Optimal Cigarette Taxation and Macroeconomic Implications: A Case Study of Indiana

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Abstract

This paper examines the economic impacts of increasing cigarette excise taxes to account for externalities and internalities in Indiana. This study evaluates the effects of different tax rates on employment, GDP, and personal income through a macroeconomic model known as the REMI model. Employing a range of excise tax rates from $1.91 to $22.12 per pack, this paper finds that moderate tax increases yield positive economic outcomes. Specifically, simulations show that raising the tax to $1.91 and $6.96 per pack results in significant improvements in employment, GDP, and income over a 20-year period. Overall, this research highlights the potential for cigarette excise taxes to positively impact Indiana's economy, providing valuable insights for policymakers under strong assumptions.

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1 Introduction

Tobacco consumption is a significant public health concern worldwide; it contributes to many preventable diseases as well as both burdens on society through loss of productivity, excessive healthcare spending, and property damage. In the State of Indiana, about $3.4 billion was spent in 2022 on healthcare related to tobacco consumption. Policymakers implement various strategies to lessen the burden on society from tobacco consumption, among which taxation is a fundamental approach. In this paper, I calculate the overall impact cigarette smoking has on the Indiana state economy, estimate a range of optimal cigarette excise taxes based on net externalities and internalities, and forecast the benefits that increasing the cigarette excise tax has on the economy of Indiana through a reliable macroeconomic model known as the REMI model. The REMI model is an input-output model, similar to the one used by the BEA, that relates various sectors of an economy to one another. The REMI model has been used in studies related to economic development, environmental and energy policies, transportation, taxation, forecasting, and planning. It has been used in various projects, including the impact cigarette consumption has on local economies. The model is described in greater detail in Section 3.3. This paper estimates that the optimal excise tax on cigarettes ranges from $1.91/pack, the net externality of smoking in Indiana, to $22.12/pack, which includes the internality of smoking. In the REMI model, it is suggested that increasing the tax to $6.96 would improve the economy through an increase in jobs, GDP, and personal income. Increasing the tax between $1.91/pack to $6.96/pack would see employment increase by 3,813 to 17,513 jobs, GDP would increase between $315 million to $1.42 billion, and personal income would increase between $237 million to $1.098 billion. Implementing a tax rate higher than $7 created conflicting results in the REMI model due to the amount of tax revenue that could be lost for the government. These results provide an upper bound estimation based on the assumption described in this paper; therefore, it will be discussed but not used to suggest policy. This paper confidently feels that there is evidence that increasing the tax on cigarettes as not only suggested by the REMI model, but also increase government tax revenue and reduce

healthcare spending through lower smoking prevalence in the state of Indiana.

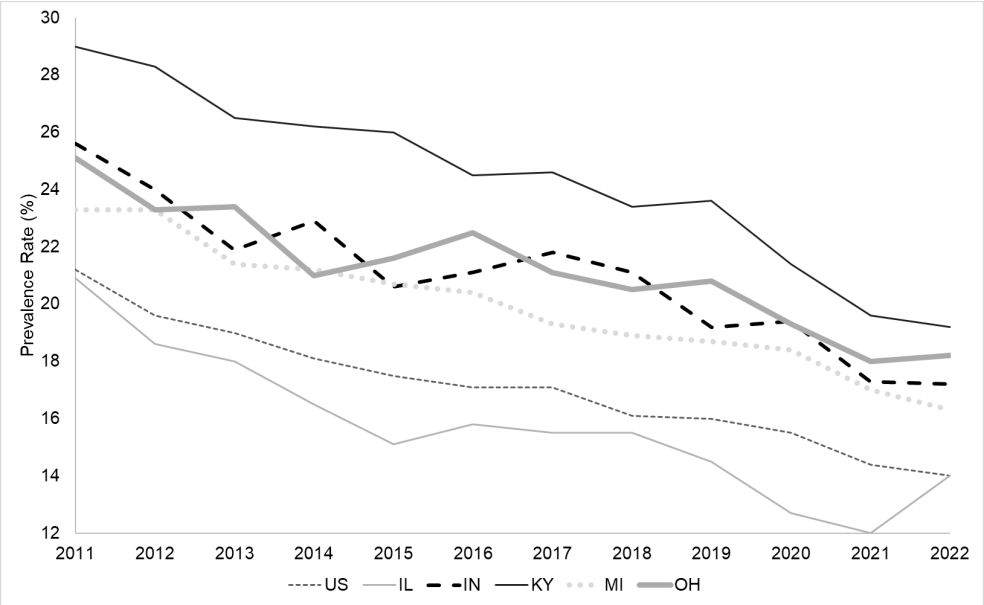
This paper contributes to the tobacco literature by implementing updated methods to calculate a range of optimal tax rates and exploring its economic implications to the state of Indiana. It builds on the works from Tauras, Chaloupka, and Esposito (2023a), Chaloupka and Tauras (2023), and Tauras, Chaloupka, and Esposito (2023b) that studied the impacts smoking has on the Indiana macroeconomy. Specifically, Tauras, Chaloupka, and Esposito (2023b) used REMI to study the impact tobacco has on the economy of Indiana; in a world without tobacco, the economy sees about 2661 new individual jobs, $353 million increase in personal income (2020 USD), and an increase in the population by 1,824, in one year if tobacco was magically eliminated. In the United States, the median tobacco prevalence rate was about 14% in 2022, which is around 2.2 percentage points lower than in Indiana. Indiana also ranks as one of the Midwestern states with the highest tobacco prevalence rates as seen in Figure 1. Indiana also has the 11th lowest tax rate on tobacco in the United States; the tax rate in Indiana is less than $1 which is approximately $0.79 lower than the national average.

Viscusi (1995) argues that taxation helps discourage tobacco consumption. From Figures 2 and 3, there is an inverse relationship between prices and sales as well as prices and prevalence rates. Taxation also addresses the external costs imposed on the rest of society. Currently, the literature suggests that tobacco, particularly cigarettes, is price inelastic with an average price elasticity of -0.4. This elasticity suggests that regular consumers of tobacco are less sensitive to price increases, which can explain why some states have really high taxes on tobacco products. For example, the City of Chicago has a cigarette tax that is $8.17 per pack (The Civic Federation, 2020), which, compared to the state of Indiana, is much larger and exceeds the median tax on tobacco in the United States.

Manning, Keeler, Newhouse, Sloss, and Wasserman (1989) estimates "the lifetime, discounted costs" imposed on those that do not consume tobacco by tobacco consumers, which they found to be in the interval of $0.89 to $1.34 in 2022 dollars for the whole United States. In their calculation, they find the costs associated with medical care, sick leave, group life insurance, nursing home care, retirement pension, house fires, and taxes on

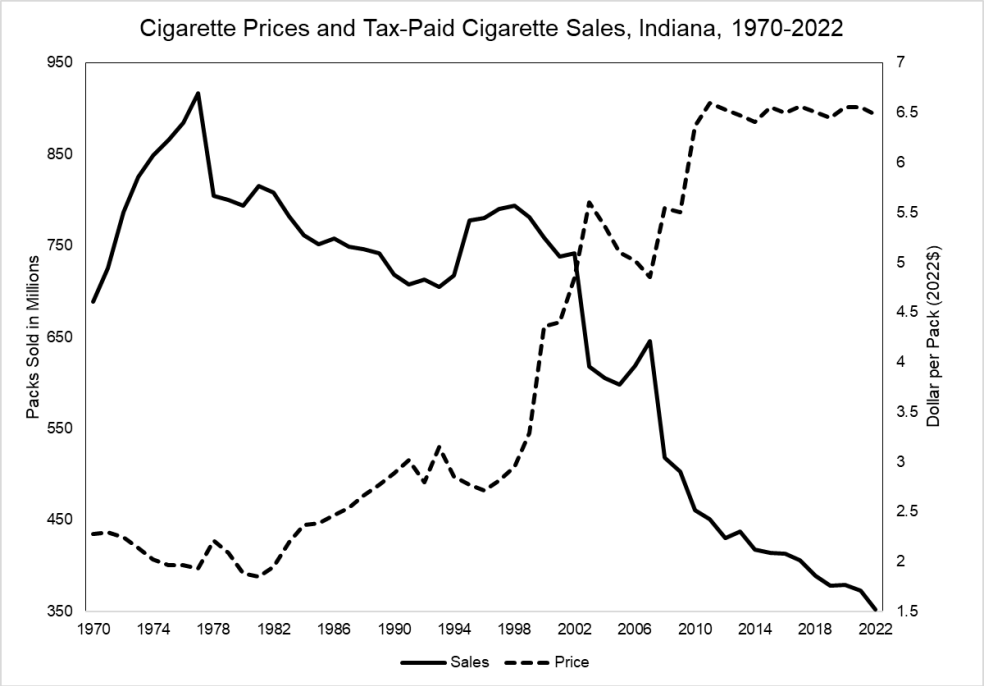
earnings. Viscusi (1995) argues that cigarette taxes (at that time) exceeded the magnitude of the estimated net externalities. Jacobs (2013) summarizes the literature on optimal taxation in various areas including tobacco. Taxation on substances like alcohol and tobacco are meant to decrease consumption and "align the private costs of consumption with their social costs." (Jacobs, 2013) Jacobs argues that literature on tobacco consumption states that the externalities from tobacco consumption might be positive, and papers like Crawford, Keen, and Smith (2010), Tollison and Wagner (1991), Sloan, Ostermann, Conover, Taylor Jr., and Picone (2004), and Cnossen (2006) reach the same conclusion as Viscusi (1995).

