the private business sector and criminal demographics to estimate the cash disappearance per arrest from 1929 to 2016. The author welcomes data suggestions on this and all topics contained in this paper.

Chart 10: Cash Disappearance, as a Share of PCE



Prices for Theft from Businesses

Each stolen good has its own price index that could be tracked separately. The industry literature suggests that expensive non-perishable goods like baby formula (Pomorski 2018) or detergent (Paynter 2013) are most likely to be shoplifted by career criminals. But almost any good can be stolen. Future work may determine the precise breakdown of stolen goods and construct a price deflator based on prices for each type of good stolen. For now, BEA's general price index for all PCE goods is used to deflate stolen goods.

Businesses generally track stolen money together with genuine operating expenses. Cash shortages are generally tracked as a component of miscellaneous operating expenses. Fraudulent bills are generally reported as if non-existent goods and services were delivered, placed into inventory, and then used. When constructing the NIPAs, BEA uses sophisticated balancing procedures to allocate reported operating expenses to a variety of commodities. Future research may determine the allocation of stolen

money by commodity and construct a price deflator based on individual commodity prices. For now, BEA's general price index for all intermediate inputs is used to deflate stolen money.[30]

Inputs to theft

Measuring theft inputs is conceptually difficult. National accounting theory considers theft to be a transfer rather than a payment to production inputs (*SNA 2008*, Section 3.98). At the same time, most theft is carried out by employees—and so businesses consider it part of labor costs (Curtis 1983). For the purposes of calculating productivity, this paper treats theft as a component of employee compensation.[31] This higher labor share has implications for measured productivity even if labor quantities are steady. Theft is assumed to have no intermediate inputs subject to tracking in the NIPAs.

International theft

Americans frequently lose money to foreign criminals and foreigners often lose money to American criminals. Unfortunately, reliable data tracking cross-country fraud losses was not available. Therefore, the paper excludes international thefts from the analysis.

Money Laundering of Theft Income

Data on the laundering of stolen money was not available. For now, the paper assumes that laundering is minimal throughout the entire 1929 to 2017 period, so no adjustment is necessary.

6. Impact of Illegal Activity on the Aggregate NIPAs

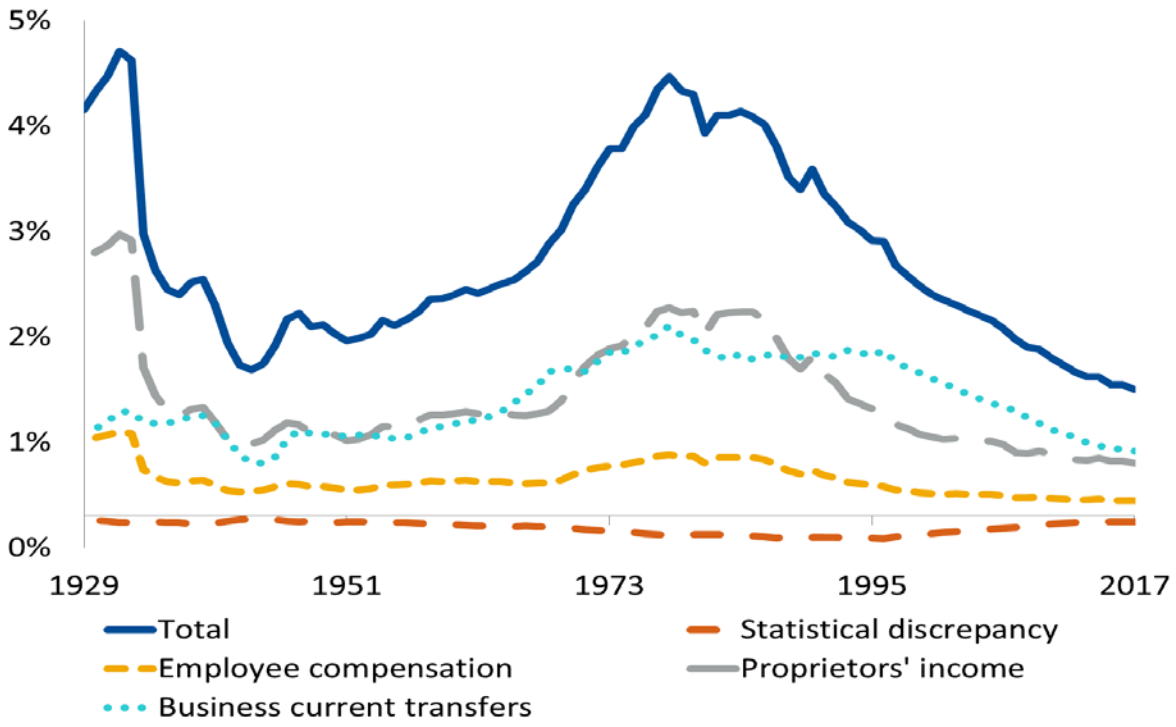
The recognition of illegal activity impacts many NIPA tables. To save space, this paper will only show the impact on nominal GDI, nominal GDP and real GDP.[32] Recognizing the illegal sector increases business current transfers and proprietors' income. However, employee compensation rises only slightly because most black market workers are self-employed.[33] The need for secrecy and the lack of

