CIRJE-F- 1232

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August 2024

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THE MACROECONOMIC EFFECT OF TAX SHOCKS

NEW NARRATIVE EVIDENCE FROM JAPAN

Nobuki Mochida*

Abstract

This study constructs a new dataset on tax shocks from the ground up and, for the first time, estimates the tax multiplier in Japan using a narrative approach pioneered by Romer and Romer (2010). Out of 104 tax reforms during the post-war period from 1955 to 2023, I identified 588 discretionary tax changes, categorizing 401 as exogenous and 187 as endogenous. The impact of tax changes on output is large and persistent, with typical SVAR estimates being smaller. The study finds that a 1 percent tax change leads to an initial 1.5 percent decline in output, peaking at a 3.6 percent decrease within three years. These findings are comparable to those for the U.S. and U.K.

Keywords: tax multiplier, narrative approach, exogenous tax changes, Japan **JEL Classification:** E62, H20, H24, H30

Professor Emeritus, The University of Tokyo,7-3-1Hongo,Bunkyo-Ku,Tokyo,Japan.Email: <u>nmochida686@gmail.com</u>; Tel: +81-3-5481-6341, I gratefully acknowledge the financial support from the JSPS Grant-in-Aid for Scientific Research(KAKENHI), Grant Number 21K01527. This paper was presented at 79th annual congress of International Institute of Public Finance (held at Utah State University, Logan, USA) on 14, August, Public Finance workshop held in University of Tokyo, on 12, March 2023 and Research Group on Local Public Finance within the Local Public Finance Association on 11, June 2024. I thank Shafik Hebous, Benito Salomao, Niels Jørgen Mau Pedersen, Atsuyoshi Morozumi, Qing Rui, Yasushi Iwamoto, Hikaru Ogawa, Masayoshi Hayashi ,Yasuhiro Sato, Hideaki Sato, Masahisa Hayashi, Akira Yokoyama and other participants for helpful comments and discussion. The responsibility for any errors contained in this manuscript lies with the author.

I. INTRODUCTION

The tax multiplier is one of key concepts in the context of fiscal policy. It measures the impact of a change in taxes on the overall economy, specifically on GDP. Understanding the tax multiplier helps policymakers gauge how changes in tax policy—such as tax cuts or increases will influence overall economic activity. The tax multiplier also has implications for government debt and deficits. If a tax cut leads to significant economic growth (high multiplier), it could potentially increase tax revenues eventually, reducing the deficit.

Japan presents a unique and instructive case when studying the tax multiplier. Since the early 1990s, Japan has grappled with the persistent challenge of promoting economic growth. Prolonged periods of extremely low interest rates have constrained the effectiveness of monetary policy, while a rising debt-to-GDP ratio has heightened concerns about the feasibility of tax cuts and increased government spending. This makes Japan a critical case for studying the effectiveness of fiscal policy, including the tax multiplier, in helping Japan emerge from prolonged slow growth and deflations (so-called "lost decades").

This study constructs a new dataset on tax shocks from the ground up and, for the first time, estimates the tax multiplier in Japan using a narrative approach pioneered by Romer and Romer (2010). Among the 104 tax reforms during the post-war period from 1955 to 2023, I identified a total of 588 discretionary tax changes, categorizing 401 as exogenous changes and 187 as endogenous changes. The impact of tax on output is substantial and persistent—typical SVAR estimates are smaller. By employing a distributed lag model and VAR analysis, this study found that a 1 percent tax change as to GDP is associated with an initial 1.5 percent decline in output, followed by a gradual decrease in output growth, reaching a negative peak of -3.6 percent in three years. These findings are comparable to those for U.S. as well as for U.K.

The results of this study challenge the conventional wisdom regarding the size and effects of tax and spending multipliers. Typically, in a Keynesian framework, the spending multiplier is larger than the tax multiplier. However, empirical studies on Japan's fiscal policy reached a different conclusion. Auerbach and Gorodnichenko (2014) estimate spending multipliers for Japan over a sample period from 1960 to 2012. They find a large spending multiplier, with a short-run impact just below 1.0 and values around 1.5 two to three years after the initial shock¹. Miyamoto, Nguyen and Sergeyev (2018) find that spending multiplier increase to values greater

¹ Auerbach and Gorodnichenko (2014) suggests that fiscal policy in Japan, like other advanced countries, has the capacity to stimulate economic activity, particularly in recession.

than two in the period when the nominal interest rate reached the zero lower bound in Japan. Nevertheless, the size of spending multiplier is smaller than the tax multiplier identified in this study. This suggests that the negative impact of tax increases may be greater than that of spending cuts, especially when considering long-term growth and confidence effects. These findings closely align with Alesina and his co-author's argument that spending cuts (associated with a smaller multiplier) might be preferable to tax increases, implying a larger negative multiplier for taxes in certain situations (Alesina, Favero and Giavazzi,2015).

Economists hold varying opinions on the magnitude of the tax multipliers. Some, notably Kuttner and Posen (2002), have argued that fiscal policy could have been effective in Japan, based on fiscal multiplier estimates, if it had been more aggressively implemented. Others believe the multiplier is small, implying that tax cuts may not significantly boost the economy and might lead to larger deficits without corresponding growth². The lack of consensus partly reflects the difficulty of identifying exogenous fiscal policy shocks made for reasons unrelated to short-term development in outputs(i.e., are not countercyclical actions). The basic problem is one of simultaneity. Changes in taxes are contemporaneously affect GDP but commonly used tax variables such as GDP also contemporaneously drives tax revenues.

Recent literature has addressed the identification problem in two ways. The first approach addressed the identification problem by estimating structural vector autoregression (SVAR). Blanchard & Perotti (2002) modeled the relationship between the reduced-form residuals and the structural shocks using external information on the output elasticity of taxes and assumed that policymakers do not react contemporaneously to output shock. For the US, the study indicates that positive government spending shocks have a positive effect on output, while the effect of a tax shock on GDP typically stands at around one percent. An empirical study on Japan's tax multipliers using SVAR approach resonates with the conclusion of Blanchard & Perotti(2002). For Japan, Watanabe et al. (2010) demonstrates that the effect of tax shock on GDP was less than 1 before 1989 and has been insignificant after then.

The second approach uses narrative records to construct a direct measure of tax shocks. Romer and Romer (2010) scrutinized legislative records, including presidential speeches and congressional reports, to identify the primary motivations behind all legislated tax changes. The so-called narrative approach enables the identification of exogenous tax changes made for reasons unrelated to short-term fluctuations, such as dealing with inherited budget deficits and

² The efficacy of stimulating aggregate demand by using public works is controversial in Japan. Ihori and Terai eds. (2015) pp.7-8 discuss competing argument on the efficacy of the fiscal policy in Japan.

raising long-run growth. They found that 1 percent of tax increase relative to GDP leads to 3 percent reduction in GDP over a two-year period. There is a growing consensus that the narrative approach, as introduced by Romer and Romer (2010) in their study of the United States, provides a more effective means of identifying exogenous tax shocks compared to the Structural Vector Autoregression (SVAR) method developed by Blanchard and Perotti (2002).

That said, the time-consuming nature of constructing datasets through the RR narrative approach, which requires detailed examination of parliamentary proceedings and presidential speeches, has limited its use in studies. Researchers have conducted empirical study on tax multipliers using the narrative approach in countries such as the UK, Germany, Portugal, and Spain, but no studies have focused on Japan³. The methodology used in this study is largely a direct application of previous studies. Nonetheless, the collection of data on the rationale or reasoning behind tax policy changes in a country with a different political and social system, and the construction of long-term data, provide valuable additions for evaluating the validity of the narrative approach. I organize this study as follows: Section II discusses identification strategies for tax changes based on documentation of policy-making processes. Section III provides an overview of new datasets. Section IV estimates the dynamic effect of exogenous tax changes. Section V expands on the specification, examining the transmission channels.