Figure 1: Cigarette Prevalence Rates for the Midwest and U.S., 2011-2022



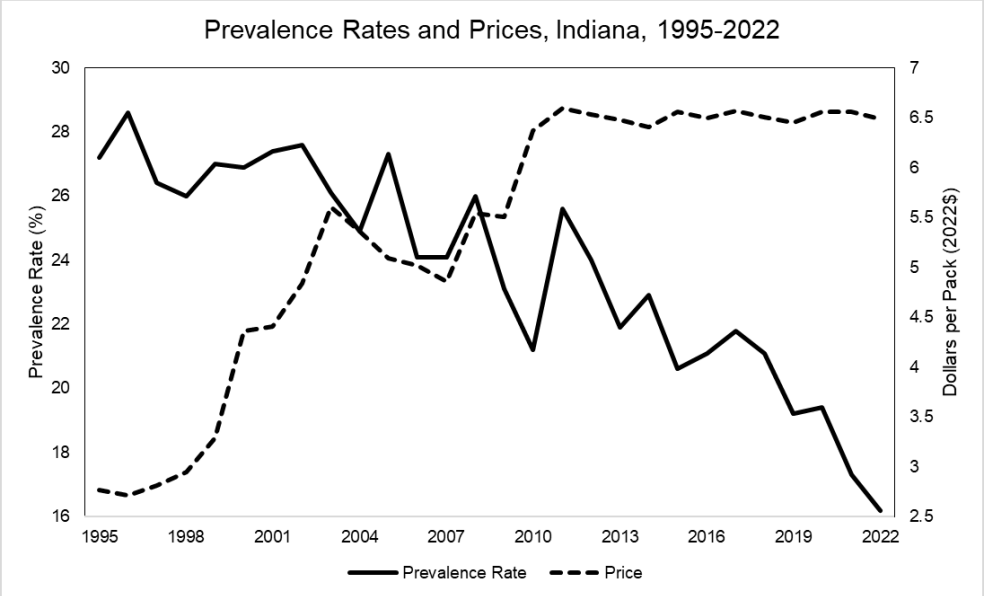
Source: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data .

Figure 2: Sales and Prices in Indiana



Source: Orzechowski and Walker, 2022, Bureau of Labor Statistics, and author's calculations.

Figure 3: Prevalence Rates and Prices in Indiana



Source: BRFSS 2022, Orzechowski and Walker, 2022, and author's calculations.

The commonality of previous work on tobacco taxation assumed those who consume tobacco have rational addiction preference. In other words, these individuals are aware of the long-term consequences and the costs associated with smoking. Gruber and Kőszegi

(2004) argue that, realistically, tobacco consumers have time-inconsistent preferences, otherwise known as the quasi-hyperbolic discounter. In the quasi-hyperbolic discounter framework, a tobacco consumer is impatient when faced with a choice to consume today or tomorrow; however, this person would like to become patient in the future. Despite wanting to be patient in the future, there is a conflict between a person's self today and tomorrow. Because of this issue, Gruber and Kőszegi assume that the tobacco user realizes that he will change his mind and behave intentionally as further described in Section 2. This means that within each period, they will play a "subgame-perfect equilibrium in an extensive-form game in which the choice variable of each self is consumption in that period." (Gruber & Kőszegi, 2004) Another assumption in response to the intertemporal conflicts occurs when the tobacco user is completely ignorant that he will be impatient in the future so he will go through the utility maximization for that period and change plans accordingly. They concluded from this framework that optimal taxes on tobacco are a function of externalities and internalities. The objective of finding this optimal tax is to offset the desire to consume in the future due to high prices (due to the nature of tobacco product demand as price inelastic) and to offset the costs imposed on non-consumers of tobacco products.

Gruber and Kőszegi argue that tobacco taxes are less regressive than previously believed. Because addiction behavior modeling is based on the rational addiction model, it is assumed that individuals are fully aware of the future consequences of their actions and make decisions that maximize their long-term utility. Gruber and Kőszegi argue that agents are time-inconsistent implying that there is a role for government taxation of addictive substances even if there are no externalities. In their argument, taxing tobacco will help discourage its consumption. The time-inconsistent agents should be taxed based on externalities and internalities. Gruber and Koszegi (2008) conduct a simulation in which they find the optimal tax of cigarettes can range from $7.53 to $14.66 if the short-term discount factor ranges from 0.6 to 0.8 in context of the whole United States. From a simplified version of their 2004 model, they find that the optimal tax is a function of externalities, short-and-long-term discount factors, and the harm to one's self associated with smoking. In this analysis, I find that solely for the state of Indiana, the optimal tax ranges from $1.91

to $22.12 per cigarette pack for various future discount factors. This paper argues that the optimal range of cigarette tax needs to cover at least the externalities of smoking if people who smoked behaved rationally in their consumption of addictive goods. In what is expected to be most cases, if people are hyperbolic future discounters, then the optimal tax needs to include the internality of smoking.

The paper is organized as follows. Section 2 discusses the theoretical framework. Section 3 estimates the economic impacts of smoking in Indiana, calculates the ranges of optimal cigarette taxes, and describes the implementation of the REMI model. Section 4 explains the results. The paper concludes in Section 5 by summarizing the paper.

2 Framework

The consumption of cigarettes has been relatively controversial and raising the price of cigarettes through taxation has been debated for a very long time. Cigarette taxation in the United States varies greatly at the state-level. In the United States, state cigarette taxes range from $0.17 per pack (Missouri) to $4.50 per pack (District of Columbia). The government will tax goods in the presence of negative externalities. Negative externalities are generated when the marginal private benefit of cigarette consumption is greater than the marginal social benefit of cigarette consumption. This implies that the socially optimal cigarette packs are less than the market equilibrium quantity. This represents that there is an over consumption of cigarettes in the market creating a deadweight loss generated by negative externalities. From this concept, there is an argument to tax cigarettes. The goal of Government intervention through taxation should help push the market equilibrium towards the socially optimal which should help lessen the cost to society.

Traditionally, when thinking about the optimal tax for cigarettes, the expectation is to set it to the marginal social cost of cigarette consumption. In many studies, it has been agreed that the social cost has been significantly less than the tax on cigarettes in the United States. The assumption was that people who consume addictive substances are rationally addicted. In the rational addiction model, it is assumed that individuals have stable pref-

erences and are able to anticipate the future consequences of their choices. Gruber and Kőszegi (2004) argue that individuals who consume addictive goods are time-inconsistent agents. Adopting from Gruber and Kőszegi (2004), an individual who consumes cigarettes (addictive good of interest) has the utility function at time t as

$$U_t = v(c_t, S_t) + u(x_t) \tag{1}$$

where c_t and x_t represent the number of cigarettes and all other goods and services consumed, respectively, in this additive utility function. S_t represents a measure of the amount of consumption of cigarettes prior to period t, which is called the stock of cigarette consumption. Given some rate of depreciation d, the relationship between today's stock and yesterday's stock is represented by $S_t = (1-d)(S_{t-1} + c_{t-1})$. Two behavioral characteristics of addiction are reinforcement and tolerance. Reinforcement, "a learned response to past consumption" (Chaloupka, Tauras, & Grossman, 1999), implies that an increase in the prior period's consumption of cigarettes will increase the marginal utility of current consumption of cigarettes, which is represented by $v_{cS} > 0$. Tolerance implies that current consumption needs to be higher than past consumption for it to satisfy and is represented by $v_S < 0$. The total utility function for an individual with time-inconsistent preferences is represented by

$$U_t + \beta \sum_{j=1}^{T-t} \delta^j U_{t+j} \tag{2}$$

where β and δ are between zero and one. The objective of this utility function form is to present the concept that an individual might have self-control in their cigarette consumption. Mathematically, the discount factor will be larger in consecutive future periods compared to the discount factor between the current period and the next period. This implies that this individual is impatient today and hopes to be more patient in the future. As mentioned before, optimal taxation of tobacco products was thought to be the social cost or externalities. In this framework, Gruber and Kőszegi find that in the absence of externalities, cigarettes should still be taxed because of the negative consequences of smoking.

They even argue that the optimal tax should be a function of both net externalities and internalities which should be at least $1. Gruber and Koszegi (2008), in a simplified version of the model described above, find that the optimal tax τ^* is represented by

$$\tau^* = \text{Externalities} + (1 - \beta)\delta \times \text{Harm}. \tag{3}$$

If $\beta = 1$, then it suggests that consumers are time consistent in their preferences, then as predicted by the rational addiction model, the optimal tax is a function of externalities of smoking. If $\beta < 1$, it suggests that their preferences are time inconsistent as described above and internalities should be used to calculate the optimal tax of cigarettes.

Warner et al. (1995) summarized a meeting of economists organized by the Office of Smoking and Health of the U.S. Centers for Disease Control and Prevention in May 1995. This meeting was meant to discuss reasons to raise the cigarette tax. In this meeting, it was concluded that raising cigarette taxes should accomplish four goals: (1) raise revenue, (2) pay for the burden imposed onto others, (3) protect youth, and (4) improve public health. As tobacco consumption is relatively price inelastic, I suspect that increasing the tax would raise government tax revenue because people will still consume regardless of the increase in the price. Traditionally, the optimal tax has been solely based on the externalities of tobacco consumption based on the rational addiction model. Given this concept that people are time inconsistent with their preferences of addictive goods, then including internalities should have some impact on decreasing tobacco consumption since it is making individuals pay upfront the costs of tobacco such as medical costs and cost of life lost. The expectation is that decreasing overall tobacco consumption will help improve public health concerns. The increase in tax would lessen the exposure children and those who do not consume tobacco would have to cigarette smoke and overall tobacco goods.