[30]Intermediate input prices are calculated from the joint BEA/BLS production accounts back to 1948. Before then, PCE prices are used as a proxy. Results are similar when capital investment prices are included in the analysis too.
[31] Like other nonwage compensation, theft is allocated proportionally to wages. Future work may allocate it by age.
[32] The paper calculates an approximate quantity index rather than the full Fisher index.
[33] Readers should note that black market firms are typically organized loosely and do not clearly distinguish between employees and self-employed business owners. For now, the employee share for multi-level marketers (NAICS 4543) is used as a proxy for drug dealers; the employee share for other personal services (NAICS 8129) as a proxy for prostitutes; and the employee share for legal gambling (NAICS 7132) as a proxy for illegal gambling.

contract enforcement generally reduce capital usage. For simplicity, this paper assumes that the capital share of the black market sector is zero.

Recognizing illegal activity raises nominal U.S. GDP by 1.67 percent in 2007. This is an increase in measured output and larger than the average European GDP increase from tracking illegal activity in 2007 (page 32 of Eurostat 2018). The primary reason for the larger impact in the United States is that most European countries are not tracking illegal gambling or theft from businesses. In the United States for 2007, tracking illegal drugs raises measured GDP by 0.56 percent and tracking illegal prostitution raises measured GDP by 0.17 percent. In comparison, case studies of other countries reveal that tracking illegal drugs raises measured GDP from 0.02 percent to 0.78 percent and tracking illegal prostitution raises measured GDP from 0.02 percent to 0.34 percent (Eurostat 2018).[34] As a result, the estimated impact of illegal activity in the United States appears well within the range of European countries.

Chart 11: Revision to Nominal Income by Source, as a Share of GDP



[34] The numbers given above apply to the 2007 GDP when possible, but some countries report different years in the Eurostat handbook. In that case, the closest year available is used. All GDP shares are approximate.

