DISCUSSION PAPER SERIES

No. 9631

HETEROGENEOUS CONSUMERS AND FISCAL POLICY SHOCKS

Emily Anderson, Atsushi Inoue and Barbara Rossi

INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP9631.php**

ISSN 0265-8003

HETEROGENEOUS CONSUMERS AND FISCAL POLICY SHOCKS

Emily Anderson, Duke University
Atsushi Inoue, North Carolina State University
Barbara Rossi, ICREA-Universitat Pompeu Fabra, BGSE, CREI and CEPR

Discussion Paper No. 9631
September 2013

Centre for Economic Policy Research
77 Bastwick Street, London EC1V 3PZ, UK
Tel: (44 20) 7183 8801, Fax: (44 20) 7183 8820
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 9631

September 2013

ABSTRACT

Heterogeneous Consumers and Fiscal Policy Shocks*

This paper studies stylized empirical facts regarding the effects of unexpected changes in aggregate macroeconomic fiscal policies on consumers that are allowed to differ depending on their individual characteristics. We use data from the Consumption Expenditure Survey (CEX) to estimate individual-level impulse responses as well as multipliers for government spending and tax policy shocks. The main empirical finding of this paper is that unexpected fiscal shocks have substantially different effects on consumers depending on their age, income levels, and education. In particular, the wealthiest individuals tend to behave according to the predictions of standard RBC models, whereas the poorest individuals tend to behave according to standard IS-LM (non-Ricardian) models, due to credit constraints. Furthermore, government spending policy shocks tend to decrease consumption inequality, whereas tax policy shocks most negatively affect the lives of the poor, more so than the rich, thus increasing consumption inequality.

JEL Classification: D1, E21, E4, E52, H31 and I3
Keywords: fiscal policy, government spending shocks, heterogeneity and tax shocks

Emily Anderson
Duke University
Social Sciences 213
419 Chapel Drive, Box 90097
Durham, NC 27708-0097
USA

Email: emily.anderson@duke.edu

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=177514

Atsushi Inoue
Dept. of Agriculture and Resoure Econ.
North Carolina State University
Campus Box 8109
Raleigh, NC 27695-8109
USA

Email: atsushi@unity.ncsu.edu

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=158326

Barbara Rossi
CREI
Universitat Pompeu Fabra
Carrer Ramon Trias Fargas
25-27, Mercè Rodoreda Building
08005 Barcelona
SPAIN

Email: barbara.rossi@upf.edu

*We thank V. Ramey and D. Romer for sharing their data and replication codes, as well as J. Gali, J. Leahy, K. Mertens, S. Schmitt-Grohe, S. Zubairy and seminar participants at the 2011 Canadian Economics Association Conference, the 2011 Exchange Rate Conference at Duke, the 2012 SED conference, the Federal Reserve Bank of St. Louis, Duke, UPF, Goethe and Ohio State Universities for comments. The authors gratefully acknowledge financial support from NSF grants # 1022159 and 1022125.

Submitted 26 August 2013

Heterogeneous Consumers and Fiscal Policy Shocks

Emily Anderson	Atsushi Inoue	Barbara Rossi*
Duke	*NC State*	*ICREA-UPF,*
University	*University*	*BGSE, and CREI.*

First Draft: February 2011. This Draft: August 2013

Abstract: This paper studies stylized empirical facts regarding the effects of unexpected changes in aggregate macroeconomic fiscal policies on consumers that are allowed to differ depending on their individual characteristics. We use data from the Consumption Expenditure Survey (CEX) to estimate individual-level impulse responses as well as multipliers for government spending and tax policy shocks. The main empirical finding of this paper is that unexpected fiscal shocks have substantially different effects on consumers depending on their age, income levels, and education. In particular, the wealthiest individuals tend to behave according to the predictions of standard RBC models, whereas the poorest individuals tend to behave according to standard IS-LM (non-Ricardian) models, due to credit constraints. Furthermore, government spending policy shocks tend to decrease consumption inequality, whereas tax policy shocks most negatively affect the lives of the poor, more so than the rich, thus increasing consumption inequality.

*Corresponding author: Barbara Rossi, CREI, Universitat Pompeu Fabra, c. Ramon Trias Fargas 25-27, Mercè Rodoreda bldg., 08005 Barcelona, Spain.