3 Methodology

This section estimates the economic impact smoking has on the state of Indiana which is needed for estimating the optimal range of cigarette taxes. This section also explains the REMI model and its implementation to estimate the impact increasing cigarette taxes has on the state of Indiana.

3.1 Estimating the Impacts of Smoking on the Indiana Economy

Table 1 displays the economic impacts of smoking in Indiana, categorized as negative externalities, positive externalities, and other economic costs. This section will show how smoking impacts healthcare expenditures, productivity loss, impacts to individuals through lost income from spending and potential disability caused from smoking, property damage, and the value of statistical life. All dollar amounts are in 2022 dollars. I calculate the per-pack costs by dividing the total financial amount by 351,200,000 packs of cigarettes purchased in 2022 (Orzechowski & Walker, 2024).

Table 1: Economic Impacts of Cigarette Consumption in Indiana

	Dollar Amount	**Dollar per Pack**
Negative Externalities		
Absenteeism	$280,812,328	$0.80
Presenteeism	$280,812,328	$0.80
Smoking Breaks	$1,733,409,434	$4.91
Healthcare Costs for Self-Insured Private Employers	$757,317,372	$2.16
Positive Externalities		
Social Security Savings	$984,230,465	$2.80
Medicare Savings	$1,267,445,414	$3.61
Employer Defined Benefit Savings	$117,910,339	$0.34
Other Costs Associated with Smoking		
Secondhand Smoke Healthcare	$485,015,650	$1.38
Pregnancy and Birth Related Healthcare	$23,496,480	$0.07
Smoker-Related Healthcare	$2,891,487,870	$8.23
Disposable Income	$1,078,344,626	$3.07
Disability	$373,878,996	$1.06
Fire Property Damage	$11,882,349	$0.03

Note: All dollar amounts are in 2022$.

Healthcare Expenditures

Chaloupka and Tauras (2023) calculate that the total healthcare expenditure related to smoking is $3.4 billion. Saywell, Zollinger, Lewis, Jay, and Spitznagle (2013) find that the 2010 medical spending for secondhand smoking-related medical spending was $327.2 million in Indiana, equivalent to $485 million in 2020 USD by using medical CPI. The expected births in the state of Indiana for 2023 were 92,668, and the 2021 smoking prevalence during pregnancy was 9.91% in Indiana (CDC Wonder). The total money spent on fetal care affected by smoking is estimated to be $23.5 million.

Costs to Employers

Tauras, Chaloupka, and Esposito (2023a) find that Indiana employers bear $2.3 billion in lost productivity from having employees who consume cigarettes. This lost productivity comes from absenteeism, presenteeism, and smoking breaks. In these calculations, Tauras, Chaloupka, and Esposito assume that the average hours worked per day is 8.1 hours, the average days worked per week is 5 days; from the literature, it is assumed that people who smoke take an additional 2.7 days a year compared to their non-smoking counterparts, the excess presenteeism rate is 0.01, and smoking breaks are 15 minutes given that smoking individuals consume about 2 cigarettes during the work day. Employers also bear the costs of spending additional money on health insurance; it was estimated to be $757 million in 2022. The costs to employers by employing workers who smoke totaled $3.05 billion in 2022.

The calculations are based on Berman, Crane, Seiber, and Munur (2014). Because employees who consume cigarettes have shorter lifespans compared to their non-smoking counterparts, and they typically have shorter working spans, employers get a benefit from defined contribution plans, e.g., 401(k), because ”the employee is entitled to the assets in the fund, nothing more, regardless of their life span.” (Berman et al., 2014) The formula to

calculate the death benefits from private employees to private employers is

$$(\%_{\text{male}} \times \text{Subsidy}_{\text{male}} + \%_{\text{female}} \times \text{Subsidy}_{\text{female}}) \times \frac{\text{Inflation Adjustment}}{\text{Years Worked}}. \tag{4}$$

From the literature (Berman et al., 2014; Sloan et al., 2004), the subsidy from a male employee who consumes cigarettes is $10,123. The subsidy from a female employee who consumes cigarettes is $383, which is argued that the difference between male and female employees is that "women have lower pension wealth than men, on average." (Berman et al., 2014) Using updated data from BLS (2023) that the labor force is composed of 46.8% female and 53.2% are male. Berman et al. (2014) also cites that workers who are cigarette consumers contribute, on average, 24 years into their defined contribution benefits. Under these assumptions, I calculate that employers benefit $311.18 per employee who consumes cigarettes. 73% of people participate a defined contribution plan for retirement. This equates to $117,910,339.

Employers face a gross cost of $3,069,862,220 from absenteeism, presenteeism, smoking breaks, and health care costs to private employers that self-insure in 2022. The death benefits private employers receive if they have a benefit defined plan will be at most $117,910,339. This results in a net cost of $2,934,441,123.

Income Lost from Cigarette Spending

To determine the disposable income lost from cigarette spending, I use the BRFSS 2022 to calculate the average number of cigarettes consumed per day by income group for the state of Indiana (CDC, 2023). Given that there are 20 cigarettes per pack, then I use that to calculate the average number of packs of cigarettes consumed per day. The total dollar amount spent on cigarettes is $6.484 which includes all taxes from federal and state levels. First, I calculate the average yearly spending on cigarettes per person by

$$\text{Pack per Day} \times \text{Cost per Pack} \times 365 \text{ Days per Year}. \tag{5}$$

Then, I find the average industry total spending by taking the results from Equation 5 and multiplying it by the number of smokers in that industry. To find the total income lost from cigarette consumption, I aggregate across industry to find that in the state of Indiana, it is approximately $1,078,344,626.

Income Lost from Disability Insurance

The income lost from Social Security Disability Insurance (SSDI) is calculated by the difference of income earned and the disability payout. I am assuming that SSDI payout is $1560 per month (SSA, 2023) based on the average for March 2022, and that 27.8% of smokers develop a disability that prohibits them from working (CDC, 2020). Similar to the calculation for income lost from cigarette spending, I will base the calculations on industry averages which aggregate to $373,878,996.

Fire Property Damage

Ahrens (2019) reports that the yearly property damage was about $476 million for the entire United States for the years 2012-2016. Given that the population of Indiana represents approximately 2% of the U.S. population, then I estimate that the average annual property damage in Indiana is about $11,882,249.

Benefits to Society from Social Security Insurance and Medicare

On average, a person who smokes lives six less years than their non-smoker counterparts (Cutler et al., 2002). From this, it can be assumed that there are six years that people who die from cigarette smoking do not receive benefits from Social Security insurance (SSI) and Medicare insurance. It is a benefit (or positive externality) because this group of people pays taxes that go into the system for government assistance for the elderly; however, they do not receive the system's full benefits. SSA (2023) paid $841 in 2022 which equates to $10,092, annually. The average monthly Medicare per-capita spending is $12,996 in Indiana for 2022 based on previous reports from the CMS (2023). Medicare

per capita spending to estimate the total government savings from SSI and Medicare can be computed as

$$\text{Program Savings} = \sum_{t=0}^{T-1} \frac{\text{Benefit Amount Person} \times \#\text{Deaths}}{(1+r)^t} \tag{6}$$

where T is the number of years less a person dies from smoking cigarettes. In Gruber and Koszegi (2008), they find that a person that smokes, on average, lives six less years. Other reports find the lifespan difference can be at least 10 years (Doll, Peto, Boreham, & Sutherland, 2004; Jha et al., 2013). In this analysis, I am going to make the assumption that people who smoke die 10 years earlier than people that do not smoke, on average. As mentioned earlier, approximately 11,100 people die per year from personal cigarette smoking in Indiana (Campaign for Tobacco-Free Kids, 2023). I assume a 3% discount rate for the future with a ten-year span to calculate $984,230,465 and $1,267,445,415 are saved from early death in Social Security Benefits and Medicare Spending, respectively. This sums to a total of $2,251,675,879.

3.2 Optimal Taxation

From Equation 3, the optimal tax of cigarettes is an expression of the net externalities of smoking, the internality or the monetary harm from lower life expectancy, and future discount factors, as explained in the Framework section. The negative externality of smoking consists of absenteeism, presenteeism, costs of smoking breaks, and the healthcare costs added to private employers that self-insure. The positive externalities of smoking consist of money saved by firms on employer-defined benefit plans, and the money saved by the government from spending less on social security and Medicare. Both businesses and government save money from lower lifespans due to smoking. The net externality is estimated to be $1.91/pack in Indiana.