Chart 12: Revision to Nominal GDP from Illegal Activity, as a Share of GDP

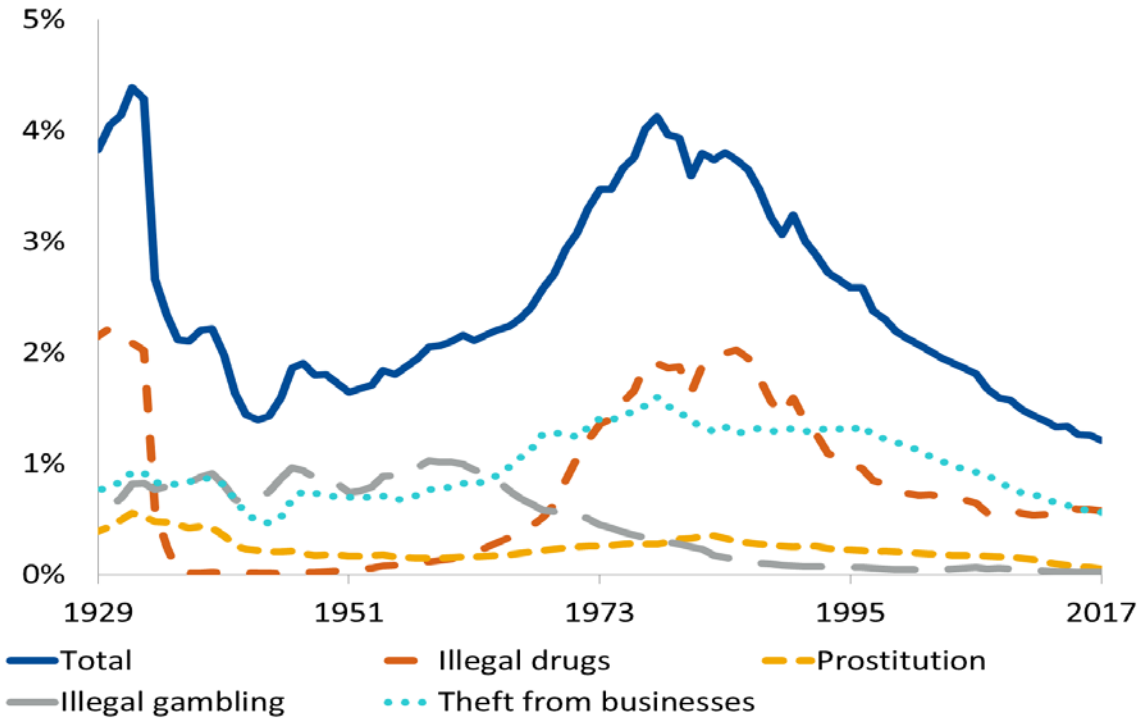
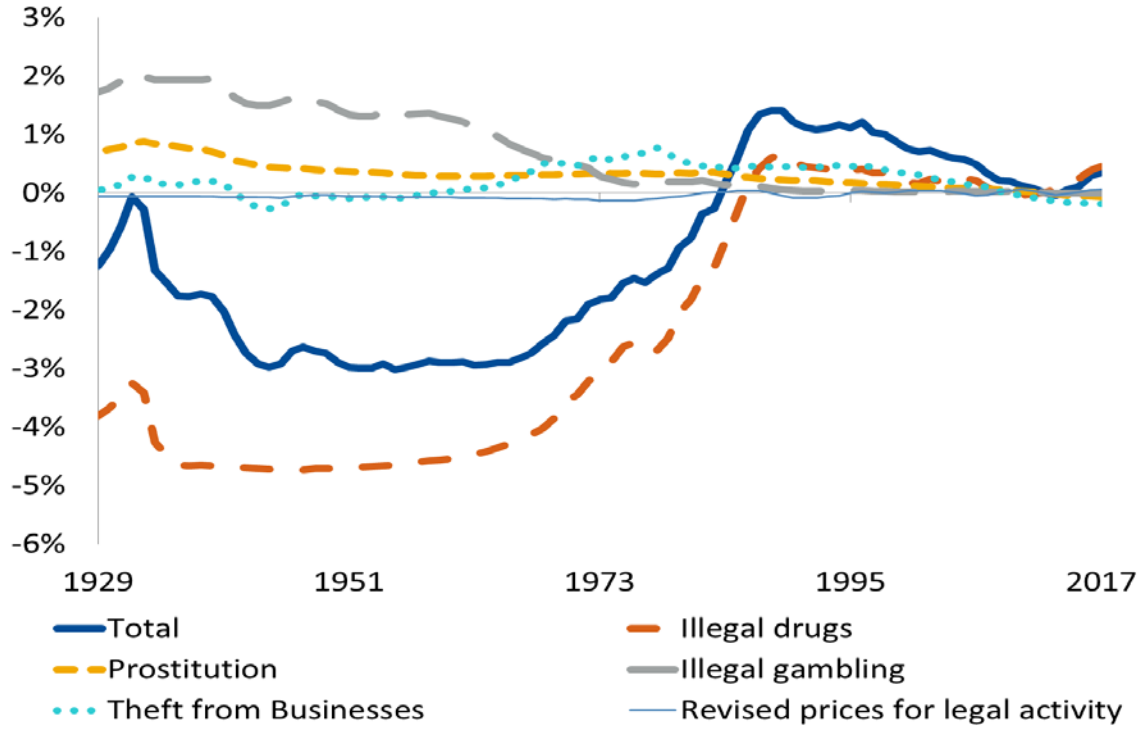


Chart 13: Revision to GDP Quantity Index, Relative to Original Quantity Index



Real illegal activity grew relatively more during the 1970s and after 2008. Rising drug consumption is the main contributor to the increase, but rising theft also contributed to the 1970s increase. The crime epidemic during the 1970s has been analyzed for decades, so the general result of increasing illegal activity is well known in the sociological and legal literature. Similarly, the recent opioid epidemic is well known in the medical, sociological and legal literature. To save space, that literature will not be reviewed here. There is also a small amount of national accounting literature discussing how cultural changes may impact measured economic activity (Weisskopf, Bowles, and Gordon 1983) and how opioids may impact labor force participation (Krueger 2017). This paper extends the national accounting literature by showing illegal activity impacts in measured GDP during those decades. Researchers studying changes in the labor share, changes in the real growth rate and other cyclical factors may need to consider how tracking illegal activity might impact their results.

7. Impact of Illegal Activity on Total Factor Productivity (TFP)

The productivity calculations in this paper are based on existing industry-level production accounts that track labor, capital and intermediate inputs for 61 separate private business sector industries (Garner et al. 2018 and Jorgenson et al. 2016). Each industry production account was then revised to track the new inputs and outputs associated with illegal activity.

