# An Empirical Analysis of Master Settlement Agreement Impacts on Cigarette Consumptions in the USA

Peter. Y. Wui

***Abstract*—In 1998 the US states and tobacco companies made the largest US litigation of the Master Settlement Agreement (MSA) – a grand sum of $246 billion or more until 2025. A rational addiction model was used to analyze the impact of this Master Settlement Agreement on cigarette consumption. A rational addiction economic model considers the effects of current consumption from the quantity of past and future consumption with the current price and income. The panel data of cigarette consumption and prices of all 50 US states and DC were collected with the data of tobacco settlement funds and incomes since 1955 until 2014. An instrument variable panel regression of a modified rational addiction function indicates that the MSA funds could decrease cigarette consumption per capita by an average 0.026 packs per $100M annually in each state.**

***Index Terms*—Master settlement agreement, cigarette, rational addiction model.**

## I. Introduction

Since the Master Settlement Agreement (MSA) in November of 1998, the tobacco companies have paid set aside funds to states around $113 billion from 1999 to 2016. $246 billion or more is anticipated to be paid by 2025 [1]. This is the largest civil litigation settlement in US history [2]. It has surely increased tobacco prevention and cessation expenditures in states, but 48 states are still spending less than 50% of the minimum levels recommended by the U.S. Centers for Disease Control and Prevention. Connecticut and New Jersey have yet to spend any settlement state funds for tobacco prevention in 2017 [1]. The settlement fund is a major revenue for the tobacco prevention programs in states with tobacco sales taxes.

The impacts of the MSA were analyzed by [3], and [4]. However, both analyses were done too soon after the MSA under low data availability. Now a new empirical analysis is needed with the aid of the abundant data from the last 18 years since the 1998 MSA inauguration to investigate the effectiveness of the program. [3] analyzed the MSA impacts on cigarette consumption by using a probit model, and [4] estimated the impacts by applying a demand price elasticity of -0.4 to an assumed price increase of $0.45 per pack. However, cigarette sales analysis is mainly analyzed by a rational addiction model initiated by [5] and applied empirically by Becker, Grossman and Murphy (BGM) [6] and Baltagi and Griffin (BG) [7]. Therefore, I would like to estimate the MSA impacts on cigarette consumptions by using the rational addiction model with a modified BGM. This paper will be the first analysis of the MSA impacts using the rational addiction model. I will introduce the modified BGM model in the next section followed by the data, the estimated results, and my conclusions.

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## II. Model

The rational addiction model aims to explain an addiction behavior by considering the interdependencies among the past, present and future consumptions. Following BGM [6], the cigarette demand function was derived from the utility maximization of a representative smoker subject to a life time budget constraint. current utility function of a cigarette consumer of i[th] state, $U_{it}$, is defined as follows:

$$U_{it} = U(C_{it}, C_{it-1}, Y_{it}, MSA_{it}, \varepsilon_{it}) \quad (1)$$

where $C_{it}$, and $C_{it-1}$ represent the cigarette consumption of the i[th] state customer over time t and t-1. $Y_{it}$ represents the consumption of composite commodity except the cigarette over time. $MSA_{it}$ represents the MSA payments paid to i[th] state, and $\varepsilon_{it}$ represents all other impacts on i[th] state customer's utility. The utility function assumes the MSA could be a direct impact on a customer's utility.