To estimate the harm, i.e., internality, of smoking, I estimate the average net present discounted loss of dying early from cigarette smoking. From the life valuation literature,

Viscusi (2008) estimates about $7 million in 2008$, EPA (2023) estimate about $7.4 million in 2006$, and DOT (2023) estimated about $12.5 million in 2022$. Because the ranges vary, I am going to use a conservative estimate of $10 million. Cutler et al. (2002) estimate that people who smoke, on average, live six fewer years than people who do not smoke. Other research has suggested that the loss of life from smoking results between 6 to 13 years (CMS, 2023; Cutler et al., 2002; Darden, Gilleskie, & Strumpf, 2018; Doll et al., 2004; Ferrucci et al., 1999; Streppel, Boshuizen, Ocké, Kok, & Kromhout, 2007). Again, I decided to make the assumption that the life expectancy decreases by 10 years. With an interest rate of 3%, I estimate the PDV for each age between 18 to 75, given that they live an average of 10 fewer years. From this, I calculate a weighted average of a person's net present discount value based on smoking from ages 18 to 75, where the weights come from the number of cigarettes consumed at each age from the 2022 Tobacco Use Supplement. Finally, I divide by the average number of cigarettes smoked in one's lifetime. I estimate that people who smoke face harm in the monetary terms of $52.08/pack. I also make the assumption that the average damage of consuming an additional cigarette is equivalent to the marginal damage of consuming an additional cigarette.

Based on Gruber and Koszegi (2008), I assume that $\delta = 0.97$ and β ranges from 0.6 to 1. Table 2 shows the range of optimal tax values. If $\beta = 1$, then the optimal tax should be $1.91/pack since this assumes people who smoke are exponential discounters. As β decreases, the more impatient people become the optimal tax increases, since it includes a percentage of the self-induced harm from smoking. The maximum optimal tax is about $22/pack.

Table 2: Optimal Taxation for Cigarettes in Indiana

Discount Factor β	1.0	0.9	0.8	0.6
Optimal Tax τ^*	$ 1.91	$ 6.69	$ 12.01	$ 22.12

Note: This assumes that $\delta = 0.97$.

3.3 REMI

3.3.1 Model Information

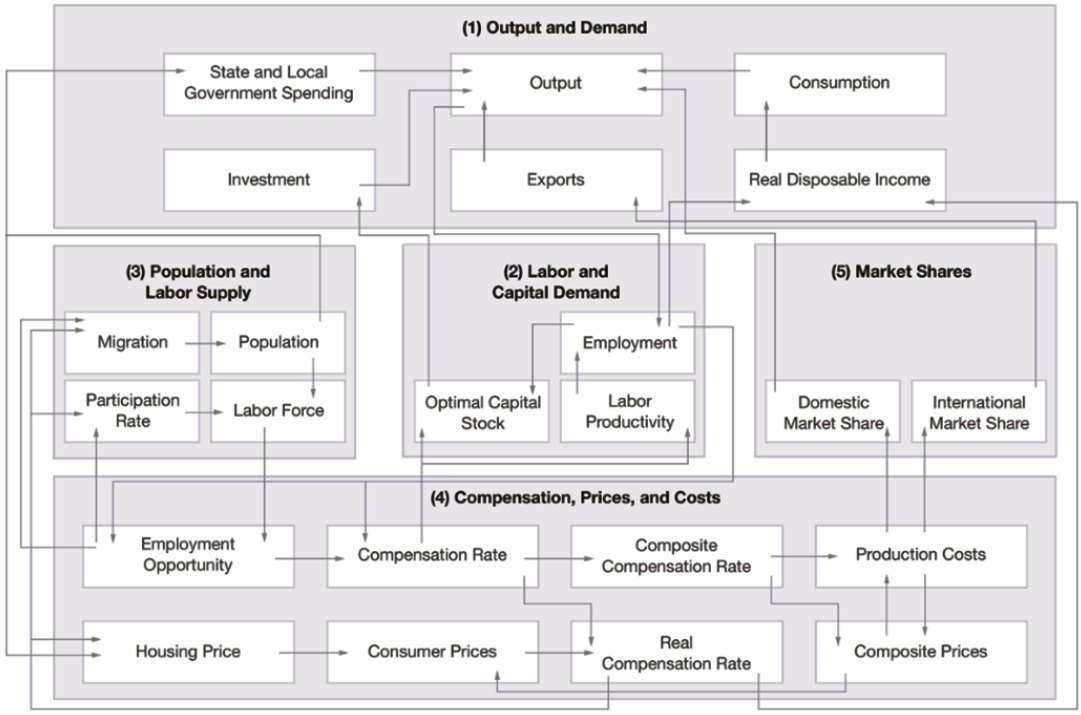
The Regional Economic Model, Inc. (REMI) is an organization that uses a dynamic input-output model (referred to as the REMI model) to forecast impacts on macroeconomic variables in the state, local, and national United States setting. The REMI model is a 70-sector input-output matrix that "describes the production relationships between industries in the economy." (Barkey, 2005) The matrix is based on the input-output matrix maintained by the United States Bureau of Economic Analysis (BEA), which REMI uses to estimate the relationship of an expansion in one sector of the economy impacts other sectors. In other words, the model involves thousands of simultaneous equations; however, the specific number of equations used in the simulation is dependent on the "extent of the industry, demographic, demand, and other detail in the specific model being used." (REMI, 2022) The channels for the impact on other sectors due to a change in one sector are represented in Figure 4. Changing one variable can change the macroeconomy through various channels; however, there are five main categories these relationships impact in the Indiana economy: (1) output and demand, (2) labor and capital demand, (3) population and labor supply, (4) compensation, prices, and costs, and (5) market shares.

The output and demand block involves industrial output, demand per industry, investment, Federal, State, and Local government spending, imports, commodity access, and export concepts. The labor and capital demand block comprises labor productivity determination, labor intensity, and optimal capital stocks. Population and labor supply block encompass comprehensive demographic information. Compensation, prices, and costs block incorporates delivered prices, production costs, equipment costs, consumption deflator, consumer prices, housing prices, and the compensation equation. Finally, the market shares block includes the market share equations that measure the part of Indiana and export markets captured by each industry.

REMI was founded in 1980 with the goal of improving public policy. The data used in the REMI model primarily comes from the Bureau of Economic Analysis (BEA) Re-

gional Economic Accounts data series. This includes personal income, employment, and total employment for the State of Indiana and Marion County, Indiana. The baseline forecasts produced by REMI are based on the Bureau of Labor Statistics (BLS) Employment Projections. In the BLS projections, they assume "the labor market is in equilibrium, i.e., labor supply meets labor demand except for some degree of frictional unemployment." (REMI, 2022) Data in the REMI model are also collected from the U.S. Census, American Community Survey, Federal Housing Finance Agency, Centers for Disease Control and Prevention, Department of Defense, National Center for Education Statistics, Bureau of Justice Statistics, Bureau of Prisons, and Energy Information Administration.

Figure 4: REMI Model Linkages



Source: REMI 2022.

3.3.2 Model Implementation

In the REMI model, I will consider the four excise taxes described in Table 3 and run simulations on each. This paper uses the REMI PI+ version of the model. Tobacco spending cannot be separated into different tobacco products. To account for the increase in tax, I

must change the overall price of all tobacco products to match. Using the growth rate in the price of cigarettes for the past twenty years, I estimate what the 2022$ of cigarettes will be for the next twenty years based on the price that contains the state and federal tax of cigarettes. I increased the price based on the difference between the original tax and the new tax, then took the percentage change of what the price is predicted to be if the tax stays the same and the price that takes into account the increase in the tax. I increased the price in REMI based on that percentage change.

Secondly, when the price changes on cigarettes, it is expected that people will quit smoking. For example, given that the price elasticity of smoking prevalence is about -0.2, then increasing the tax from $0.995 to $1.91 is predicted to induce 31,394 to stop smoking which translates to almost 20,000,000 packs of cigarettes not sold based on a price elasticity of packs sold of -0.4. In the REMI model, I predict how many packs of cigarettes are expected not to be sold when the tax increases then assume that there is a yearly decrease of 2%. I take the amount of cigarettes that will not be smoked, then estimate how much money will be saved from not smoking, remove it from tobacco spending, and redistribute it to all other aspects of consumer spending.

Lastly, when there is an increase in the tax rate, it is expected that government tax revenue will increase. I estimate that the government will raise over $280 million dollars. To account for the increase in government tax revenue, I make the modeling decision to allow the state government to spend it. I increase the state government spending to be the extra amount of money they are expected to collect from the increase in the tax revenue.

Table 3: Changes in Overall Price, Consumption, Taxes in Indiana for the First Year

Optimal Tax	**$ 1.91**	**$ 6.96**	**$ 12.01**	**$ 22.12**
Overall Change in Price	14%	92%	170%	326%
Reduction in Packs	19,824,059	129,268,557	238,713,055	351,200,000
Tax Revenue (2022 USD)	$283,484,047	$1,195,537,119	-$134,593,936	-$2,702,642,093

4 Results

When increasing the tax rate for cigarettes, there should be expected improvement on the economy. People quit smoking, the government gets an increase in tax revenue, and long-run healthcare savings are available as well. For the $1.91 and $6.96 excise taxes, there are positive impacts on employment, Indiana's GDP, and income as shown in Tables 4 and 5. However, when increasing the tax to $12.01, the Indiana economy sees an opposite effect, i.e., negative shocks to the economy as shown in Table 17. In the simulation, increasing the tax to $22.12 has really volatile estimates as shown in Table 18. I believe the predictions of the tax rates higher than $6.96 are too volatile and economically are not fully sensible, especially when estimating that the government would lose tax revenue from having the tax so high; this exacerbates the effects of increasing the price of all tobacco products onto the Indiana economy. The model may not take into consideration that retail jobs should not have significant changes as suggested by Powell, Wada, Persky, and Chaloupka (2014), Wada, Chaloupka, Powell, and Jernigan (2017), Mounsey, Powell, and Chaloupka (2022), Tauras and Chaloupka (2023) and Tauras, Chaloupka, Braganza, Diaz, and Donovan (2023). In this section, I will explain how increasing the tax to $1.91 and $6.96 improve the Indiana economy through employment, GDP, and income. In interpreting the results from REMI, it is important to note that I am comparing the impact the tax increase has compared to their base economic forecasts. The analysis in this section forecasts for 20 years as well as focuses on increasing the excise tax to $1.91 and $6.96 since the results align better with what is expected based on the empirical research. Overall, this section will argue increasing the tax, to about $7, will result in economic improvements with respect to employment growth, increased GDP, and increased personal and disposable income.