Labor Inputs to Illegal Activity

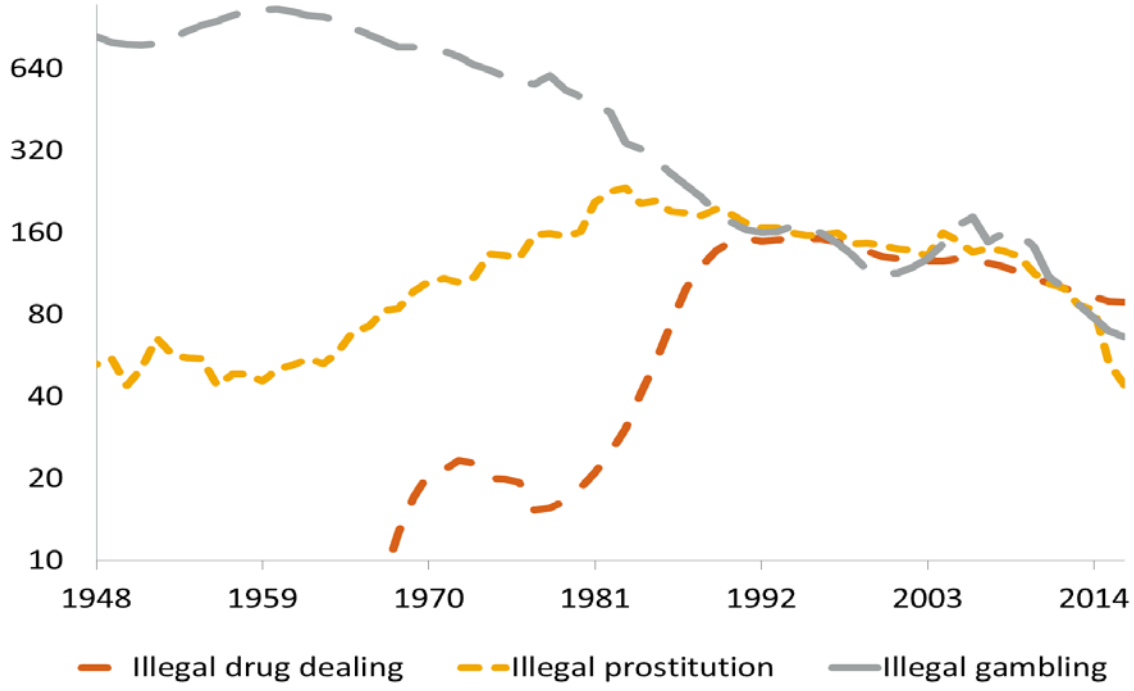
Labor is the main input to black market firms and theft. The labor quantity data for prostitution, gambling, and theft were described earlier in sections 3, 4 and 5 respectively. This section will briefly describe labor inputs for illegal drugs. Readers should note that each European country uses its own methodology to estimate workers in the black market. The specific procedures are briefly described in answer 1.6 of Eurostat's Employment Questionnaires.[35]

The drug labor quantity is based on a count of individual arrests for drug sales or manufacturing. The FBI's Uniform Crime Report (Department of Justice 1977-2017) splits drug arrests into three relevant categories: cocaine or heroin; marijuana; and synthetic or other dangerous nonnarcotic drugs. It is not possible to clearly distinguish between arrests of domestic drug dealers and arrests of foreign drug

[35] Available at https://ec.europa.eu/eurostat/web/national-accounts/methodology/member-states-accounts/employment-questionnaires

importers. This paper assumes that the import revenue shares shown in chart 4 are a proxy for the foreign arrest shares. The combined labor quantity index weights each drug category in proportion to the value-added per domestic arrest.[36] In recent years, the marijuana quantity index is also adjusted for sellers of legal marijuana who are not subject to state arrest.

Chart 14: Labor Quantity Indexes by Black Market Activity, 2012 Base



Non-labor Inputs to Illegal Activity

Black market firms have few non-labor inputs. Housing services are used by the marijuana growing industry, the drug manufacturing industry, the prostitution industry and the gambling industry. In addition, these industries also require minor inputs like electricity for marijuana grow lights, diverted drugs for meth labs and clothing for prostitution. However, it is assumed that the drug retailing industry does not use any non-labor inputs or capital services in production.

[36] The arrest data gives a very different time series than the National Survey of Drug Use and Health (NSDUH). Earlier survey data on drug dealing (Fairlie 2002) also fails to track the arrest data. Perhaps the drug sector is shifting from a few full-time workers to many part-time workers? This shift may relate to the broader gig economy.

Measuring the TFP Impact of Illegal Activity by Industry

The retail sector is the most affected due to the inclusion of illegal drug value added and employee theft in this sector. To simplify the discussion, the paper only shows TFP impacts for the retail sector and aggregate TFP impacts for the combined business sector.