II. IDENTIFYICATION APPROACH

A. Simultaneity problem

One of the key problems in estimating the tax multiplier is simultaneity. Discretionary tax changes can contemporaneously affect GDP, while economic fluctuations also affect commonly used tax measures. To consistently estimate the dynamic effects of a tax shock on output, it is crucial to use 'exogenous tax changes' as predictors. The key identifying assumption is that tax changes are not correlated with the error term (Given x1,x2,...x1,x2,...x1,x2,...,x1 the conditional expectation of the error term is zero). However, discretionary tax changes, which include both exogenous components and policy responses to economic fluctuations, will lead to inconsistent estimates. First, omitted variables may bias the coefficient. Second, tax changes may respond

³ Based on the narrative approach for country specific studies, RR(2010), Cloyne(2013), Hayo and Uhl(2013), Gil *et* al.(2017), and Pereira and Wemans (2013) find a tax multiplier of -2.7, -2, -2.4, -2, and -1.7 (cumulatively) for the U.S., U.K., Germany, Portugal, and Spain, respectively. Gil *et* al.(2017), and Pereira and Wemans (2013) report for Portugal and Spain even more negative tax multiplier for indirect taxation of about -2.7 and -5 (cumulatively) respectively.

to changes in output, reversing causality. Third, even if these concerns are addressed, one might predict tax changes, leading to output changes prior to the tax changes. This study uses a narrative approach by Romer and Romer (2010) to classify all legislated tax changes by motivation, allowing for the direct identification of decisions made for reasons uncorrelated with macroeconomic fluctuations.

B. Narrative Approach for Japan

1.Data Sources.

I used documentation from the policy-making process to identify exogenous tax changes. To construct an exogenous tax series, the first step involved collecting projected revenue impact of discretionary tax policy changes. The author sourced the projected revenue impacts from a detailed table. This table is attached to the 'Outline of Tax Reform (Cabinet Decision),' which has been published by the Ministry of Finance in the Monthly Report of Financial and Monetary Statistics since 1949. However, since 1992, the Ministry of Finance have not publicly shown revenue losses stemming from tax incentives. I sent an information disclosure request to the Ministry of Finance and obtained the relevant data.

The next step involves categorizing the series by motivations. As clues for identifying the motivations of tax reforms, I considered the roles of the ruling party and the bureaucracy. This involves using 'Tax Reform Recommendations' by the Government Tax Commission and the 'Tax Reform Outline' by the Ruling Party. The former serves as an advisory body to the Prime Minister of Japan, responsible for investigating and deliberating on basic tax matters and expressing opinions. The latter is an internal organization within the ruling party, where knowledgeable members of parliament make decisions on specific tax matters. The Ministry of Finance published the documents, and The Japan Tax Association made the documents accessible on their website. Additionally, other documents prove useful, such as the Minister of Finance's speeches in the National Diet and explanations provided by the Tax Bureau of the Ministry of Finance.

The narrative approach involves analyzing consistent, contemporaneous, and correct records that document the circumstances and developments leading to policy decisions. By doing so, it aims to identify the motivations of individual tax reforms based on endogenous and exogenous criteria. In Japan, the relevant records for this approach are the series "History of Fiscal and Monetary Policies in Japan" compiled by The Policy Research Institute of the Ministry of Finance. However, like RR and Cloyne, I take policymakers' intentions at face value.

The goal is not to provide a review from various commentators but rather to present a narrative based on the stated motivations for tax changes. The tax acts themselves specify the implementation dates of tax changes. I consider the date of specific events as the announcement date because it offers consumers and private companies' substantial information about future tax changes. I identified events such as the Liberal Democratic Party tax committee submitting the 'Outline of Tax Reform' to the government as announcements of future tax changes.

2. Classifying the Motivation behind Tax Changes

Following Romer and Romer (2010), I categorize tax changes broadly into two groups: endogenous tax changes and exogenous tax changes. In the online appendix, I classified major discretionary tax changes and present keyword and phrase as criteria of classification. Endogenous tax actions are those taken to counteract developments that would otherwise cause output growth to deviate from normal⁴. This study classified endogenous changes into two categories. The first is 'countercyclical' tax changes. If the policymakers predict the economy will contract and the government cuts taxes to mitigate the recession, this action might respond to both current and projected economic conditions. A classic example is the tax cut in the 1971 supplementary budget. In 1971, one of the measures taken by U.S. President Richard Nixon was the unilateral suspension of the U.S. dollar's convertibility into gold. Consequently, the yen appreciated significantly against the U.S. dollar, adversely affecting Japan's export-driven economy. In anticipation of the severe economic conditions, the Sato cabinet swiftly implemented tax cuts. The other type of endogenous tax changes is spending-driven tax changes. In Japan, it is rare to see tax changes intended to offset the expansionary effect of government spending⁵. This study categorizes spending-driven tax changes as those where tax actions explicitly finance a spending action and assigns this category when there is a clear link between tax changes and spending decisions. A notable example is the increase in the insurance premium rate and the upper limit of the standard monthly reward due to the introduction of the price indexing system in 1973. The automatic revision of benefits to reflect wage and price increases led to a dynamic adjustment of insurance premiums. Another example is the petrol tax earmarked for road repair and construction.

The exogenous tax changes are those made for reasons unrelated to short-term developments in output⁶. The concept of exogenous can be intuitively understood through the

⁴ The 'endogenous tax change' is clearly defined by Romer and Romer (2010),p.769.

⁵ In conjunction with the aggressive taxation enforcement implemented during Dodge's super balanced budget in 1949, income tax effectively served as one of the potent means for curbing inflationary pressures.

⁶ Romer and Romer (2010, p. 770) define the exogenous tax changes.

examples: the tax hike used to fund the redemption of public bonds during the Gulf War in 1990, when the U.S. requested Japan to contribute \$9 billion, addressing the discrepancy in tax rates between imported whiskey and domestic shochu following a WTO ruling in 1997, Disaster Reconstruction Tax to fund the reconstruction efforts after the Great East Japan Earthquake in 2011 driven by fiscal sustainability and equity consideration. More generally I systematically classified exogenous tax changes into four categories. The first type involves tax changes to deal with inherited budget deficits (hereafter, referred to as deficit-driven tax changes). Past economic conditions and fiscal profligacy shape inherited budget deficits, but the current state of the economy does not influence these deficits. A prime example is the 1989 Takeshita Tax Reform, during which the government introduced a Consumption Tax for the first time since World War II. The timing of the deficit-driven tax changes was decided based on the economic assessment clause. However, the inside lag associated with raising the consumption tax rate in Japan is typically longer than expected. It took 12 years to introduce consumption tax, 3 years to raise the tax rate from 3 percent to 5 percent, and 9 years to increase it from 5 percent to 10 percent. The decision to increase the consumption tax rate, choose the type of consumption tax to introduce, attribution of revenue increases to the national and local governments and conduct the legislative procedures was made independently of the macroeconomic conditions at the time.