Maximizing a quadratic utility function of equation (1) subject to an initial consumption and an initial present value wealth conditions with respect to all the variables of $C_{it}$, $Y_{it}$, and $MSA_{it}$ derives the following demand equation:

$$C_{it} = \beta_0 + \beta_1 C_{it-1} + \alpha\beta_1 C_{it+1} + \beta_3 P_{it} + \beta_4 Y_{it} + \beta_5 MSA_{it} + \beta_6 \varepsilon_{it} + \beta_7 \varepsilon_{it+1} \quad (2)$$

where $P_{it}$ is the price of consumed products of i[th] state at the t-time, $\beta_1$ through $\beta_6$ represent the marginal impacts on consumption by each variable when all other variables are constant. An empirical testable demand equation of the equation 2 is as follows:

$$C_{it} = \beta_0 + \beta_1 C_{it-1} + \beta_2 C_{it+1} + \beta_3 P_{it} + \beta_4 Y_{it} + \beta_5 MSA_{it} + \varepsilon_{it} \quad (3)$$

On the equation (3), $\beta_0$ represents an intercept of the consumption equation, and $\beta_1$ represents the cigarette consumption caused by a marginal increase of the previous

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cigarette consumption when all other variables are constant. Other $\beta$ 's also represents the cigarette consumptions incurred by each variable's marginal increase under ceteris paribus.

The MSA's impacts on the cigarette consumption could be estimated by the value of $\beta_5$ . If $\beta_5$ is statistically significant in negative values, the MSA would deter cigarette consumptions. Whether the cigarette consumptions are a rational addiction or not would be evaluated by the statistical significance of $\beta_1$ and $\beta_2$ as in BGM [6] and BG [7].

Equation 3 is estimated by a multi-variate panel regression with random effects. To avoid an autocorrelation problem caused by correlations among dependent variable $C_{it}$ and independent variables $C_{it-1}$, $C_{it+1}$, instrument variables are introduced to substitute the previous and future consumptions by the previous and fast state cigarette taxes following the BGM and BG.

## III. Data

The secondary level data of cigarette consumptions in 50 states and D.C., prices per pack of cigarette, MSA funds paid to states, and state and federal cigarette taxes were collected on the annual base from the Tax Burden on Tobacco [8] over the period 1955 to 2014. All the prices, taxes and MSA funds are inflation-adjusted by CPI.

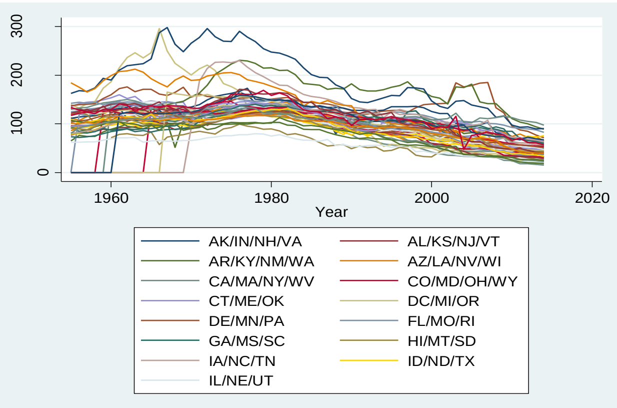


Fig. 1. US States cigarette sales over 1955 to 2014.

Cigarette consumption per capita in the USA increased with high variations among states until 1980 and decreased with reduced deviations as shown at Fig. 1. The downward consumption trends are explained by the increasing real cigarette prices since 1980 shown in Fig. 2. Once New Hampshire, DC and Nevada's per capita smoking was higher than 200 packs annually. In 2014, West Virginia, New Hampshire and Kentucky states are showing high smoking at above 90 packs per capita. At the same year, New York, DC, Washington and Utah states are the lowest smoking at below 20 packs per capita. On average, the per capita smoking hit the highest in 1976 at 139 packs and down to 47 packs in 2014 as 66% decreases. The real cigarette prices were flat until 1985 between $1.50 and $2.00 and then increased until $5.62 in 2014 gradually at the annual 1.8% increase rate. The main tobacco production states of North Carolina, Kentucky, Virginia and South Carolina used to keep the lowest cigarette prices. But Alaska, Hawaii, and Northwestern states of New York and Massachusetts, Rhode Island, and Connecticut are charging highest cigarette prices due to the highest cigarette state taxes. One interesting trend in prices is higher price deviations among states. Before 1990, the price standard deviation was below $0.20, but after 1990, the standard deviation has been increased to $1.23 in 2014, 6 times higher. The decreased standard deviation of cigarette smoking among states could be explained somewhat by the expanded cigarette prices with the increased state taxes on the high smoking states. The high prices on high smoking states could reduce smoking in higher impact.