Chart 15: Revision to TFP Index for Retail, Relative to Original TFP Index

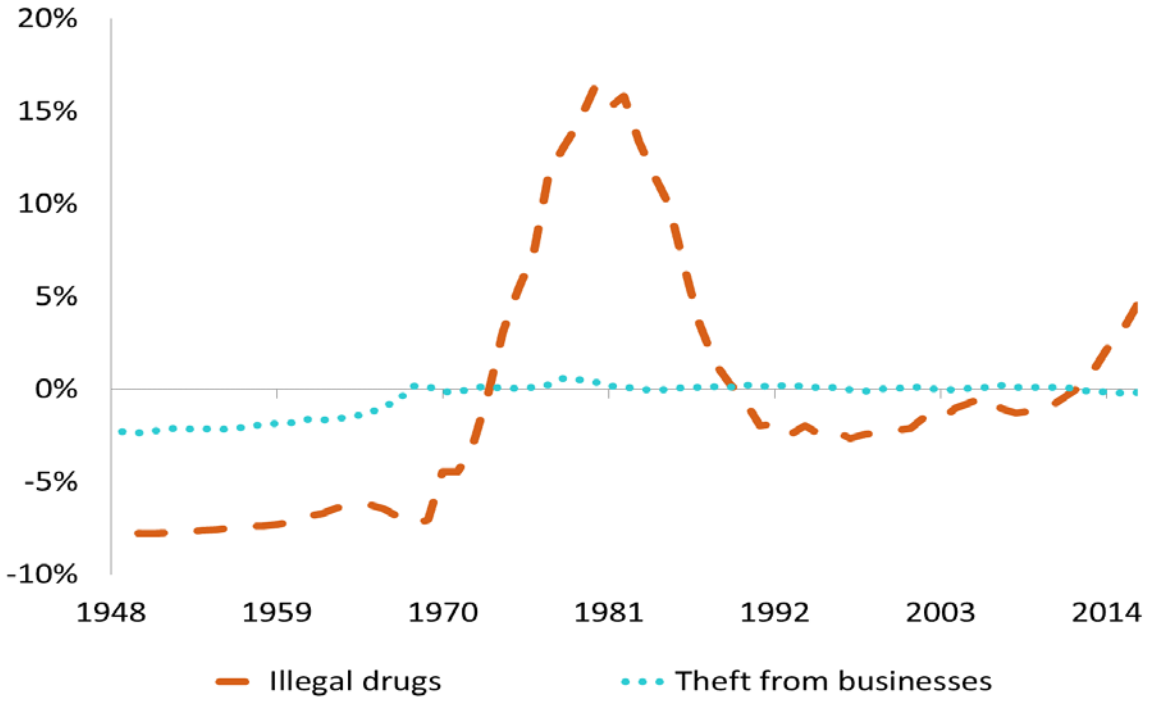


Chart 15 shows that tracking illegal drugs changes retail productivity growth dramatically. Between 2008 and 2016, measured productivity growth is raised from 0.74 percentage points per year to 1.41 percentage points per year. This faster growth is due to the introduction of fentanyl, a major technological innovation that enabled drug retailers to sell a more potent drug at the same retail price as before. Between 1980 and 1990, measured productivity growth is lowered from 0.68 percentage points per year to -0.84 percentage points per year. This slower growth is due to the drug labor supply increase during the 1980s, which lowered real output per worker.