The second type involves tax changes motivated by a desire to raise long-run growth (hereafter, referred to as long-run tax changes). A representative example is the series of annual personal income tax cuts implemented from the 1950s to the early 1970s. There was no fear of a recession at the time of high growth era. But there is rationale for tax cut the need to cut fiscal drag. The report of government tax committee said that "the current taxation has diminished the preparedness for life-threatening burdens" and "due to high income tax rates and the steep progressivity, the motivation for labor and business among the citizens is hindered, leading to a loss of stimulus for productivity improvement." The report warned that "if all the increases in tax revenue, particularly those from income tax, had been allocated to expenditures," "the scale of the government would have expanded, creating a big government." (Ministry of Finance, "Showa Fiscal History," Volume 6, Taxation, page 127).

Third, I classify certain tax changes as tax incentives. Tax incentives are tax policies designed to achieve specific policy objectives, typically outlined in the Special Tax Measures Law, which is separate from ordinary income tax laws (hereafter, referred to as tax incentives). Tax incentives aim not to restore the economy to a normal level but to raise economic growth by encouraging personal savings, enhancing corporate savings and investment, and promoting exports and overseas investment. To achieve these goals, tax devices such as tax exemptions,

non-taxable reserves, and special depreciation allowances have been introduced into both personal and corporate tax systems. This growth-centric paradigm of tax incentives has endured steadfastly since the waning of the high-growth era in the 1970s, persisting resiliently to adapt to economic decelerations up to the present day. Fourth, tax changes motivated by preservation and restoration of tax principles such as equity, neutrality, simplicity are classified as tax changes driven by tax principle. A good example of this is the tax system based on the 1949 Shoup Recommendations, which emphasized tax equity. Another classic example is the abolition of the tax-exempt savings system in the 1989 Tax Reform. Policymakers believed that abolishing the tax-exempt savings system was fairer. It is important to note the similarities with the RR categories. Countercyclical is the same category. Spending-driven is similar but more restrictive. Long-run and deficit-driven tax changes are the same categories. Tax incentive is a new addition. Tax principle is similar but is differentiated from long-run tax changes rather than being grouped together with it.

3. Key words and wording.

The Japanese case serves as a touchstone for assessing the applicability of the narrative approach beyond the U.S. and the U.K. There are two reasons for this. First, Japan adopts a representative democracy, which structurally differs from that of the U.S. The government sends tax reform proposals to the Diet, and the ruling parties in the Diet often pass these tax reform proposals with few modifications⁷. Second, compared to the UK, Japan's bureaucracy holds a strong influence in policy decisions due to its high prestige and close relationship with the ruling party⁸. As a result, various interest groups and government organizations have diverse ideas, and the goals of the policies themselves can vary widely. Given Japan's unique research background, which differs from other countries, questions may arise about the classification process. In addition to the results of the Granger causality test, I used keywords and wording as objective criteria for classification.

By doing so, the classification process for tax shocks is based not on researchers' experiences or intuition, but on specific keywords or phrases derived from earlier studies, making it inherently a data-driven process. Using keywords and phrases is a classification

⁷ In decision making process of tax policy, the government sends tax reform proposals to the Diet (parliament), and the majority party in the Diet often passes the tax reforms without modification in Japan.

⁸ The Liberal Democratic Party has remained the majority party for the post-war period. As a result, tax reforms in Japan have been incremental, with an exception such as the introduction of the consumption tax in 1989. The role of bureaucracy in Japan is also interesting. Japan's bureaucratic system has a stronger influence on tax reforms compared to that of the U. S. and the U. K.

process where I trained myself to learn from the RR background paper (Romer and Romer 2009) and made classifications based on that source. The RR background paper provides fifty examples of endogenous and exogenous tax changes, helping us to learn the differences, such as economic conditions, motivations, and characteristics of legislated tax acts. It can consistently help to identify, for example, long-run exogenous tax changes. Over time, patterns become recognizable, such as specific phrases ("gave as the rationale for the tax cut the need to eliminate fiscal drag so the economy could grow faster") or certain words ("no fear of recession," "lowered marginal tax rates"). With enough training, one can determine whether they resemble RR's long-run tax changes. The same process applies to other types of exogenous tax changes.

Key words and phrases use large dataset that includes a variety of cases, including clear, grey, and everything in between. In particular, there are grey areas in deficit-driven tax changes in Japan's tax policy. Since the failed attempt to introduce a consumption tax by the Ohira Cabinet in 1978, policymakers have become cautious in publicly using the phrase "raising taxes for fiscal consolidation." Policymakers now typically cite more specific and publicly acceptable reasons, such as "broad and shallow burden," "spreading burden across income, consumption, and assets" or "the enhancement of social security." I learned how different combinations of keyword and phrases are typically associated with the motivation. In the Online Appendix, I present the main keywords and phrases that serve as objective criteria to clarify the classification of tax changes.

4. Transforming the Narrative into time series dataset.

I constructed quarterly time series data of exogenous tax changes from 1955 to 2023⁹. These data are expressed as the change in projected revenue normalized by GDP. I dated the tax changes based on when tax liability changed, not on when firms and households recognized changes in tax¹⁰. This is consistent with literature that finds consumers react to changes in their current disposable income. To convert these specific dates into quarterly time series data, if the

⁹ Real, seasonally adjusted series of quarterly GDP data based on the 2005 standard (2008SNA) includes information from the first quarter of 1994 onwards. For earlier data, I connected it to the "Simplified Backward Extrapolation Series Based on the 2005 Standard," estimated and published by the Cabinet Office. The connection was made by adding the average difference between the 2005 standard data and the simplified backward extrapolated data for the overlapping period to the simplified extrapolated data. Since the simplified backward extrapolated data covers the period from the first quarter of 1980 onwards, we connected it to the 1990 standard data for the years 1955-1999 for earlier data (68SNA). For the overlapping period, I calculated the ratio of GDP under the simplified extrapolated data to that under the 1990 standard data. Using this ratio, I adjusted the 1990 standard data and then merged it with the simplified extrapolated data to create a consistent time series.

¹⁰ Romer and Romer (2010) assigned data on tax changes to the effective date of tax changes. This is consistent with the empirical work of Shapiro and Slemrod (1995).

effective date falls on or before the midpoint of the quarter, I assigned it to that quarter; if it falls after the midpoint, I assigned it to the following quarter. In Section 5, I will adjust the specific effective dates to the quarters when consumers recognized the tax changes, rather than when the liability changed. This study expresses projected revenue impacts at an annual rate. In other words, I use the projected revenue impact in the first full fiscal year following the change. I chose this approach because changes in full-year tax liabilities are more proper indicators than quarterly tax collections reaching the exchequer. Projections of tax changes typically assume that tax revenues do not affect the levels of output. Thus, the change in projected revenue may not necessarily equal the effect of a one-percentage-point change in actual, ex-post revenues to GDP. This limitation is an unavoidable aspect of this type of research.

III. OVERVIEW OF THE NEW DATASET

A. Exogenous Tax Changes

Following the narrative approach pioneered by Romer and Romer (2010), I have identified a total of 588 individual tax change in post war Japan, with 401 classified as exogenous tax changes and 187 as endogenous tax changes. The first step in using this newly compiled dataset involves discussing its key attributes. Panel A of Figure 1 stands for the exogenous tax changes dataset since 1955, revealing both positive and negative alterations in taxes throughout the postwar period. Certain epochs, notably the 1950s to early 1970s and the later 1970s, experienced frequent changes, with quarterly fluctuations of 0.2 to 0.4 percent of GDP being typical¹¹. Panel B of Figure 1 provides a breakdown of exogenous tax changes: deficit-driven and long-run tax changes. The period from the 1950s to early 1970s saw annual income tax cuts aimed at offsetting the suppressive effect of progressive income tax on aggregate demand¹². The comprehensive income tax with a progressive rate structure, including the middle and lower classes in tax net, was established between 1940 and 1950 in Japan. This structural change was driven by the sudden, exogenous forces of wartime mobilization, defeat, and Allied governance. In a growing economy, rising incomes will inevitably push those at the lowest taxable threshold

¹¹ Ministry of Finance (2003,pp.153-159) provides detail information on the context and highlighting more events of relevance about large tax cut in 1974.