Acknowledgments. We thank V. Ramey and D. Romer for sharing their data and replication codes, as well as J. Gali', J. Leahy, K. Mertens, S. Schmitt-Grohe', S. Zubairy and seminar participants at the 2011 Canadian Economics Association Conference, the 2011 Exchange Rate Conference at Duke, the 2012 SED conference, the Federal Reserve Bank of St. Louis, Duke, UPF, Goethe and Ohio State Universities for comments. The authors gratefully acknowledge financial support from NSF grants # 1022159 and 1022125.

J.E.L. Codes: E4, E52, E21, H31, I3, D1.

1 Introduction

Most of the macroeconomic literature relies on the representative agent paradigm. The assumption of a representative agent is generally made for technical simplicity, since the solution of dynamic models with heterogeneous agents is computationally challenging. However, the study of aggregate data might provide the incorrect evaluation of economic theories. For example, Attanasio and Weber (1993) demonstrate that the use of microeconomic data can overturn rejections of consumer intertemporal optimization models based on aggregate data. In addition, the assumption comes at the cost of preventing the analysis of important questions such as whether economic policies equally affect individuals with different characteristics, whether they influence inequality, or what are the macroeconomic consequences of aggregate fluctuations on the welfare of individuals that differ in their consumption patterns. In other words, while the representative agent assumption allows macroeconomists to study how average values of macroeconomic variables are affected by economic policies, it does not allow them to study how these policies affect the distribution of such variables across households.

This paper focuses on studying the effects of unexpected changes in aggregate macroeconomic policies on consumers that are allowed to differ depending on their individual characteristics. We ask the questions: "Do fiscal shocks affects individuals differently? And, if so, how?". Fiscal policy analysis is an especially important area of macroeconomics since it has direct implications for consumers' welfare.[1] The literature has extensively studied the effects of government spending and tax policy shocks on aggregate macroeconomic variables; one of the approaches, which we focus on, has been narrative – see Ramey and Shapiro (1998), Ramey (2009, 2011a), and Romer and Romer (2010).[2] The narrative approach uses narrative records (such as presidential speeches and newspapers) to identify the timing and magnitude of major fiscal changes, and identifies fiscal shocks as those changes that were

[1] Although our paper does not directly provide a welfare analysis, it provides an analysis of the effects of fiscal policy "shocks" on one of the most important consumers' variables, namely their consumption.

[2] See also Edelberg, Eichenbaum, and Fisher (1999), Burnside, Eichenbaum, and Fisher (2004), Cavallo (2005), Perotti (2005, 2007) and Rossi and Zubairy (2011) for related papers. Ramey (2011b) provides an extensive review of the literature.

taken for reasons exogenous to the business cycle. However, since these analyses focus on aggregate data, by construction they only provide an estimate of the average response of agregate macroeconomic variables to fiscal shocks (on average across individuals), while being uninformative regarding heterogeneity across individual responses. Realistically, fiscal shocks may affect individuals differently depending on their individual-specific characteristics, such as income, education, or age. Studying whether this is the case, and who gains and who loses from unexpected changes in government spending and tax policy is the main focus of this paper. An additional benefit of using household level data besides analyzing heterogeneity is that we can avoid the so-called "aggregation bias", unavoidable in aggregate data where researchers have no control over the aggregation process. We evaluate the empirical importance of the aggregation bias and analyze its implications for the analysis of fiscal policy shocks on aggregate behavior.

The main empirical finding of this paper is that unexpected government spending and tax policy shocks have substantially different effects on consumers depending on their age, income and education levels. Our empirical evidence is based on a narrative approach, and in particular a Vector Autoregressive (VAR) model, as in Ramey (2011a) and Romer and Romer (2010).[3] By using a Structural VAR model where the shock is ordered first, we ensure that the shock series is orthogonal to past information contained in the other variables included in the VAR; at the same time, we allow variables other than the shock to contemporaneously react to the shock itself. Our main finding is that individuals whose consumption levels are most negatively affected by a government spending policy shock (i.e. an unexpected increase in government spending) are the wealthiest and younger individuals (the working and the young age groups), whereas consumption of the poorest increases the most. Thus, positive government spending policy shocks tend to decrease consumption inequality.

Regarding tax policy shocks, an unexpected increase in taxes mainly decreases consumption of the poorest, and it is mostly borne by the youngest category, whereas consumption of the wealthiest individuals increases the most.[4] The differences among groups are strongly

[3] See Perotti (2005, 2007) for a VAR analysis of fiscal policy shocks without a narrative approach.