Chart 16: Revision to Aggregate TFP Index, Relative to Original TFP Index

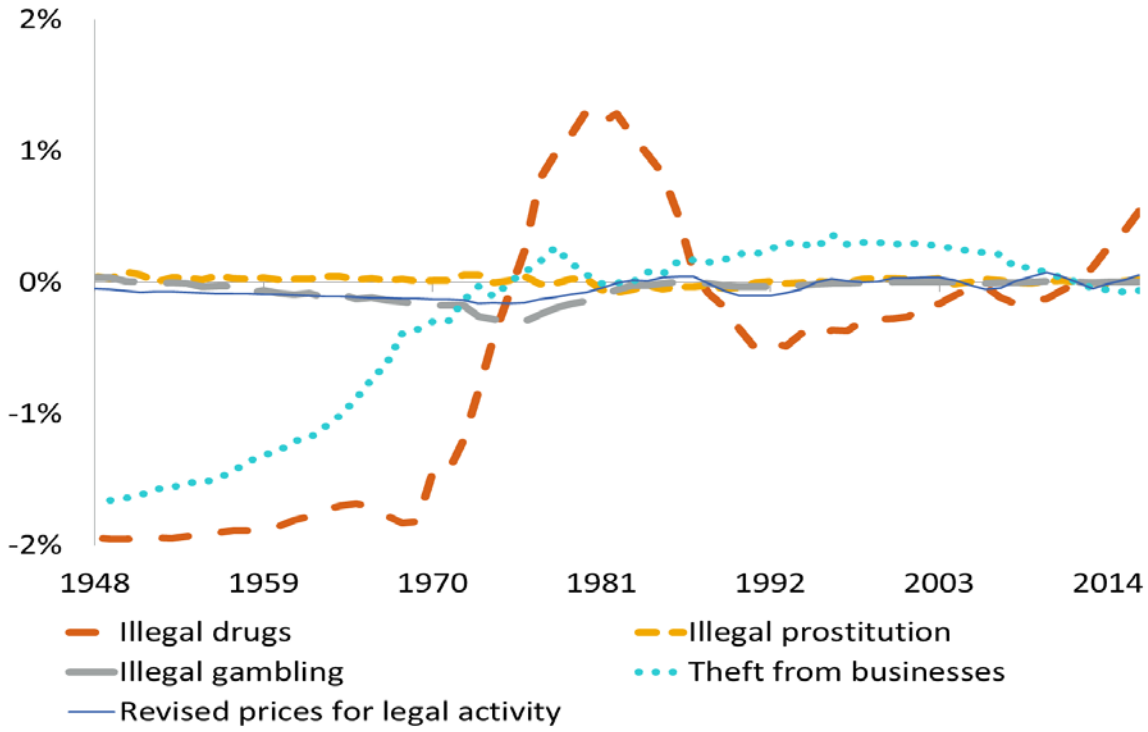


Chart 16 shows that tracking illegal activity has a muted but still important impact on overall productivity. When illegal activity is tracked, measured productivity growth during the 1970s increases by 0.34 percentage points per year and measured productivity growth after 2008 increases by 0.07 percentage points per year. This is sufficient to ameliorate the 1970s slowdown and partially ameliorate the post-2008 slowdown. However, there is little impact on long-run TFP growth.

Conclusion

The *SNA 2008* recommends that illegal market activity be included in measured output. Consistent with that recommendation, European Union countries have integrated illegal drugs and illegal prostitution into their national accounts (Eurostat 2018). BEA does not implement the recommendation because of challenges in source data and different conceptual traditions (Carson 1984a and 1984b). This preliminary paper explores how tracking illegal drugs, illegal prostitution, illegal gambling and theft from businesses might impact the U.S. national economic accounts. Much more work is needed before BEA could achieve a similar integration of illegal activity into the NIPAs.

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Appendix A: Datasets Used to Estimate Illegal Activity

Data Source	Time-Series Derived from Source
Abruzzese (1989)	Quantity Index for Cocaine (1985-1989)
Abt Associates (1984)	Retail Theft (1970-1979)
Abt Associates (2001)	Import Prices for Cocaine, Heroin, Marijuana and Methamphetamines (1981-2000)
Antigua (2006)	Imports of Online Gambling Services (1999-2002)
Brecher (1973)	Quantity Index for Marijuana (1954-1964); Price Index for Marijuana (1929-1964)
Capitol Matrix (2014)	Imports of Online Gambling Services (2011-2013)
Caulkins (1994)	Import Prices for Cocaine (1975-1981)
Chandra et al. (2019)	Marijuana Quality (2008-2017)
Cunningham, Gross and Nugent (1978)	Embezzlement, Kickbacks, Insurance Fraud and Cash Disappearance (1975)
Cusack (1974)	Quantity Index for Heroin (1960-1968)
Dank et al. (2014)	Male Employment in Prostitution
Department of Commerce (1975)	Theft in Wholesale, Manufacturing and Services (1975)
Department of Justice (1929-2017)	Illegal drug workforce, Illegal prostitution workforce, Illegal gambling workforce and a count of fraud and embezzlement arrests (1929-2017)
Drug Intelligence Report (1994)	Quantity Index for Methamphetamines (1977-1988)
ElSohly et al. (1984 and 2000)	Marijuana Potency (1972-1994)
Executive Office of the President (2002)	Quantity Index for Heroin (1979-1988)
Executive Office of the President (2016)	Nominal Expenditures on Cocaine, Heroin, Marijuana and Methamphetamine (1988-2006); Nominal Expenditures on Miscellaneous Drugs (1988-1998); Price Indexes for Cocaine, Heroin, Marijuana and Methamphetamine (1981-2006); Marijuana Quality (1995-2007); Import Prices for Cocaine, Heroin, Marijuana and Methamphetamines (2001-2012)
Executive Office of the President (2019)	Nominal Expenditures on Cocaine, Heroin, Marijuana and Methamphetamine (2006-2017); Price Indexes for Cocaine, Heroin, Marijuana and Methamphetamine (2006-2017)
Gerstein and Harwood (1992)	Judgmental Quantity Index for Heroin (1929-1959)
Gootenberg (2008)	Quantity Index for Cocaine (1929-1961)
Hinkes-Jones (2011)	Domestic Methamphetamine Production (1990-2010)
Hyland (2011)	Quantity Index for Cocaine (1976-1982)