¹² Ministry of Finance (1990,pp.125-135) provides detail information on the context and highlighting more events of relevance about annual income tax cut.

into the tax net each year if the tax system remains unchanged and deduction levels are fixed¹³. The government aimed to remove fiscal drags and raise long-run growth by returning natural revenue increases to the private sector (Ishi,1976,pp.368-369; Ihori,2001,pp.63-64).

All deficit-driven tax changes involved tax hikes. As shown in Panel B of Figure 1, these were especially common from the late 1970s to the early 1980s. During this time, while the government adjusted the personal allowance and basic income tax rate for inflation, it Notably, in the 1950s and 1960s, I found no instances where addressing a budget deficit was the primary impetus. The most significant deficit-driven tax increases occurred with the Tax Bills of 1989 and 1994, and the Integrated Reform of Social Security and Taxation in 2012. The first of these, introduced under the Takeshita cabinet, marked the postwar implementation of a comprehensive value-added tax¹⁴. The second significant measure was the 1997 consumption tax increase by the Hashimoto administration, which was announced 30 months earlier in September 1994¹⁵. The third was the 2014 consumption tax increase by the second Abe administration, initially announced in 2012 by the DPJ-led government but later postponed twice.

Panel C of Figure 1 illustrates the evolution of tax changes resulting from tax incentives¹⁶. Initially introduced in the 1950s as temporary measures, these tax incentives were repeatedly extended beyond their original deadlines. Analyzing the revenue shortfalls as a proportion of GDP shows a consistent upward trend until the end of Japan's high-growth era¹⁷. Subsequently, the government deliberately reduced the size of these incentives, a trend that continued until Fiscal Year 2000. The spike in tax incentives series in 2003, driven by research and development tax credits and investment tax deductions, reflects a substantial reduction in taxes amounting to 1.427 trillion yen¹⁸. A decade later, with the launch of economic strategy under Prime Minister Shinzo Abe, known as Abenomics, which aimed to revitalize Japan's economy through monetary easing, fiscal stimulus, and structural reforms, the government reinstated tax incentives, focusing on corporate tax reductions. It is essential to recognize that exogenous tax changes do not show a direct correspondence with business cycles, as evident from Figure 1.

¹³ The percentage of income taxpayers among the population rose from 0.99 percent in 1935 to 17 percent in 1950. By 1970, the percentage of income taxpayers among the population had increased to 29 percent.

¹⁴ Ministry of Finance (2003)ch.3 provides detail information on the context and highlighting more events of relevance about the introduction of value added tax (VAT) in Japan.

¹⁵ Ishi(2008, ch.16) discusses the announcement and implementation of 1997 VAT increase.

¹⁶ Figure 1 omits tax changes drive by tax principles, mainly due to its small sample size.

¹⁷ Revenue shortfalls are defined as year-over-year difference for revenue decrease in Panel C of Figure 1.

¹⁸ The expansion of 2013 tax incentives was justified by two main reasons: (1) there was no room to further lower the basic tax rate, and (2) due to the abundant cash flow of companies, general tax cuts would not effectively stimulate investment (Ishi, 2008, pp. 708-809).

For example, deficit-driven tax changes have been implemented not solely during periods of economic expansion but also amid recessions. Likewise, long-run tax changes do not seem to adhere to specific phases of the business cycle nor align closely with the concurrent state of the economy. The predictability of tax policy based on historical data will be subject to more rigorous investigation in later sections.

B. Endogenous Tax Changes

Panel A of Figure 2 presents our series of endogenous tax changes. The graph shows that while endogenous tax changes occurred throughout the postwar era, significant actions became more frequent after 1990 and were rare before this period. Panel B of Figure 2 breaks down these changes into countercyclical and spending-driven tax changes. The peak of countercyclical tax changes occurred in the 1990s. Prior to this era, only two instances primarily aimed at restoring growth to normal levels were noted. The most substantial countercyclical changes included the reduction in income tax and individual inhabitant tax in the November 1994 tax reform, and the reduction in individual income tax (often referred to as the permanent tax cut) in the 1999 tax revision¹⁹. However, evidence also indicates countercyclical motivations behind the 1965 and 1971 tax cuts²⁰. The former followed the issuance of government bonds for the first time since the war, while the latter was linked to the Nixon shock in 1971. Spending-driven tax changes consistently involved modest tax increases. A significant portion of these changes can be traced to the 1973 introduction of a price indexing system, which raised insurance premium rates and the upper limit of standard monthly remuneration. Additionally, increases in petrol tax, often earmarked for specific projects such as road and airport construction, were not always correlated with adjustments in social security benefits.

It is important to note that, unlike exogenous tax changes, countercyclical tax changes are implemented specifically during periods when the macroeconomy is recovering from a downturn. The predictability of tax policy based on historical data and its impact on output will be examined in more detail in later sections.

C. Testing the Predictability of the Tax Changes

¹⁹ To view more detail about 1998-99 Hashimoto-Obuchi tax cut, visit Ishi (2008) pp.631-638 for detail.

²⁰ Ministry of Finance (1990) pp.309-329 provides detail information on the context and highlighting more events of relevance about 1965 tax cut.

To ensure the consistency of the ordinary least squares estimator for the distributed lag model, exogenous tax changes must not be predictable based on past information. Romer and Romer (2010) define "exogenous tax changes are those not taken for offset factors pushing growth away from normal" (Romer and Romer, 2010, p. 770). Consequently, the definition of exogeneity incorporates an assumption of orthogonality with other contemporaneous structural shocks that influence current output growth, while acknowledging the possibility that tax changes may be predictable based on lagged values of observable variables and may suffer from endogeneity (Mertens and Ravn, 2012). To formally investigate this issue, I present the results of two alternative tests for the predictability of exogenous tax changes.

In the first, I simply regress exogenous tax changes at the time of announcement on lags of the vector of observables X_t (consisting of output, consumption, investment and government spending) and report the outcome of *F*-tests of the hypothesis that the lags of the observables have explanatory power. This test, so called Granger's causality test, examines both the extent to which the size of the tax changes and their timing is predictable. Second, since there are instances of no changes in taxes, I also report the outcome of a test that focuses on the predictability of the timing only. According to Mertens and Ravn (2012) and Cloyne (2013), I performed an ordered probit regression. The underlying latent process is the tax series itself, call this τ_t . Now define policy action dummy variable φ_t as follows,

$$\varphi_t = \begin{cases} -1 & if \quad T_t < 0 \\ 0 & if \quad T_t = 0 \\ 1 & if \quad T_t > 0 \end{cases}$$

Thus, φ_t is a dummy variable that takes on the value -1 when tax cuts are announced, zero when there are no tax liability changes, and the value 1 when tax increases are announced. I estimated the ordered probit model by maximum likelihood with four regressors such as movements of output, consumption, investment, and government spending²¹. This method addresses whether the decision itself is forecastable. Of course, this does not consider the size of the announcement but gives a sense of whether the policy action was a product of economic conditions.