Table 4: Economic Impact Summary of a $1.91 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Employment	3812.736	3143.029	2439.892	1824.3	1342.756
Gross Domestic Product	314.843	265.579	209.921	160.857	120.483
Personal Income	237.012	264.985	241.529	197.44	151.805
Disposable Personal Income	166.56	184.16	169.473	138.303	105.388
Disposable Personal Income per Capita	0.02	0.014	0.011	0.01	0.012

Total Employment is measured in individual jobs.
GDP is measured in millions of 2022$.
Personal Income is measured in millions of 2022$.
Disposable Personal Income is measured in millions of 2012$.
Disposable Personal Income per Capita is measured in 1000s of 2012$.

Table 5: Economic Impact Summary of a $6.96 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Employment	17512.86	14159.53	11087.51	8313.955	6005.764
Gross Domestic Product	1.417	1.154	0.916	0.694	0.502
Personal Income	1.098	1.197	1.091	0.889	0.662
Disposable Personal Income	0.772	0.831	0.764	0.621	0.457
Disposable Personal Income per Capita	0.096	0.067	0.057	0.056	0.062

Total Employment is measured in individual jobs.
GDP is measured in billions of 2022$.
Personal Income is measured in billions of 2022$.
Disposable Personal Income is measured in billions of 2012$.
Disposable Personal Income per Capita is measured in 1000s of 2012$.

4.1 Employment

Overall, employment is predicted to increase by 3813 and 17,513 as the tax rate increases to $1.91 or $6.96 in the first year the tax is implemented, respectively. However, Tables 6 and 7 show decreases in the retail trade industry, which discussed earlier is inconsistent with current research. However, in the model, it appears that the 325 and 2670 jobs are lost in retail trades; by increasing the tax rates to $1.91 or $6.96, respectively, jobs are being moved to other sectors of the economy. Due to the increased state government tax revenue that they spend, the employment sector sees the most new jobs. Secondly, the health care and social assistance sector sees the next highest growth in employment. As time continues with the implementation of higher taxes, the economy will continue to grow for at least 20 years after the tax is initially implemented. For example, when increasing the tax rate to

$1.91 and $6.96, employment will grow by 1343 and 6006 jobs, respectively, twenty years later.

Table 6: Impacts on Employment from $1.91 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
All Industries	3812.736	3143.029	2439.892	1824.3	1342.756
Forestry, fishing, and hunting	2.912	1.714	0.882	0.389	0.132
Mining	2.507	1.437	0.82	0.381	0.16
Utilities	5.315	2.421	1.455	0.699	0.154
Construction	293.363	242.699	176.684	102.029	58.254
Manufacturing	64.493	11.374	-11.875	-21.624	-24.946
Wholesale trade	1.221	7.98	2.162	-1.168	-2.815
Retail trade	-324.925	-61.115	-38.564	-30.921	-27.38
Transportation and warehousing	47.537	37.961	22.135	11.447	4.432
Information	9.099	5.522	3.656	2.386	1.547
Finance and insurance	35.39	12.251	3.664	-0.423	-2.122
Real estate and rental and leasing	71.959	42.866	34.33	21.224	8.722
Professional, scientific, and technical services	88.283	65.321	47.7	32.526	21.239
Management of companies and enterprises	0.232	-1.49	-2.12	-2.108	-1.871
Administrative, support, waste management, and remediation services	101.93	72.037	51.017	33.717	20.916
Educational services; private	25.762	11.528	5.021	0.967	-1.262
Health care and social assistance	311.769	169.993	131.6	104.397	81.084
Arts, entertainment, and recreation	32.978	17.493	11.627	8.018	5.146
Accommodation and food services	185.072	118.438	95.532	64.181	32.608
Other services (except public administration)	194.987	111.016	84.654	64.517	47.796
State and Local Government	2662.854	2273.582	1819.513	1433.665	1120.962

Note: Units are the number of individuals.

Table 7: Impacts on Employment from $6.96 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
All Industries	17512.86	14159.53	11087.51	8313.955	6005.764
Forestry, fishing, and hunting	13.057	7.405	3.596	1.293	0.045
Mining	12.477	7.418	4.246	1.94	0.605
Utilities	38.448	24.643	17.784	11.233	6.497
Construction	1239.153	976.651	729.097	394.689	182.975
Manufacturing	374.493	138.032	16.115	-40.046	-63.108
Wholesale trade	-85.74	-70.935	-76.113	-64.505	-50.308
Retail trade	-2669.52	-1527.07	-1151.48	-845.434	-614.163
Transportation and warehousing	175.688	123.92	62.738	23.169	-7.135
Information	49.535	33.514	24.894	18.216	13.957
Finance and insurance	220.389	115.457	67.773	32.799	15.421
Real estate and rental and leasing	551.37	423.623	347.561	235.069	132.569
Professional, scientific, and technical services	451.336	342.445	259.455	185.318	123.512
Management of companies and enterprises	1.31	-6.861	-9.975	-10.137	-9.162
Administrative, support, waste management, and remediation services	525.87	375.694	274.12	183.823	113.194
Educational services; private	181.03	113.399	79.137	43.652	20.521
Health care and social assistance	2157.399	1580.311	1306.015	1044.418	775.697
Arts, entertainment, and recreation	224.49	151.763	111.274	81.839	46.979
Accommodation and food services	1462.731	1153.041	902.118	648.088	409.945
Other services (except public administration)	1342.196	934.514	714.98	549.988	383.627
State and Local Government	11247.15	9262.559	7404.17	5818.543	4524.097

Note: Units are the number of individuals.

4.2 Gross Domestic Product

GDP is predicted to increase, especially through consumer spending, investment, and government spending. GDP is expected to grow by at least $315 million after implementing the tax in the first year. Even though there is an overall increase in consumption, non-durable consumption decreases by $214 million and $1,615 million with a $1.91 and $6.96 excise tax, respectively. The money that will not be spent on non-durable goods will be spread to other areas of consumption by 23 million and $163 million. In 20 years after increasing the tax to either $1.91 to $6.96, GDP is expected to increase by $120 million and $502 million, respectively. The most notable issue predicts that residential investment will decrease in Indiana, where residential investment is the purchases of private residential structures and residential equipment that is owned by landlords and rented to tenants as defined as BEA (2018). It is unclear the reason residential investment decreases. My hypothesis is that with cigarette taxes increasing, people who continue to smoke have a lower preference for homeownership, creating a negative demand shock for housing, in order to afford their smoking habit. Otherwise, overall investment is expected to increase by millions of dollars through other aspects of firm investment.

4.3 Personal Income

In the first year of the tax implementation, personal income would increase at least by $295 million when increasing the tax rate to $1.91/pack compared to the baseline forecast. Drivers of an increase in total earnings by place of work is driven by an increase in total wages and salaries as shown in Tables 10 and 11. Over time, income will continue to be higher in Indiana in the presence of an increase in tax, which will be driven by an increase in the total wages and salaries earned.

Table 8: Impacts on GDP from $1.91 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Gross Domestic Product (GDP)	314.843	265.579	209.921	160.857	120.483
Consumption	23.096	74.899	77.223	62.504	41.291
Durables	51.225	36.558	36.353	35.208	34.376
Non-Durables	-213.182	-82.517	-68.572	-62.765	-60.213
Services	185.054	120.859	109.442	90.061	67.128
Investment	1.222	8.578	7.002	-0.184	-4.086
Residential	-10.919	-7.787	-8.065	-12.487	-13.789
Nonresidential Structures	6.942	4.413	2.529	0.774	-0.162
Nonresidential Equipment	4.403	8.977	8.568	7.32	5.98
Nonresidential Intellectual Property Products	0.796	2.975	3.97	4.209	3.885
Change in Private Inventories	2.913	0.5	0.22	0.084	0.023
Net Trade	-6.402	-72.881	-82.054	-69.415	-51.51
Exports	74.736	40.389	16.552	6.103	1.338
Imports	81.139	113.269	98.606	75.517	52.847
Government Spending	294.014	254.483	207.531	167.867	134.764

Note: Units are in Millions of 2022$.

Table 9: Impacts on GDP from $6.96 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Gross Domestic Product (GDP)	1.417	1.154	0.916	0.694	0.502
Consumption	0.163	0.341	0.336	0.256	0.139
Durables	0.334	0.286	0.267	0.267	0.277
Non-Durables	-1.615	-1.161	-1.013	-0.902	-0.817
Services	1.444	1.216	1.082	0.891	0.679
Investment	0.006	0.054	0.061	0.03	0.006
Residential	-0.067	-0.061	-0.047	-0.064	-0.071
Nonresidential Structures	0.042	0.037	0.022	0.009	0.001
Nonresidential Equipment	0.026	0.057	0.057	0.052	0.044
Nonresidential Intellectual Property Products	0.005	0.021	0.03	0.033	0.032
Change in Private Inventories	0.014	0.002	0.001	0	0
Net Trade	-0.008	-0.278	-0.324	-0.271	-0.185
Exports	0.3	0.137	0.033	-0.011	-0.03
Imports	0.307	0.415	0.358	0.26	0.155
Government Spending	1.241	1.034	0.842	0.679	0.542

Note: Units are in Billions of 2022$.