Internal Revenue Service (1983)	Nominal Expenditures on Heroin (1973-1979); Price Index for Heroin (1973-1979), Price Index for Marijuana (1973-1979); Nominal Prostitution Income (1979); Retail Theft (1970-1979)
Isaacson (1960-1969)	Retail Theft (1957-1969)
Kerr (1986)	Quantity Index for Heroin (1969-1972)
McNair (1948-1957)	Retail Theft (1948-1956)
Miech et al. (2019)	Quantity Index for Miscellaneous Drugs (1975-1987) and (1998-2003); Availability for Drugs (1975-2018)
Miron and Zweibel (1991)	Judgmental Quantity Index for Illegal Alcohol (1929-1935)
Nakamura, Samuels, and Soloveichik (2018)	Nominal Expenditures and Prices for "Free" Digital Content. Used as a proxy for Nominal Online Gambling Expenditures (1995-1998) and Prices for Online Gambling (1995-2017)
National Retail Security Survey	Retail Theft (1991-2017)
New York Times (1972)	Quantity Index for Marijuana (1965-1971)
NIPA Table 2.4.4, 6.2 and 6.5; Joint BEA/BLS Production Accounts	Input Prices for Prostitution (1929-2017); Output Prices for Theft (1929-2017); Nominal Earnings from Prostitutes, Illegal Gambling Providers and Cash Theft (1929-2017)
Platzer (2016)	Imports of Online Gambling Services (2014-2016)
Retailing Today (1988)	Retail Theft (1980-1987)
Robinson, Cattan and Bain (2015)	Domestic Marijuana Share (2000-2015)
Rydell and Everingham (2005)	Quantity Index for Cocaine (1962-1975) and Price Index for Cocaine (1972-1980)
Schulenberg et al. (2019)	Availability for Drugs (1975-2018)
Spectrum Gaming Group (2010)	Imports of Online Gambling Services (2003-2010)
U.S. Department of Health and Human Services (1995)	Quantity Index for Marijuana (1972-1979)
U.S. Sentencing Commission (2003-2017)	Nominal Expenditures on Miscellaneous Drugs (1999-2017)
Volberg, Nysse-Carris and Gerstein (2006)	Nominal Gambling Losses in 2006
Volsky (1985)	Quantity Index for Cocaine (1981-1985)

Appendix B: Nominal Revision to GDP from Tracking Illegal Activity, as a share of Nominal GDP