For the both the Granger causality's test and the ordered probit, I conduct the tests using detrended values of X_t and allow for four lags of the X_t and all regressions include a constant

²¹ This study uses four lags of the series such as output, consumption, investment, and spending. I detrended these series using HP filter.

term. Tabel1 reports the *p*-values of the hypothesis of no predictability specified as a test of zero coefficients on the vector of lagged observables. The conclusion is that the hypothesis of no predictability cannot be rejected when considering tests of all exogenous tax changes and their subsets (long-run tax changes, deficit-driven tax changes, tax incentive and tax changes for philosophical reasons). Result of granger causality test for all exogenous tax changes does not reject the null hypothesis, even at a significance level of 10 percent (p-value = 0.47). For the exogenous series, the *p*-value of the Likelihood Ratio statistics was also 0.45, implying that the observables hold no information for forecasting the exogenous tax series²². It is safe to say that the evidence in favor of exogeneity is strong for our exogenous tax changes.

In contrast, I can reject the non-predictability hypothesis when considering tests of all endogenous tax changes and countercyclical tax changes. However, I cannot reject the null hypothesis about spending-driven tax changes. This implies that endogenous tax changes except spending driven tax changes are predictable based on past observables²³. These two tests suggest that the exogenous tax series identified using the documented policy-making process are unforecastable based on past information. Utilizing these exogenous tax changes, I go ahead to estimate the OLS coefficients in the distributed lag model.

IV. THE EFFECT OF TAX CHANGES ON OUTPUT

A. Specifications

Indeed, there is no basis to assume correlation between our exogenous tax series and other determinants of output growth²⁴. Consequently, I have specified a very straightforward model: employing a distributed lag model, I regress output growth on a constant, the contemporaneous value and lags of our exogenous tax changes as follows,

$$\Delta y_t = a + \sum_{j=0}^{12} b_j \Delta T_{t-j} + g D_{sb} + h D_{1974} + e_t \tag{1}$$

 $^{^{22}}$ The results show that the timing of deficit-driven tax changes can be predicted using past information(p-value = 0.018). This suggests that the timing of the announcements was chosen with an eye on economic conditions at the time. However, recognizing the need to increase the consumption tax rate, deciding on the type of consumption tax to introduce, and conducting the legislative procedures were decided independently of macroeconomic conditions.

²³ In Japan, it is rare to see tax changes intended to offset the expansionary effect of government spending . This study categorizes spending-driven tax changes as those where tax actions explicitly finance a spending action and assigns this category when there is a clear link between tax changes and spending decisions.

Where y_t is the logarithm of real output and ΔT_{t-j} is exogenous tax changes. D_{sb} denotes shift dummy where,

$$D_t = \begin{cases} 1 & if \quad t < 1970Q3 \\ 0 & if \quad t > 1970Q4 \end{cases}$$
(2)

To estimate the time series data, I conducted a sequential test for multiple breaks at unknown breakpoints (Ditzen, Karavias, and Westerlund, 2021). Structural changes were detected in 1970Q3, 2001Q3, and 2011Q2, all significant at the 1% level. I introduced three dummy variables into the regression model, each representing a regime shift at one of these breakpoints. Since only the shift dummy for 1970Q3 was significant in specification (1), I assume a single structural change, with a shift dummy D_{sb} set to 1 before 1970Q3 and 0 otherwise.

It is natural to ask whether the outliers of exogenous tax changes influence the estimation results. I identified outliers in a dataset using two statistical methods: (i) setting thresholds (e.g., $\mu \pm 2\sigma$) and identify data points outside this range as outliers, (ii) identifying data points with Z-scores outside the chosen threshold (e.g., \pm 3) as outliers. The outliers separately identified by the two methods were consistent, specifically in the quarters 1974Q2, 1981Q2, 1997Q2, 2014Q2, and 2019Q4. Compared to the regression model using the entire dataset, including 1974Q2, the model's performance improved with the introduction of a dummy variable for 1974Q2. This suggests that the so-called two trillion-yen tax cut implemented by the Tanaka Cabinet is an outlier. In the following, I added it as D_{1974} . Adding control variables to specification (1) is crucial. The first plausible candidate for an omitted variable would be the lagged term of the GDP growth rate.

$$\Delta y_{t} = a + \sum_{i=0}^{M} b_{j} \Delta T_{t-j} + \sum_{i=1}^{N} c_{i} \Delta y_{t-i} + g D_{sb} + h D_{1974} + e_{t}$$
(3)

Including lagged output growth serves the purpose of controlling for the typical dynamics of output. Moreover, given the likelihood of serial correlation among several factors influencing output growth, incorporating lagged output growth helps mitigate the influence of a multitude of other factors. For our third specification, I conduct a four-variable vector regression (VAR) incorporating output, consumption, investment, and our exogenous tax changes. I estimated the effects of a tax shock using following VAR:

$$\boldsymbol{X}_{t} = \boldsymbol{A}_{0} + \boldsymbol{B}(\boldsymbol{L})\boldsymbol{X}_{t-1} + \boldsymbol{C}(\boldsymbol{L})\Delta T_{t} + \boldsymbol{A}_{1}\boldsymbol{D}_{sb} + \boldsymbol{e}_{t}$$

$$\tag{4}$$

where B(L) and C(L) represent lag polynomials with P and (Q+1) lags, respectively. These lag polynomials capture the dynamics of the variables in the model over time. The exogenous variable ΔT_t , standing for tax changes, is included in the model as an exogenous factor. This follows the discussion and method outlined in Mertens and Ravn (2012) and Cloyne (2013). Additionally, the inclusion of narrative shocks as exogenous variables aligns with the narrative approach to analyzing government spending shocks as discussed in Burnside, Eichenbaum, and Fisher (2004). Following RR, I use twelve lags of ΔT_t and the contemporaneous value. In addition, I take P = 4 which is common. The baseline estimation includes the log of real per capita GDP (y_t) , consumption (c_t) , and investment (i_t) , Thus $X_t = [y_t, c_t, i_t]'$.

B. Baseline Estimation

The baseline estimate suggests that exogenous tax changes have a significant and lasting impact on output. Figure 3 shows the results of specification (3) using an autocorrelation-distributed lag model (ADL(12,12)) with a HAC standard error band. A 1 percent tax change leads to an initial 1.5 percent decline in output, followed by a gradual decrease, reaching a peak negative effect of -3.6 percent in the 12th quarter. The point estimate becomes significantly different from zero after the 8th quarter, highlighting the substantial impact of tax changes on economic activity. Notably, these baseline results are consistent with findings from Romer and Romer (2010) and Cloyne (2013). Given that most identified exogenous tax changes are reductions, the results suggest that such cuts lead to substantial and persistent positive effects on output.

Figure 4 presents the results from specification (4) using a Vector Autoregression (VAR) model. The graph shows the responses of output, consumption, and investment to a one-unit shock in the tax series, with a HAC standard error band. Panel A of Figure 4 illustrates the response of exogenous tax changes to a 1 percent shock in output, where the tax changes fluctuate between zero and -0.013, with a narrow confidence interval, indicating minimal responsiveness to output shocks. Panel B of Figure 4 reveals that real output decreases by 1.3 percent immediately after a 1 percent shock in the exogenous tax series, gradually declining to a low of - 4.4 percent after the 11th quarter. The stronger output response in the VAR model aligns closely with results from a distributed lag model, highlighting that exogenous tax changes significantly impact economic activity.