Table 10: Impacts on Income from $1.91 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Earnings by Place of Work	295.444	300.768	263.974	217.927	179.886
Total Wages and Salaries	204.189	209.086	183.428	151.154	123.918
Supplements to Wages and Salaries	65.888	69.194	63.277	53.531	44.422
Employer contributions for employee pension and insurance funds	43.968	46.393	42.426	35.891	29.783
Employer contributions for government social insurance	21.92	22.801	20.851	17.64	14.639
Proprietors' income with inventory valuation and capital consumption adjustments	25.367	22.487	17.269	13.243	11.546
Less: Contributions for Government Social Insurance	40.109	42.404	37.23	30.831	25.205
Employee and Self-Employed Contributions for Government Social Insurance	18.189	19.604	16.379	13.191	10.566
Employer contributions for government social insurance	21.92	22.801	20.851	17.64	14.639
Plus: Adjustment for Residence	-19.075	-17.709	-15.939	-14.839	-14.459
Gross Inflow	37.629	37.748	33.113	27.235	22.391
Gross Outflow	56.704	55.457	49.052	42.074	36.85
Equals: Net Earnings by Place of Residence	236.261	240.654	210.805	172.257	140.222
Plus: Property Income	3.459	12.589	14.004	11.135	5.967
Personal Dividend Income	1.282	4.143	4.081	3.192	1.698
Personal Interest Income	1.435	6.106	7.465	6.087	3.329
Rental Income of Persons	0.743	2.34	2.458	1.856	0.941
Plus: Personal Current Transfer Receipts	-2.708	11.742	16.72	14.047	5.616
Equals: Personal Income	237.012	264.985	241.529	197.44	151.805
Less: Personal Current Taxes	34.868	41.481	35.848	29.589	23.901
Equals: Disposable Personal Income	202.145	223.505	205.681	167.851	127.904

Note: Units are in Millions of 2022$.

Table 11: Impacts on Income from $6.96 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Earnings by Place of Work	1.366	1.372	1.218	1.013	0.831
Total Wages and Salaries	0.93	0.938	0.831	0.689	0.561
Supplements to Wages and Salaries	0.292	0.301	0.277	0.235	0.194
Employer contributions for employee pension and insurance funds	0.195	0.202	0.186	0.158	0.13
Employer contributions for government social insurance	0.097	0.099	0.091	0.078	0.064
Proprietors' income with inventory valuation and capital consumption adjustments	0.145	0.133	0.11	0.089	0.076
Less: Contributions for Government Social Insurance	0.18	0.187	0.165	0.138	0.112
Employee and Self-Employed Contributions for Government Social Insurance	0.083	0.088	0.074	0.06	0.048
Employer contributions for government social insurance	0.097	0.099	0.091	0.078	0.064
Plus: Adjustment for Residence	-0.09	-0.085	-0.078	-0.075	-0.073
Gross Inflow	0.182	0.18	0.16	0.132	0.108
Gross Outflow	0.272	0.265	0.238	0.206	0.181
Equals: Net Earnings by Place of Residence	1.096	1.101	0.974	0.801	0.646
Plus: Property Income	0.015	0.051	0.055	0.04	0.013
Personal Dividend Income	0.006	0.017	0.016	0.011	0.004
Personal Interest Income	0.006	0.025	0.029	0.022	0.007
Rental Income of Persons	0.003	0.009	0.01	0.007	0.002
Plus: Personal Current Transfer Receipts	-0.012	0.045	0.063	0.049	0.003
Equals: Personal Income	1.098	1.197	1.091	0.889	0.662
Less: Personal Current Taxes	0.161	0.188	0.164	0.135	0.108
Equals: Disposable Personal Income	0.937	1.008	0.928	0.754	0.555

Note: Units are in Billions of 2022$.

5 Discussion and Conclusion

Increasing taxes has been a controversial argument which probably explains the heterogeneity of cigarette excise taxes in the United States. Indiana has one of the lowest tax

rates and one of the highest prevalence rates in the United States. This paper contributes to the tobacco taxation literature by estimating a range of optimal taxations based on not only the net externalities but also internalities since people who smoke are not always rational and simulate its economic impact. This paper argues that the excise tax in the state of Indiana should be much higher than its current rate of $0.995 per pack and shows the economic benefits of an increase to the tax rate to about $7 per pack.

Based on the framework of Gruber and Koszegi (2008) and work from Chaloupka and Tauras (2023), Tauras, Chaloupka, and Esposito (2023a), and Tauras, Chaloupka, and Esposito (2023b), I estimate the range of optimal tax by calculating the externality and the harm that people who smoke induce onto themselves by having about 10 years less of life than people who do not smoke. The negative externalities of smoking consist of absenteeism, presenteeism, smoking breaks, and the costs that private employers take on from self-insuring. The positive externalities of smoking derive from the money saved from Medicare and Social Security spending on people who smoke and die earlier. This results in a net externality of $1.91 per pack, which is an upper-bound estimation. The harm people who smoke is based on the amount of money they lose from early death based on the value of statistical life, which equates to about $52 per pack. From the calculation of net externalities and internality of smoking, the optimal per-pack excise tax ranges from $1.91 to $22.12, assuming the people have different evaluations of the future, in both short-run and long-run futures.

The estimates calculated in this paper were derived from current literature and government agencies due to the unavailability of raw data. While the estimates related to the government's savings on Medicare and Social Security might not fully capture the actual costs associated with smoking, I believe these average estimations are adequate and align well with established literature. Additionally, this study does not address individuals leaving Indiana to purchase cigarettes in neighboring states, a factor that previous studies have estimated and which future research should include. Although this study cannot account for the healthcare benefits from an increased tax rate, Chaloupka and Tauras (2023) suggests that raising the tax rate to $2 per pack could result in long-term healthcare savings of

$795 million for Indiana, potentially boosting the economy by extending residents' lifespans and enabling longer working lives. The REMI model accurately depicts the impact of tobacco taxation on Indiana's macroeconomy but may overstate the economic impact through government spending, as indicated by the substantial rise in GDP and state and local government employment driven by such spending.

The results presented in this paper should be considered upper-bound estimates of the economic impact of increasing cigarette taxes. According to Mounsey et al. (2022), employment is expected to rise due to increased demand and new job creation in other sectors. They also suggest that productivity will improve as health outcomes and the working lifespan of individuals increase. However, these findings contradict those of Brown (2009). My interpretation is that Brown (2009) does not account for the benefits of increased tax revenue and the shift in consumer spending to other areas.

This paper suggests that increasing the tax rate to $1.91/pack and $6.96/pack, there are many benefits to the state economy of Indiana. Within the first year, total employment is expected to improve by at least 3813 jobs, GPD is expected to increase by at least $315 million, and personal income is expected to increase by at least $237 million which increases the disposable personal income by $167 million. These estimates increase as the tax rates goes up to $6.96/pack. Increasing the tax to $12.01 and $22.12 had volatile results, and I do not believe the economy would behave as predicted in the model as it does not follow the current literature. Therefore, I only focus on taxing up to $6.96/pack. Overall, I strongly believe, based on the evidence presented in this paper, that a drastic increase in the price of cigarettes would improve Indiana's economy, in spite of limitations.

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Appendix A

Table 12: Ten States with Highest Cigarette Prevalence Rates in 2022

State	**Prevalence Rate**
United States	*14.02%*
West Virginia	21.00%
Arkansas	18.74%
Tennessee	18.54%
Kentucky	17.39%
Mississippi	17.38%
Ohio	17.08%
Missouri	16.76%
Louisiana	16.73%
Indiana	16.21%
Arkansas	15.94%

Source: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data [online]. 2015. [accessed Oct 13, 2023]. URL: https://www.cdc.gov/brfss/brfssprevalence/.

Appendix B

Table 13: 2022 State Cigarette Taxes

STATE	TAX RATE (¢ per pack)	STATE	TAX RATE (¢ per pack)
Alabama[(a)]	67.5	Nebraska	64
Alaska	200	Nevada	180
Arizona	200	New Hampshire	178
Arkansas	115	New Jersey	270
California	287	New Mexico	200
Colorado	194	New York[(a)]	435
Connecticut	435	North Carolina	45
Delaware	210	North Dakota	44
Florida[(b)]	133.9	Ohio	160
Georgia	37	Oklahoma	203
Hawaii	320	Oregon	333
Idaho	57	Pennsylvania	260
Illinois[(a)]	298	Rhode Island	425
Indiana	99.5	South Carolina	57
Iowa	136	South Dakota	153
Kansas	129	Tennessee[(a)(c)]	62
Kentucky	110	Texas	141
Louisiana	108	Utah	170
Maine	200	Vermont	308
Maryland	375	Virginia[(a)]	60
Massachusetts	351	Washington	302.5
Michigan	200	West Virginia	120
Minnesota[(d)]	304	Wisconsin	252
Mississippi	68	Wyoming	60
Missouri[(a)]	17	District of Columbia[(e)]	450
Montana	170	U. S. Median	178

Source: Compiled by FTA from state sources.