Year	Total	Illegal drugs	Illegal Prostit.	Illegal gambling	Theft from business	Year	Total	Illegal drugs	Illegal Prostit.	Illegal gambling	Theft from business
2017	1.21%	0.57%	0.05%	0.02%	0.56%	1972	3.30%	1.21%	0.26%	0.50%	1.32%
2016	1.26%	0.59%	0.06%	0.02%	0.58%	1971	3.07%	1.05%	0.25%	0.54%	1.23%
2015	1.26%	0.59%	0.07%	0.02%	0.59%	1970	2.94%	0.85%	0.24%	0.57%	1.27%
2014	1.34%	0.61%	0.08%	0.03%	0.62%	1969	2.71%	0.63%	0.23%	0.57%	1.27%
2013	1.33%	0.56%	0.10%	0.03%	0.64%	1968	2.58%	0.51%	0.21%	0.58%	1.27%
2012	1.39%	0.54%	0.12%	0.03%	0.69%	1967	2.40%	0.44%	0.20%	0.64%	1.13%
2011	1.43%	0.54%	0.14%	0.04%	0.72%	1966	2.30%	0.37%	0.19%	0.69%	1.05%
2010	1.49%	0.56%	0.15%	0.05%	0.74%	1965	2.23%	0.33%	0.18%	0.76%	0.97%
2009	1.57%	0.58%	0.16%	0.05%	0.78%	1964	2.20%	0.29%	0.18%	0.85%	0.89%
2008	1.59%	0.55%	0.16%	0.06%	0.83%	1963	2.16%	0.24%	0.17%	0.90%	0.85%
2007	1.67%	0.56%	0.17%	0.05%	0.90%	1962	2.11%	0.20%	0.16%	0.94%	0.81%
2006	1.81%	0.64%	0.17%	0.06%	0.93%	1961	2.16%	0.18%	0.16%	1.00%	0.82%
2005	1.86%	0.68%	0.17%	0.06%	0.95%	1960	2.10%	0.14%	0.15%	1.01%	0.79%
2004	1.91%	0.70%	0.17%	0.05%	0.98%	1959	2.06%	0.13%	0.15%	1.01%	0.78%
2003	1.95%	0.70%	0.18%	0.05%	1.02%	1958	2.05%	0.12%	0.15%	1.02%	0.76%
2002	2.01%	0.72%	0.19%	0.04%	1.06%	1957	1.94%	0.12%	0.15%	0.96%	0.72%
2001	2.07%	0.72%	0.19%	0.04%	1.12%	1956	1.87%	0.10%	0.16%	0.93%	0.69%
2000	2.13%	0.73%	0.20%	0.04%	1.15%	1955	1.80%	0.09%	0.16%	0.89%	0.67%
1999	2.19%	0.75%	0.21%	0.05%	1.19%	1954	1.84%	0.07%	0.18%	0.88%	0.70%
1998	2.30%	0.81%	0.21%	0.05%	1.22%	1953	1.71%	0.06%	0.17%	0.79%	0.69%
1997	2.37%	0.85%	0.21%	0.06%	1.26%	1952	1.68%	0.05%	0.17%	0.75%	0.71%
1996	2.58%	0.96%	0.22%	0.06%	1.35%	1951	1.64%	0.04%	0.17%	0.74%	0.70%
1995	2.58%	1.00%	0.23%	0.07%	1.29%	1950	1.72%	0.03%	0.18%	0.81%	0.69%
1994	2.66%	1.05%	0.22%	0.07%	1.31%	1949	1.80%	0.03%	0.18%	0.87%	0.72%
1993	2.72%	1.09%	0.24%	0.07%	1.33%	1948	1.80%	0.02%	0.17%	0.87%	0.73%
1992	2.88%	1.27%	0.25%	0.07%	1.29%	1947	1.90%	0.02%	0.19%	0.94%	0.75%
1991	3.01%	1.38%	0.26%	0.07%	1.29%	1946	1.86%	0.01%	0.21%	0.96%	0.68%
1990	3.24%	1.59%	0.25%	0.08%	1.32%	1945	1.59%	0.01%	0.20%	0.87%	0.52%
1989	3.06%	1.43%	0.25%	0.08%	1.29%	1944	1.43%	0.01%	0.20%	0.75%	0.47%
1988	3.22%	1.56%	0.27%	0.10%	1.30%	1943	1.40%	0.01%	0.22%	0.69%	0.48%
1987	3.47%	1.78%	0.27%	0.10%	1.32%	1942	1.44%	0.02%	0.23%	0.65%	0.55%
1986	3.65%	1.95%	0.29%	0.12%	1.29%	1941	1.63%	0.02%	0.26%	0.68%	0.68%
1985	3.74%	2.03%	0.30%	0.14%	1.28%	1940	1.98%	0.01%	0.35%	0.81%	0.81%
1984	3.80%	1.99%	0.32%	0.15%	1.33%	1939	2.21%	0.02%	0.42%	0.91%	0.86%

1983	3.74%	1.92%	0.35%	0.17%	1.29%	1938	2.20%	0.01%	0.44%	0.88%	0.87%
1982	3.79%	1.88%	0.35%	0.23%	1.34%	1937	2.10%	0.01%	0.42%	0.83%	0.84%
1981	3.59%	1.64%	0.32%	0.25%	1.38%	1936	2.12%	0.02%	0.45%	0.84%	0.81%
1980	3.93%	1.87%	0.32%	0.28%	1.47%	1935	2.34%	0.25%	0.47%	0.80%	0.82%
1979	3.96%	1.86%	0.29%	0.29%	1.52%	1934	2.66%	0.59%	0.48%	0.77%	0.83%
1978	4.13%	1.90%	0.28%	0.35%	1.60%	1933	4.28%	2.02%	0.52%	0.82%	0.92%
1977	4.01%	1.88%	0.27%	0.33%	1.52%	1932	4.39%	2.09%	0.56%	0.82%	0.92%
1976	3.76%	1.66%	0.28%	0.36%	1.47%	1931	4.14%	2.12%	0.49%	0.69%	0.83%
1975	3.66%	1.55%	0.27%	0.39%	1.45%	1930	4.05%	2.22%	0.44%	0.60%	0.79%
1974	3.47%	1.40%	0.26%	0.42%	1.39%	1929	3.83%	2.14%	0.39%	0.54%	0.76%
1973	3.47%	1.36%	0.25%	0.44%	1.41%						