Considering the effect of both endogenous and all legislated tax changes on output is a natural extension, given their correlation with other output-influencing factors. If policymakers were success fully adjusting taxed in response to information about other forces affecting the economy, countercyclical tax changes would be positively correlated with other influences on output growth, and so regression of growth on the countercyclical or endogenous changes would yield estimates with positive bias. I observed this. Figure 5 shows the results of specification (4) using an alternative measure that includes both endogenous and all legislated tax changes. Panel A of Figure 5 indicates that the output response to all legislated tax changes is smaller than that to exogenous tax changes, with the largest estimated decline in GDP growth being -2.3 percent after the 11th quarter, compared to -4.4 percent for exogenous changes. This difference is due to the inclusion of endogenous tax changes. Panel B of Figure 5 shows that endogenous tax changes result in minimal output fluctuations around zero percent, with few significant estimates.

From the preliminary results, two key observations emerge: first, exogenous tax changes, unaffected by economic conditions, have a significant impact on economic activity; second, the definition of tax changes is crucial, as including endogenous changes obscures their effects.

C. Robustness Check

In this section, I assess the robustness of earlier findings. First, I evaluate whether the Newey-West standard errors are affected by the choice of the HAC truncation parameter. Using the rule $m = 0.75T^{1/3}$, where T is the number of observations, the truncation parameter is rounded to m=5 for 245 quarterly observations. Panel A of Figure 6 shows results using m=10, double the baseline value. Variations in truncation parameters have minimal impact on the estimated effects of exogenous tax changes. Although slight differences in standard errors exist, they are not statistically significant. Notably, tax changes have substantial and lasting effects on output.

Given the potential omission of government spending in the baseline estimation, it's important to consider its impact. While exogenous tax changes are identified through policy documentation, including government spending in the error term could correlate tax changes with the error term. For example, deficit-driven tax changes may occur independently but are often accompanied by spending cuts. In this analysis, I defined changes in government spending as the actual change in spending minus interest payments, divided by real GDP, including a lag term up to period 11. Panel B of Figure 6 shows that controlling for government spending has minimal impact on the baseline estimation of tax changes on GDP. A one percent tax change

leads to an immediate 1.6 percent reduction in output, with the decline peaking at -3.8 percent in the 11th quarter.

v. THE EFFECT OF THREE TYPES OF TAX CHANGES

Our current findings suggest that exogenous tax changes have a significant and enduring impact on output. It is essential to go beyond the reduced form of outcomes and clarify the transmission mechanisms involved. This section expands on the earlier baseline specifications in three areas: disaggregating exogenous tax changes into subcategories, analyzing the transmission channels affecting GDP components, and examining the role of expectations (in appendix²⁵).

A. Different Impacts on Output

Our measure of exogenous tax changes comprises tax change with four categories of motivations: deficit-driven tax changes, long-run tax changes, tax incentives, and tax changes driven by tax principles. It is natural to consider the impact of each of these types of exogenous tax changes on output separately. Among the four subcategories, I will omit the fourth one, tax changes driven by tax principles, due to the small sample size and limited amounts involved. First, long-run tax changes and deficit-driven tax changes different effects on the trajectory of output. Panel A of Figure 7 shows that the effects of long-run tax changes are qualitatively like those of exogenous changes. One percent of tax changes is associated with -0.3 percent decline in output immediately, then it gradually declines to reach a negative peak of -4.4 percent in the 11th quarter. All the point estimates are significant, suggesting that long-run tax changes have a large, persistent positive impact.

Second, the results are particularly intriguing when considering deficit-driven tax changes. Households may engage in arbitrage behavior, such as accelerated purchases of durable goods and stockpiling of storable items, at once before and after a price change. Panel B of Figure 7

²⁵ The findings can be summarized in the following two points. (1) GDP does not respond to announcements of long-term tax changes. The initial impact of the policy at the time of implementation is slightly negative but turns positive after 6th quarter, peaking at 9.7 percent in the 12th quarter. The estimated impact of tax policy announcements shows insignificant point estimates, which does not support the permanent income hypothesis. (2) GDP reacts strongly to announcements of deficit-driven tax changes. The impact of the policy at the time of implementation peaks at -3.9 percent in 10th quarter. With policy announcements, it peaks at 7.4 percent in the 12th quarter, driven by short-term arbitrage behaviors, such as accelerating durable goods purchases or stockpiling storable goods before and after price changes. For more details, please refer to the appendix.

shows that tax changes are associated with a sharp fall in output upon implementation. The cumulative effect of a 2.5 percent decrease in GDP lasts for two years, after which it dissipates. These findings are consistent with Cashin and Unayama (2021)²⁶. The small output response suggests that the reaction to deficit-driven tax changes is induced by arbitrage rather than more persistent factors, such as large intertemporal substitution of consumption. One might be concerned that the negative effects on output are underestimated because output contemporaneously affects the timing of deficit-driven tax changes. However, Section 3.3 shows that both the Granger causality test and the ordered probit indicate that we cannot reject the hypothesis that the observables (lags of output, consumption, and investment) contain no information for forecasting deficit-driven tax changes.

Third, the effect of tax incentives is noteworthy. The government has employed tax incentives to achieve specific policy goals, of which second-largest share is related to the promotion of business saving and investment. The tax devices used to promote these activities include 1) tax exemption and credit for export industry²⁷, 2) tax-free reserve for enhancement of corporate internal reserves²⁸, and 3) accelerated depreciation for renewal of corporate machinery and equipment²⁹. The result of this study shows that tax incentives to promote business savings and investments have a substantial effect on output³⁰. Panel C of Figure 7 illustrates the results of specification (3) using these tax incentives as tax changes. It shows that tax changes are associated with a sharp fall in output, reaching negative peak in third quarter. Output returns to its earlier long-run level over a period of two years.

B. Transmission Channels

Thus far, our findings show that long-run tax changes yield large effects on output. This prompts the natural inquiry into the mechanisms or reasons underlying such pronounced effects. To

²⁶ Cashin and Unayama (2021) finds that spending on a wide range of durables and storable surged in the months prior to the tax rate increase, fell sharply upon implementation, but returned to their earlier long-run levels within a few months.

²⁷ Tax exemption for export industry is an amount deducted as a loss from export revenue and is equivalent to "export subsidies," which are stipulated to be abolished under Article 16 of the GATT.

²⁸ Tax-free reserves consist of retirement benefit reserve, unmanageable debt provision and price fluctuation reserve. The price fluctuation reserve is considered part of kept earnings and is viewed as a non-taxable item that raises concerns.

²⁹ The special depreciation system gives taxpayers the privilege of deferring corporate tax payments according to their investments in fixed assets. This is equivalent to the government giving the taxpayer an interest-free loan equivalent to the amount of the deferred tax payment. As Komiya (1975) points out, the effect of the special depreciation on capital accumulation and thereby output is large.

³⁰ Hereafter, I use 'tax incentives to promote business savings and investments' as a subset of tax incentives..

address this inquiry, I analyze the responses of various components of GDP, such as consumption and investment, to our metric of long-run tax changes. Additionally, I investigate the reactions of GDP components to the subset of our exogenous tax changes. Our model mirrors Specification (3) outlined in Section 4.1. I employ a four-variable vector autoregression (VAR) with output, consumption, investment, and our subsets of exogenous tax changes.