(a) Counties and cities may impose an additional tax on a pack of cigarettes: in Alabama, 1¢ to 25¢; Illinois, 10¢ to $4.18; Missouri, 4¢ to 7¢; New York City, $1.50; Tennessee, 1¢; and Virginia, 2¢ to 15¢.

(b) Florida's rate includes a surcharge of $1 per pack.

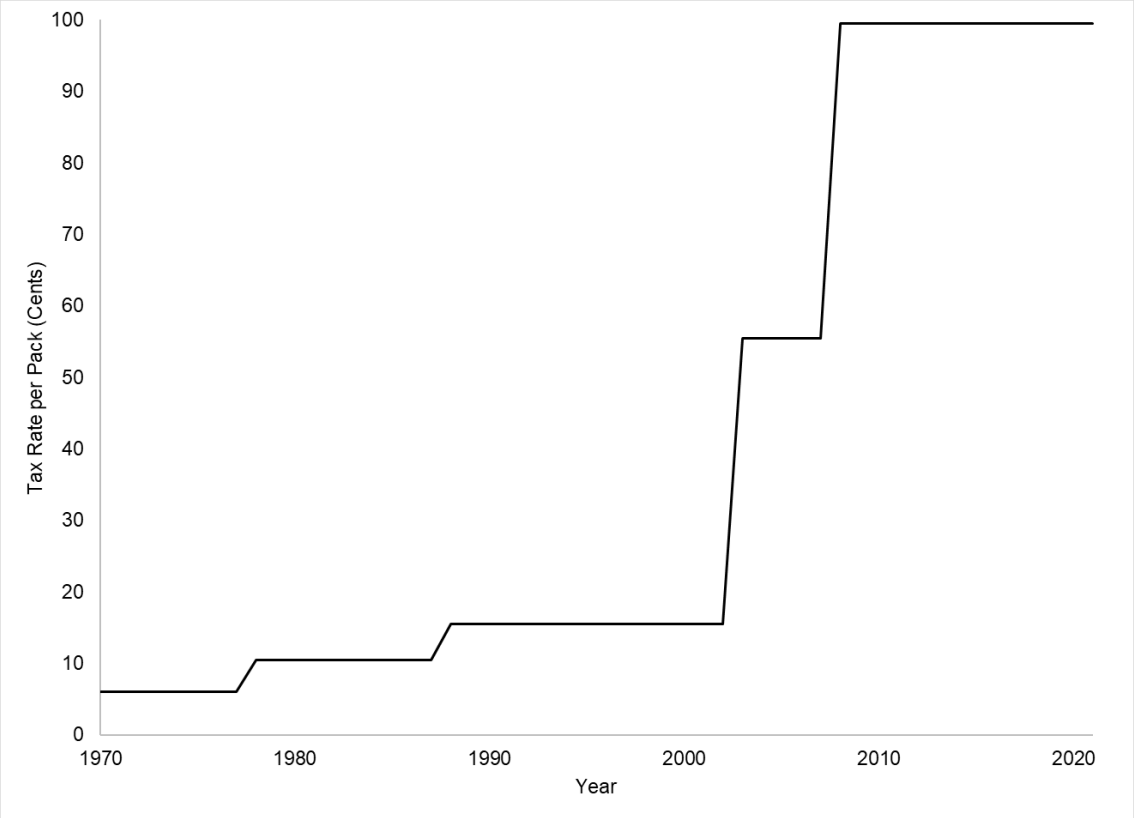
(c) Dealers pay an additional enforcement and administrative fee of 0.05¢ in Tennessee.

(d) Minnesota imposes an in-lieu cigarette sales tax determined annually by the Department. The current rate is 69.2¢ through December 31, 2023.

(e) District of Columbia imposes an in-lieu cigarette sales tax calculated every March 31. The current rate is 52¢.

Appendix C

Figure 5: Nominal Tax Rate in Indiana, 1970-2021



Source: Orzechowski and Walker, 2022

Appendix D

Table 14: Summary of Calculation Assumptions

Assumption		**Source**
Hours Worked per Day	8.1	BLS (2023)
Days Worked per Week	5	BLS (2023)
Absenteeism Days	2.6	Berman et al. (2014)
Weeks Worked/Year	52	BLS (2023)
Excess Presenteeism Rate	0.01	Berman et al. (2014)
Days Worked per Year	260	BLS (2023)
Time on Break	0.25	BLS (2023)
Cigarettes per day at work	2	Berman et al. (2014)
Cost per Pack (total)	$ 7.47	Campaign for Tobacco-Free Kids (2023)
Excise Tax Per Pack	$ 0.995	Campaign for Tobacco-Free Kids (2023)
Subsidy Male	$ 10,123.00	Sloan et al. (2004)
Percent Male Workers	53%	BLS (2023)
Subsidy Female	$ 383.00	Sloan et al. (2004)
Percent Female Workers	47%	BLS (2023)
Years Worked by Smoker	24	Berman et al. (2014)
Monthly SSDI	$ 1,560.47	SSA (2023)
Percent of Smokers with Disability	27.80%	CDC (2020)
Number of Packs of Cigarettes Purchased*	365,473,666	Author's Calculations
Lifetime Cigarettes Smoked**	267,500	Author's Calculations

Note:* From Orzechowski and Walker (2024), they show millions of packs sold by state. Based on their findings, I see there is an average annual 1.97% decrease in the sales of cigarettes which I use to predict the number of cigarettes sold in 2022.

*Note**:* Based on the Current Population Survey Tobacco Use Supplement 2022 and Shaw, Mitchell, and Dorling (2000), I estimate an appropriate amount of cigarettes smoked.

Appendix E

Table 15: Prevalence Rate and Cigarettes Consumed by Income Group, Indiana 2022

Income	Prevalence Rate (%)	Cigarettes per Day	Packs per Day
< $15,000	34.73	18	0.88
[$15,000, $25,000)	23.58	18	0.89
[$25,000, $35,000)	22.28	14	0.71
[$35,000, $50,000)	19.84	15	0.76
[$50,000, $100,000)	14.59	15	0.73
[$100,000, $200,000)	9.95	13	0.67
> $200,000	5.06	30	1.48

Source: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data [online]. 2015. [accessed Oct 13, 2023]. URL: https://www.cdc.gov/brfss/brfssprevalence/.
Note: The assumption is that there is an average of 20 cigarettes per pack.

Appendix F

Table 16: Predicted Population and Smoking Prevalence Rates, Indiana, 2022-2042

Year	Prevalence Rate (%)	Population	Smokers
2022	16.2	6,832,274	1,106,828
2023	15.9	6,905,567	1,096,328
2024	15.6	6,929,798	1,078,171
2025	15.2	6,943,226	1,058,655
2026	14.9	6,961,159	1,040,162
2027	14.6	6,983,926	1,022,692
2028	14.4	7,007,066	1,005,559
2029	14.1	7,032,983	989,093
2030	13.8	7,062,726	973,410
2031	13.5	7,094,676	958,258
2032	13.2	7,128,899	943,622
2033	13.0	7,164,984	929,431
2034	12.7	7,202,741	915,642
2035	12.5	7,241,982	902,218
2036	12.2	7,282,210	889,085
2037	12.0	7,322,848	876,166
2038	11.7	7,363,262	863,381
2039	11.5	7,403,539	850,742
2040	11.3	7,443,627	838,241
2041	11.0	7,483,784	825,908
2042	10.8	7,523,537	813,689

Source: Census, BRFSS, REMI, and author's calculations

Appendix G

Table 17: Economic Impact Summary of a $12.01 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Employment	-3533.22	-3122.57	-1239.11	-1930.46	-2893.26
Gross Domestic Product	-0.553	-0.506	-0.305	-0.427	-0.553
Personal Income	-0.235	-0.385	-0.255	-0.366	-0.561
Disposable Personal Income	-0.167	-0.286	-0.206	-0.289	-0.432
Disposable Personal Income per Capita	0.01	0.086	0.117	0.117	0.116

Total Employment is measured in individual jobs.
GDP is measured in billions of 2022$.
Personal Income is measured in billions of 2022$.
Disposable Personal Income is measured in billions of 2012$.
Disposable Personal Income per Capita is measured in 1000s of 2012$.

Appendix H

Table 18: Economic Impact Summary of a $22.12 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Employment	650.386	25.201	1508.848	-71.214	-2156.03
Gross Domestic Product	0.076	-0.04	0.102	-0.148	-0.414
Personal Income	0.087	-0.117	-0.014	-0.218	-0.553
Disposable Personal Income	0.06	-0.105	-0.044	-0.195	-0.44
Disposable Personal Income per Capita	0.047	0.132	0.168	0.169	0.169

Total Employment is measured in individual jobs.
GDP is measured in billions of 2022$.
Personal Income is measured in billions of 2022$.
Disposable Personal Income is measured in billions of 2012$.
Disposable Personal Income per Capita is measured in 1000s of 2012$.