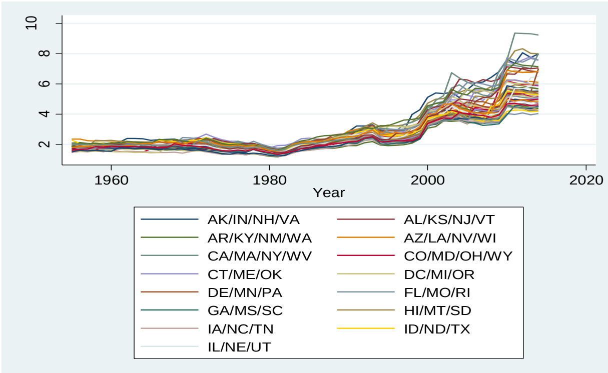


Fig. 2. Real cigarette price (2010 $) per pack of states: 1955-2014.

The real cigarette price increase could be understood clearly with state tax increase since 1998 as shown in Fig. 3. With some increases during 1970s, until 1998 the average real cigarette state taxes were stayed below 50 cents mostly. However, the MSA changed the average state cigarette tax rates sharply to high level to $1.42 in 2014, almost triple times after the MSA. The MSA changed the tobacco production states of North Carolina and Kentucky to charge 5 times higher taxes from below 10 cents to 50 cents. In 2014 the high cigarette price states of New York, Massachusetts, and Rodhe Island were charging more than $3.00. As like the price standard deviation, state tax standard deviation was increased since 1998.

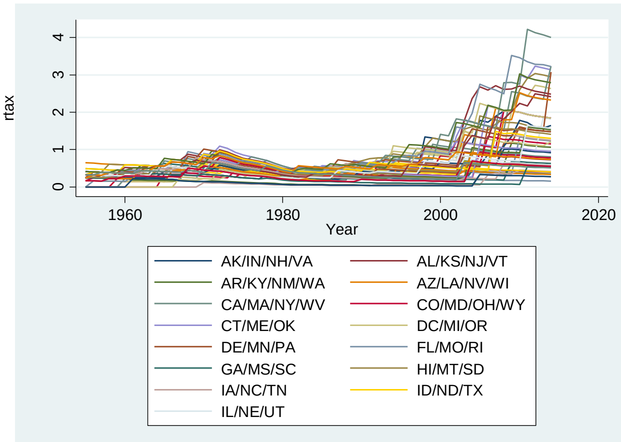


Fig. 3. Real cigarette state tax (2010 $): 1955-2014.

The US states' real income has been increased steadily over year from around $15,000 in 1955 to $42,000 in 2014 as shown in Fig. 4. The increased income is expected to smoke more depending on income elasticities.

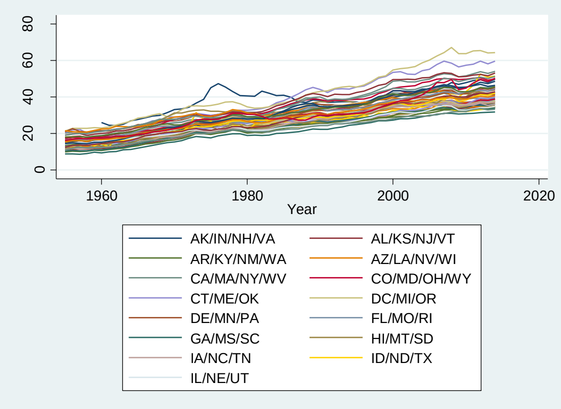


Fig. 4. Real income (2010 $) in the USA: 1995-2014.