Figure 8 shows that long-run tax changes can have a significant impact on output. Panel A shows that consumption immediately decreases by 0.3 percent in response to an increase in income tax, gradually reaching a negative peak of - 4.4 percent by the 11th quarter. All point estimates are statistically significant. Income taxes have been cut every year rather than increased, so the tax changes are considered to have raised growth rate from the demand side by mitigating the fiscal drag on household buying power. Next, Panel B shows the effect of long-run tax changes on investment. None of point estimates are significant, suggesting that main transmission channels of long-run tax changes are consumption. This suggests that returning natural revenue increases to the private sector in the form of tax cuts offsets the suppressive effect of progressive income tax on aggregate demand in a growing economy, thereby alleviating fiscal drag and enhancing growth.

The estimated results on deficit-driven tax changes are intriguing when compared to the impact on consumption by long-run tax changes. Panel C of Figure 8 shows the estimated response of consumption to deficit-driven tax changes. The primary conduit through which deficit-driven tax changes affect output is consumption. The result is like those from Panel C of Figure 7. Tax changes are associated with sharp fall in consumption upon implementation of tax changes. The cumulative effect of a 2.8 percent decrease in GDP lasts for three years³¹. The only notable difference is that response of consumption is larger and more prolonged. The reduction in consumption resulting from tax changes is equal to the extent of the tax rate hike (the inflation rate). This implies that the intertemporal elasticity of substitution is low and, at the very least, not greater than one as Cashin and Unayama (2016) points out³². Deficit-driven tax changes primarily affect consumption rather than investment. Panel D of Figure 8 shows the response of investment to tax changes, showing that none of point estimates are significant.

³¹ Acosta-Ormaechea and Morozumi (2021) investigates the effect of VAT increase on output. The article shows that a revenue-neutral rise in the VAT promotes growth when it is raised through a rise in C-efficiency, while it does not when it is raised through a rise in the standard VAT rate. Gunter et al.(2019) find that the effect of value added taxes (VAT) on growth are highly non-linear: At low rate with minor changes, the effect is zero.

³² Cashin and Unayama(2016) makes progress in estimating the intertemporal elasticity of substitution in consumption(IES) using an increase in the Japanese consumption tax rate as a natural experiment, showing that point estimate of the IES is significantly small (0.21).

The effect of tax incentives to promote business saving and investment is noteworthy. The results of this study support the idea that tax incentives have a substantial effect on investment. Panel F of Figure 8 shows that tax incentives lead to a sharp decline in investment, and their effects are not temporary but have lasted for approximately two years, suggesting that tax incentives lead to substantial increase in investment³³. Panel E of Figure 8 also shows that response of consumption to tax incentive is not significant at all, suggesting that the main transmission channels of tax incentive is investment. These findings are consistent with the findings of earlier studies on the impact of the special depreciation system on private investment. It gives taxpayers the privilege of deferring corporate tax payments according to their investments in fixed assets which is equivalent to the government giving the taxpayer an interest-free loan equivalent to the amount of the deferred tax payment. On the one hand, the special depreciation system increases the profitability of investments in fixed assets to which it applies (profitability effect), and the other hand, it provides investment funds to companies that have invested in the form of depreciation expenses (liquidity effect) promotes investment from two aspects. As Komiya (1975) points out, the investment promotion effect of the special depreciation system is large in Japan.

VI. CONCLUSION

This study constructs a novel dataset on tax shocks and estimates the tax multiplier in Japan using a narrative approach. Analyzing 104 tax reforms from 1955 to 2023, I identified 588 discretionary tax changes—401 exogenous and 187 endogenous. The impact of exogenous tax shocks on output is large and persistent, with typical SVAR estimates being smaller³⁴. This study finds that a 1 percent tax change leads to a 1.5 percent initial decline in output, peaking at a 3.6 percent decrease in the 12th quarter. These findings are comparable to those for U.S. and U.K. The results of this study challenge the conventional wisdom regarding the size and effects of tax and spending multipliers. The size of spending multiplier is smaller than the tax multiplier identified in this study. This suggests that the negative impact of tax increases may be greater than that of spending cuts, especially when considering long-term growth and

³³ Of course, different taxes may have different effect. Many researchers have conducted empirical study on the marginal effective tax rate of corporate income tax in Japan. These found that since the beginning of the 2000s, the impact of the marginal effective tax rate on investment has become insignificant.

 $^{^{34}}$ Based on the SVAR approach, Blanchard and Perotti (2002) and Watanabe *et.* al.(2010) finds tax multipliers of range between -0.78 and -0.86 for the U.S. and range between -0.56 and 0 for Japan, respectively.

confidence effects.

Exogenous tax changes significantly boost output, particularly through long-term tax cuts aimed at raising long-run output. This aligns with previous research. Easy money/government austerity policy mix³⁵ is thought to boost growth by raising savings(accumulation) rates (Komiya 1975, pp.24-30; Tachi 1993, pp.48-50). On the demand side, in a rapidly growing economy, the income elasticity of revenue from progressive income taxes is substantially greater than one. Without periodic tax cuts, the ratio of tax revenue to GDP would increase rapidly with economic growth. Returning natural revenue increases to the private sector in the form of tax cuts is thought to offset the suppressive effect of progressive income tax on aggregate demand, thereby alleviating fiscal drag and enhancing growth (Ishi 1976, pp.364-369). Deficit-driven tax changes also have a substantial and lasting impact, leading to a sharp consumption decline and a cumulative 2.8 percent decrease in GDP over three years. This suggests a low intertemporal elasticity of substitution, as highlighted by Cashin and Unayama (2016). Post-war tax policies have consistently aimed to spur economic growth by encouraging savings, investment, and exports. These tax incentives, especially those promoting business savings and investment, have had a significant positive effect on output. However, consumption response to tax incentives is minimal, suggesting investment is the main transmission channel.

These findings reflect the average impact of exogenous tax changes, focusing on central government taxes. Local taxes, which largely overlap with central taxes except for property tax ³⁶, and the lack of continuous quarterly data on tax incentives since 2008 ³⁷, present opportunities for future research. Narrative data could provide valuable insights in these areas.

[Acknowledgements]

³⁵ Regarding fiscal policy, the principles of sound finance and the restriction on the issuance of government bonds were established. According to these principles, expenditures were to be covered by revenue other than government bonds, with the exception that 'construction bonds' could be issued specifically for public works projects (Fiscal Law, Article 4). The issuance of a large volume of government bonds began only after the first oil crisis in 1975.

³⁶ See, for example, Mochida (2008) for intergovernmental fiscal relations in Japan.

³⁷ In the tax reform of fiscal year 2010, measures were established to conduct surveys to understand the actual application of special tax measures and to report the results to the National Diet. The corporation is required to submit details of the applied amounts to the tax office. By aggregating the applied amounts of tax special measures as stated in the submitted detailed application forms, the application status of tax special measures becomes apparent, and their effectiveness can be verified. This law does not apply to individual income taxes.

This paper was presented at 79th annual congress of International Institute of Public Finance (held at Utah State University, Logan, USA) on 14, August, Public Finance workshop held in University of Tokyo, on 12, March 2023 and Research Group on Local Public Finance within the Local Public Finance Association held on 11, June 2024. I thank Shafik Hebous, Benito Salomao, Niels Jørgen Mau Pedersen, Atsuyoshi Morozumi, Qing Rui, Yasushi Iwamoto, Hikaru Ogawa, Masayoshi Hayashi ,Yasuhiro Sato, Hideaki Sato, Masahisa Hayashi, Akira Yokoyama and other participants for helpful comments and discussion. The responsibility for any errors contained in this manuscript lies with the author.