Appendix I

Table 19: Impacts on Employment from $12.01 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
All Industries	-3533.22	-3122.57	-1239.11	-1930.46	-2893.26
Forestry, fishing, and hunting	-0.548	-1.307	-2.233	-4.282	-5.499
Mining	-0.329	-1.386	0.918	-1.196	-3.147
Utilities	49.49	30.417	23.63	12.402	5.073
Construction	-1907.7	-1636.53	-333.454	-368.696	-517.318
Manufacturing	235.97	175.768	96.622	-27.319	-100.315
Wholesale trade	-674.014	-483.028	-373.183	-289.756	-219.935
Retail trade	-8033.48	-5353.21	-4032.58	-3013.09	-2224.85
Transportation and warehousing	-396.72	-276.408	-221.248	-218.76	-226.05
Information	24.569	20.282	19.954	13.206	9.37
Finance and insurance	237.306	176.205	134.96	60.452	20.649
Real estate and rental and leasing	652.24	392.638	361.34	173.519	16.758
Professional, scientific, and technical services	51.318	11.345	51.121	0.869	-54.367
Management of companies and enterprises	-1.456	-2.119	-5.29	-8.014	-8.887
Administrative, support, waste management, and remediation services	79.696	21.988	35.368	-38.999	-98.494
Educational services; private	260.189	165.307	147.876	84.684	37.858
Health care and social assistance	2993.27	2388.038	2068.255	1510.408	935.527
Arts, entertainment, and recreation	302.908	223.98	180.781	123.292	49.346
Accommodation and food services	2313.846	1357.48	922.746	542.439	229.736
Other services (except public administration)	1877.543	1321.531	1025.306	738.715	430.055
State and Local Government	-1597.33	-1653.57	-1340	-1220.33	-1168.77

Note: Units are the number of individuals.

Appendix J

Table 20: Impacts on Employment from $22.12 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
All Industries	650.386	25.201	1508.848	-71.214	-2156.03
Forestry, fishing, and hunting	1.632	-0.807	-3.086	-6.165	-8.041
Mining	8.42	3.759	3.809	-0.297	-3.808
Utilities	135.578	88.387	68.42	42.445	24.962
Construction	-2197.23	-1930.57	-424.195	-556.131	-804.62
Manufacturing	845.585	599.099	391.909	179.954	51.846
Wholesale trade	-1254.73	-921.034	-713.276	-519.821	-363.949
Retail trade	-16027.3	-10760.4	-8037.31	-5794.05	-4087.29
Transportation and warehousing	-621.546	-432.808	-347.69	-322.775	-330.378
Information	77.909	60.872	56.227	42.801	35.092
Finance and insurance	611.664	434.681	336.786	184.977	102.268
Real estate and rental and leasing	1975.069	1354.712	1135.585	695.439	335.078
Professional, scientific, and technical services	427.811	286.524	282.202	178.374	61.305
Management of companies and enterprises	-0.15	-4.499	-9.642	-13.234	-14.122
Administrative, support, waste management, and remediation services	543.168	324.837	273.784	116.343	-14.496
Educational services; private	647.96	426.093	371.981	229.625	126.972
Health care and social assistance	7497.374	5872.639	4978.258	3734.937	2452.277
Arts, entertainment, and recreation	756.246	538.364	421.536	299.231	136.456
Accommodation and food services	6020.272	3967.206	2827.685	1900.454	1145.231
Other services (except public administration)	4651.469	3206.111	2416.12	1766.575	1071.487
State and Local Government	-3448.78	-3087.93	-2520.25	-2229.9	-2072.31

Note: Units are the number of individuals.

Appendix K

Table 21: Impacts on GDP from $12.01 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Gross Domestic Product (GDP)	-0.553	-0.506	-0.305	-0.427	-0.553
Consumption	-1.129	-0.938	-0.832	-0.896	-0.981
Durables	0.427	0.386	0.347	0.358	0.389
Non-Durables	-3.946	-3.133	-2.743	-2.424	-2.15
Services	2.389	1.809	1.564	1.17	0.78
Investment	-0.391	-0.317	0.004	0.004	-0.043
Residential	-0.419	-0.383	-0.085	-0.071	-0.09
Nonresidential Structures	0.016	0.033	0.029	0.011	-0.004
Nonresidential Equipment	0.01	0.022	0.037	0.035	0.024
Nonresidential Intellectual Property Products	0.002	0.011	0.023	0.029	0.027
Change in Private Inventories	0.004	0	-0.001	-0.001	-0.001
Net Trade	1.144	0.942	0.685	0.616	0.619
Exports	-0.086	-0.061	-0.104	-0.14	-0.152
Imports	-1.23	-1.003	-0.788	-0.756	-0.771
Government Spending	-0.181	-0.193	-0.16	-0.15	-0.147

Note: Units are in Billions of 2022$.

Appendix L

Table 22: Impacts on GDP from $22.12 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Gross Domestic Product (GDP)	0.076	-0.04	0.102	-0.148	-0.414
Consumption	-1.157	-0.98	-0.895	-1.024	-1.198
Durables	1.054	0.921	0.79	0.802	0.865
Non-Durables	-8.205	-6.557	-5.652	-4.878	-4.226
Services	5.995	4.656	3.967	3.052	2.163
Investment	-0.407	-0.269	0.124	0.111	0.03
Residential	-0.54	-0.513	-0.136	-0.117	-0.144
Nonresidential Structures	0.076	0.102	0.069	0.028	-0.002
Nonresidential Equipment	0.048	0.098	0.117	0.112	0.092
Nonresidential Intellectual Property Products	0.009	0.044	0.074	0.088	0.085
Change in Private Inventories	0.016	0.003	0	0	-0.001
Net Trade	2.015	1.567	1.176	1.04	1.016
Exports	-0.229	-0.207	-0.261	-0.298	-0.302
Imports	-2.244	-1.775	-1.437	-1.338	-1.318
Government Spending	-0.391	-0.361	-0.303	-0.275	-0.262

Note: Units are in Billions of 2022$.

Appendix M

Table 23: Impacts on Income from $12.01 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Earnings by Place of Work	-0.155	-0.049	0.221	0.192	0.103
Total Wages and Salaries	-0.162	-0.099	0.065	0.046	-0.012
Supplements to Wages and Salaries	-0.046	-0.042	-0.009	-0.013	-0.027
Employer contributions for employee pension and insurance funds	-0.031	-0.028	-0.006	-0.009	-0.018
Employer contributions for government social insurance	-0.015	-0.014	-0.003	-0.004	-0.008
Proprietors' income with inventory valuation and capital consumption adjustments	0.053	0.092	0.165	0.159	0.141
Less: Contributions for Government Social Insurance	-0.03	-0.023	0.003	0	-0.01
Employee and Self-Employed Contributions for Government Social Insurance	-0.015	-0.01	0.006	0.004	-0.001
Employer contributions for government social insurance	-0.015	-0.014	-0.003	-0.004	-0.008
Plus: Adjustment for Residence	-0.065	-0.073	-0.094	-0.101	-0.104
Gross Inflow	0.019	0.02	0.047	0.034	0.02
Gross Outflow	0.084	0.093	0.141	0.135	0.124
Equals: Net Earnings by Place of Residence	-0.191	-0.099	0.125	0.091	0.008
Plus: Property Income	-0.03	-0.123	-0.154	-0.182	-0.224
Personal Dividend Income	-0.011	-0.041	-0.045	-0.052	-0.064
Personal Interest Income	-0.012	-0.06	-0.082	-0.1	-0.125
Rental Income of Persons	-0.006	-0.023	-0.027	-0.03	-0.035
Plus: Personal Current Transfer Receipts	-0.014	-0.163	-0.226	-0.275	-0.345
Equals: Personal Income	-0.235	-0.385	-0.255	-0.366	-0.561
Less: Personal Current Taxes	-0.033	-0.037	-0.006	-0.016	-0.036
Equals: Disposable Personal Income	-0.202	-0.348	-0.25	-0.35	-0.525

Note: Units are in Billions of 2022$.

Appendix N

Table 24: Impacts on Income from $22.12 Tax on Cigarettes

	1 Year	5 Years	10 Years	15 Years	20 Years
Total Earnings by Place of Work	0.24	0.339	0.616	0.524	0.344
Total Wages and Salaries	0.026	0.105	0.274	0.221	0.109
Supplements to Wages and Salaries	-0.022	-0.012	0.025	0.016	-0.01
Employer contributions for employee pension and insurance funds	-0.016	-0.009	0.016	0.01	-0.007
Employer contributions for government social insurance	-0.007	-0.003	0.009	0.006	-0.003
Proprietors' income with inventory valuation and capital consumption adjustments	0.236	0.246	0.316	0.287	0.245
Less: Contributions for Government Social Insurance	-0.005	0.006	0.033	0.025	0.006
Employee and Self-Employed Contributions for Government Social Insurance	0.002	0.009	0.024	0.019	0.009
Employer contributions for government social insurance	-0.007	-0.003	0.009	0.006	-0.003
Plus: Adjustment for Residence	-0.105	-0.115	-0.141	-0.151	-0.156
Gross Inflow	0.11	0.1	0.123	0.091	0.063
Gross Outflow	0.215	0.215	0.264	0.243	0.22
Equals: Net Earnings by Place of Residence	0.14	0.218	0.442	0.348	0.181
Plus: Property Income	-0.033	-0.142	-0.183	-0.225	-0.287
Personal Dividend Income	-0.012	-0.047	-0.053	-0.064	-0.082
Personal Interest Income	-0.014	-0.069	-0.098	-0.123	-0.16
Rental Income of Persons	-0.007	-0.026	-0.032	-0.037	-0.045
Plus: Personal Current Transfer Receipts	-0.021	-0.193	-0.273	-0.342	-0.447
Equals: Personal Income	0.087	-0.117	-0.014	-0.218	-0.553
Less: Personal Current Taxes	0.014	0.011	0.039	0.018	-0.019
Equals: Disposable Personal Income	0.073	-0.128	-0.053	-0.236	-0.534

Note: Units are in Billions of 2022$.