The master settlement fund data is illustrated at Fig. 5 including 4 separate contracting states of Florida, Minnesota, Mississippi, and Texas started from 1998. The high populated states of Texas, California, New York, and Florida are the highest fund payment states over years with somewhat downsizing trend. On average, the high paying states has been paid more than $500 M annually. Wyoming, South Dakota and Idaho were the lowest payment states over year at lower than $30M annually. The total annual payment in the USA has been $8 B across states.

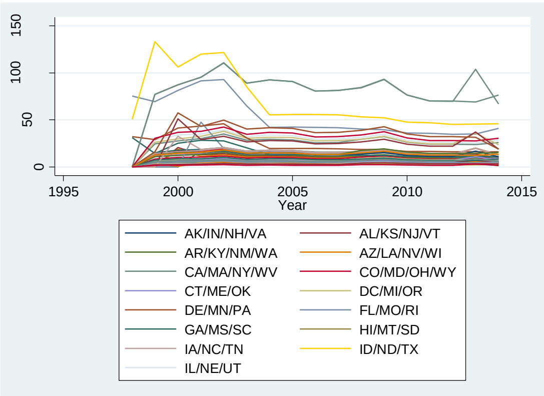


Fig. 5. Master Settlement Fund (2010 10M$) in the USA: 1995-2014.

## IV. Results

TABLE I: Cigarette Consumption Model Estimation

| Variable (Unit) | Wui | | BG | BGM |
|---|---|---|---|---|
| | 1955-2014 Estimates | Standard Errors | 1963-1992 Estimates | 1955-1985 Estimates |
| Past sales (pack) | 0.584 | 0.062 | 0.456 | 0.481 |
| Future sales (pack) | 0.264 | 0.075 | 0.248 | 0.228 |
| Price (cents) | -0.0591 | 1.112 | -0.76 | -0.971 |
| Personal Income ($100) | 0.165 | 0.044 | -0.081 | 0.608 |
| Settlement Fund ($100M) | -0.025 | 0.016 | | |
| Discount rate | 121% | | 84% | 111% |
| Short-run elasticity | -0.1 | | -0.65 | -0.36 |
| Long-run elasticity | -0.37 | | -1.36 | -0.79 |

$R^2$=0.97 and $\chi^2$=32942.

The estimated equation shown in Table I is significant in all variables and shows rational addiction behaviors which are consistent with previous analyses done by BGM and BG. Because past sale and future sale impacts to current cigarette consumptions are all significantly positive, this highly suggests more past and future consumptions increase the current consumptions. Price coefficients are negative, but very low compared to the previous coefficients. And price elasticity is also very low compared to previous findings. The short run own-price elasticity was 0.1 compared to 0.36 and o.65 of BG and BGM. It means US cigarette customers have not been very sensitive to cigarette prices, and so a high price cannot drastically reduce cigarette consumption. And the smoker has become less sensitive to price compared to the past. Even the long run elasticity is 0.37 which is much lower than the previous 1.36 or 0.79. The discount rate is still extremely high at 121% – higher than previous findings of 84% and 111%. Today, Smokers prefer to smoke now than any other time. Income coefficient is 0.165, which tells a $100 income increases 0.165 cigarette packs and is not consistent with the previous results.

Finally, the MSA fund estimate is -0.025 per $100 M in each state; it is definitely not enough impact to the reduce cigarette consumption. When 2014 average state MSA of $128.5M is applied, the average state cigarette reduction of MSA is -0.032. This is proved by low budgets in tobacco prevention programs supported by MSA funds paid to states by tobacco manufacturing firms [2]. Based on estimated MSA coefficients of -0.025 packs per $100M, the total impact of MSA funds on each state’s cigarette consumption reduction is illustrated by Fig. 6. The total impact values were calculated by multiplying -0.025 to MSA funds of each state so that the trend is parallel shift of the MSA funds in Fig. 5. Even though the impacts vary from close to 0 to 0.33 packs per year, the average is at 0.40 packs per year. In 2014, the average smoking reduction of MSA was -0.032, which was 0.07% of average cigarette smoking per capita.