[Conflict of Interest Disclosure]

I gratefully acknowledge the financial support from the JSPS Grant-in-Aid for Scientific Research(KAKENHI), Grant Number 21K01527. The author has no financial arrangements that might give rise to conflicts of interest with respect to the research reported in this paper.

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Note: The shaded areas indicate periods of recession as recognized by the Cabinet Office. Tax incentive series from 2008 onward are missing. Figure 1 omits tax changes drive by tax principles, mainly due to its small sample size.

Figure 2. Endogenous Tax Changes



Note: The shaded areas indicate periods of economic recession as recognized by the Cabinet Office.

	All exogenous tax changes	
	Test statistics	<i>p</i> -value
Granger causality	3.51	0.47
Ordered probit	20.86	0.45
	long-run tax changes	
Granger causality	8.23	0.83
Ordered probit	2.04	0.84
	deficit driven tax changes	
Granger causality	4.71	0.31
Ordered probit	13.57	0.02
	tax incentive	
Granger causality	6.33	0.17
Ordered probit	2.83	0.73
	philosophical tax changes	
Granger causality	3.42	0.48
Ordered probit	0.88	0.97
	All endogenous tax changes	
Granger causality	13.6	0.009
Ordered probit	10.6	0.058
	countercyclical tax changes	
Granger causality	13.9	0.007
Ordered probit	10.4	0.063
	spending driven tax changes	
Granger causality	6.52	0.163
Ordered probit	4.06	0.541

Table1 Tests for Exogeneity of Tax Changes

Notes: The table reports the outcome of tests of nonpredictability of the tax changes dated by their announcements. The rows denoted probit contain the p-value of likelihood ratio tests of the null hypothesis. The rows denoted granger causality contain the p-value of F-tests of the null hypothesis. The vector Xt include linearly detrended logarithms of output, investment, consumption and government spending.

Figure 3 Estimated Impact of 1 Percent Exogenous Tax Changes on Output



Note: This figure shows the results of estimating specification (3) by displaying the result of autocorrelation-distributed lag model (ADL(12,12)) with controlling lagged GDP. Dashed line is 68 percent confidence interval.





Note: this figure displays the results of estimation of specification (3). Panel A shows the response of exogenous tax changes to output. Panel B shows the response of output to the exogenous tax changes. Grey areas are 68 percent confidence intervals. 'Tax' showed exogenous tax changes.

Figure 5. Results of VAR for all legislated tax changes and endogenous tax changes



Note: this figure displays the results of estimation of specification (3). Panel A. shows the response of output to all legislated tax changes. Panel B shows the response of output to endogenous tax changes. Grey areas are 68 percent confidence intervals. 'Tax' shows exogenous tax changes.

Figure 6 Robustness check



Panel A. Reponse of GDP to Tax (number of trancation parameter=10)



Note: Panel A. shows the result of specification (3) by changing truncation parameters to ten. Panel B. shows the result of specification (3) with controlling government spending. Dashed line is 68 percent confidence intervals. 'Tax' shows exogenous tax changes.



Figure 7. Result of VAR for subcategories of Tax Changes

Note: this figure displays the results of specification (4) using VAR. Panel A. shows the response of output to counter cyclical tax changes. Panel B shows the response of output to long-run tax changes. Panel C. shows the response of output to deficitdriven tax changes. Panel D shows the response of output to tax incentives to promote business savings and investments. Grey areas are 68 percent confidence intervals.



Figure 8. Response of Consumption and Investment

Note: this figure displays the results of specification (4) using VAR. Panel A. shows the response of consumption to long-run tax changes. Panel B shows the response of investment to long-run tax changes. Panel C. shows the response of consumption to deficit-driven tax changes. Panel D shows the response of investment to deficit-driven tax changes. Panel E. shows the response of consumption to tax incentives to promote business savings and investments. Panel F. shows the response of investment to tax incentives to promote business savings and investments. Grey areas indicate 68 percent confidence intervals.

APPENDIX: ROLL OF EXPECTATION

So far, estimation has focused on exogenous tax changes recorded at their implementation quarter, assuming consumers base their decisions on current income. However, this approach overlooks expectation effects. The permanent income hypothesis suggests that while consumers might react to tax announcements, they may not adjust behavior immediately upon implementation. Consumers are believed to update their views during key events, such as: (1) the Prime Minister's tax advisory commission making recommendations, (2) the Liberal Democratic Party tax committee submitting the reform outline, (3) the Cabinet approving the proposal, and (4) the Diet passing the bill. I consider the second event—the submission of the reform outline—as the main announcement, providing significant information about future tax changes.

$$\Delta y_{t} = a + \sum_{i=0}^{M} b_{i} \Delta T_{t-i} + \sum_{j=0}^{M} c_{j} \Delta T_{t-j}^{e} + \sum_{k=1}^{N} d_{k} \Delta y_{t-k} + g D_{sb} + e_{t}$$
(5)

Specification (5) builds on the distributed lag model from specification (3) by including exogenous tax changes ΔT_{t-i} , lagged GDP growth terms, and the discounted present value of future tax changes ΔT_{t-j}^{e} .³⁸ In permanent income hypothesis models, the coefficient for c_{j} is expected to be negative, showing no immediate response to a tax increase. However, models focusing on substitution effects may show a positive c_{j} due to anticipatory behavior like accelerated durable goods purchases. After implementation, \mathcal{L}_{i} might turn negative due to reduced work incentives and durable goods purchases. Additionally, news of a tax hike could enhance confidence in the government's fiscal health, opposing the permanent income hypothesis.

Panel A of Figure 9 illustrates the impact of long-term tax changes, including expectation effects. The solid line shows the effect when taxes are implemented, holding the present value of changes constant at announcement. The effect size is large, peaking at - 9.7 percent from the sixth quarter onward, supporting studies that over 80 percent of Japanese consumers react to implemented tax changes rather than announcements. The dashed line, representing the effect of announcements while holding enacted changes constant, shows no significant point estimates, suggesting the permanent income hypothesis may not hold. Conversely, announcing deficit-

³⁸ I calculate the present discounted value of tax changes at the time of the announcement using discount rate of 3 percent.

driven tax changes significantly impacts output. Panel B of Figure 9 examines deficit-driven tax changes with expectation effects. The solid line shows the effect of these changes while keeping the present value constant at announcement, leading to a -3.9 percent output decline by the 10th quarter. The dashed line, showing the effect of news about future deficit-driven changes while holding enacted changes constant, peaks at 7.4 percent by the 12th quarter. This suggests households may accelerate purchases or stockpile goods before and after a tax hike³⁹. After implementation, deficit-driven tax changes sharply reduce output. The negative coefficient for enacted changes and the positive coefficient for announcements contradicts the permanent income hypothesis.

Figure 9. Tax changes dated at the time of implementation and announcement.







³⁹ Despite a potential decrease in consumption following the announcement of a tax increase, it stays plausible that a portion of this decrease could be mitigated by accelerated purchase of durables. Cashin and Unayama (2016) saw a significant decline in the consumption of non-durable goods, such as perishable food items and utility expenses, following Prime Minister Abe's confirmation of the scheduled tax hike in October 2013. Subsequently, consumption levels have exhibited a sustained downward trend.

Note: This graph depicts the estimation results of expanded specification of distributed lag model (specification 3). The solid line shows the effect of tax changes at the time of implementation on output. The dashed line shows the effect of the discounted present value of tax changes at the time of announcement. Panel A shows the effect of long-run tax changes, Panel B depicts the effect of deficit-driven tax changes on output. Sixty-eight percent of confidence interval.