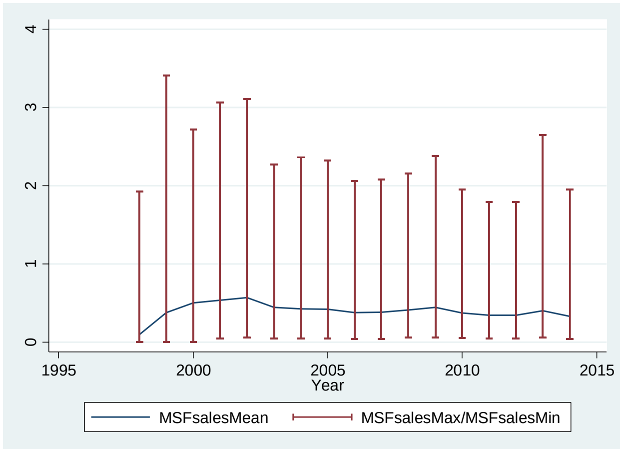


Fig. 6. The US each States’ total sales reduction by the MSA funds: 1998-2014.

## V. Conclusion

MSA was a historical monument for the promotion of US consumer health. However, MSA’s direct impacts on cigarette consumption were not high enough due to two reasons. The first is due to low budget allocations on tobacco prevention program which were out of MAS revenue. The second is due to a low-price elasticity and a high discount rate which makes increased cigarette pricing to compensate for paid MAS funds quite useless. The reduced and condensed smokers are not very sensitive to a price increase nowadays as they would have been to decades ago. These results are contrary to findings from [3] which showed a 5% reduction at age 21 to 64. Our findings concluded only around 0.07%. However, whereas our findings are only direct impacts of MSA funds, Sloan and Trogdon's findings were indirect impacts. Based on the findings of this paper, I would like to leave a further analysis of the MSA's indirect impacts by the increased cigarette prices using the rational addiction model.

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## References

[1] Campaign for Tobacco Free Kids. (2016). *Broken Promises to Our Children*. [Online]. Available: http://www.tobaccofreekids.org/microsites/statereport2017/pdf/StateReport_FY2017.pdf

[2] Tobacco Control Legal Consortium. (2015). The master settlement agreement: An overview, public health law center. [Online]. Available: http://www.publichealthlawcenter.org/sites/default/files/resources/tclc-fs-msa-overview-2015.pdf

[3] F. Sloan and J. Trogdon, "The impact of the master settlement agreement on cigarette consumption," *Journal of Policy Analysis and Management*, vol. 23, no. 4, 2004.

[4] D. Cutler, J. Gruber, R. Hartman, M. Landrum, J. Newhouse, and M. Rosenthal, "The economic impacts of the tobacco settlement," *Journal of Policy Analysis and Management*, vol. 21, no. 1, Winter, 2002.

[5] G. Becker and K. M. Murphy, "A theory of rational addiction," *The Journal of Political Economy*, vol. 96, pp. 675-700, 1988.

[6] G. S. Becker, M. Grossman, and K. M. Murphy, "Rational addiction and the effect of price on consumption," *American Economic Review, American Economic Association*, vol. 81, no. 2, pp. 237-41, 1991.

[7] B. H. Baltagi and J. M. Griffin, "The econometrics of rational addiction: The case of cigarettes," *Journal of Business and Economic Statistics*, vol. 19, no. 4, pp. 449-454.

[8] W. Orzechowski and R. C. Walker. (2015). *The Tax Burden on Tobacco: Historical Compilation 2014*. Arlington, VA. [Online]. 49. Available: https://www.taxadmin.org/assets/docs/Tobacco/papers/tax_burden_2014.pdf

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