[4] The fact that an increase in government spending has a large positive effect on the oldest individuals and negative effects on the youngest individuals may signal that the government spending crowds out the

statistically significant. This implies that positive tax policy shocks most negatively affect consumption of the poor, more so than the rich, thus increasing consumption inequality. We also show that our main results are robust to considering different types of tax policy shocks as well as considering only unexpected tax policy shocks or the political party that implemented the tax changes.

Regarding the economic interpretation of our results, our paper is very related to Galí, López-Salido and Vallés (2006). Galí, López-Salido and Vallés (2006) show that a calibrated Keynesian model with sticky prices and rule-of-thumb consumers can generate an increase in consumption when government spending increases. Our results provide further empirical support to the analysis in Gali et al. (2006) by showing that the poorest individuals, the ones that are more likely to be credit constrained, have a positive consumption response to fiscal policy shocks; on the other hand, the richest individuals' consumption responds negatively. Overall, the response of the whole population will depend on which of the two prevails. Other related papers include Schmitt-Grohe' and Uribe (2010), who study the contribution of anticipated shocks to business cycles in US data, including government spending, and Zubairy (2011), who develops a DSGE model where deep habits generate a positive response of consumption to a positive government spending shock.

This paper's analysis is closely related to the large literature on the effects of government spending and tax shocks on macroeconomic aggregates, such as Ramey (2009, 2011a) and Romer and Romer (2010). While the latter literature focuses on the effects of shocks on aggregate data, we focus instead on effects on individual consumption by allowing individuals to be heterogeneous. Our research is also very related to Owyang and Zubairy (2009) and Nekarda and Ramey (2011); the former analyze the effects of government spending shocks on state-level personal income and employment, and find regional patterns in the way government spending policy shocks affect state-level variables. The latter study the effects of government purchases at the industry level. The difference between our paper and theirs is that we focus on heterogeneity across individual consumers, whereas Owyang and Zubairy (2009) focus on heterogeneity across states and Nekarda and Ramey (2011c) across

younger groups consumption since the latter know they will have to pay back later.

industries.

Our paper is also related to the recent advances in the study of heterogeneity. Heathcote, Storesletten and Violante (2009) review the theoretical literature on quantitative macroeconomic models with household heterogeneity; our paper instead is an empirical paper that estimates whether heterogeneity in responses to policy shocks are important.[5] Other empirical studies have also become available since the first version of our paper. Misra and Surico (2011) study tax rebates for specific events, whereas we focus on time series data since the 1980s, and hence our results cover a longer time period and more events/shocks.[6] Giavazzi and McMahon (2012) study heterogeneity in household responses in hours worked to shifts in fiscal policy. They identify state-specific variation in military contracts driven by aggregate changes in US military spending, which is their measure of fiscal shocks. We instead analyze heterogeneity in household responses to aggregate fiscal shocks identified via a narrative approach in a VAR setting. Also, after a draft of this paper was circulated, we became aware of work by De Giorgi and Gambetti (2012), who study the effects of government spending on the distribution of consumption. Their analysis is different from ours in that it is based on an unobserved component model of consumption and considers heterogeneity measured by consumption deciles, while we measure individual heterogeneity in terms of income deciles as well as age and education levels.

The paper is organized as follows. Section 2 describes the data while Section 3 describes the VAR we estimate. Section 4 and 5 discuss results for government spending and tax policy shocks, respectively. Section 6 reports more results based on aggregate data, and Section 7 discusses robustness to the source of the tax shock, expectations as well as the political party in power. Section 8 concludes.

[5] Theoretical papers on heterogeneous agents models also include Rios-Rull (1995), Krusell and Smith (1998), Heathcote (2005), among others. The latter papers have theoretically developed and calibrated heterogeneous agents models, whereas our focus is on the empirical estimation of the effects of fiscal policy shocks.

[6] Also Johnson, Parker and Souleles (2006) exploit the 2001 U.S. tax rebate to measure the change in consumption expenditures caused by the receipt of the rebate.

2 Data Description

We collect information on consumption and income heterogeneity across individuals by using household consumption expenditure data from the interview portion of the Consumer and Expenditure Survey (CEX), conducted by the Bureau of Labor Statistics. The measure of government spending and tax policy shocks we use are the time series developed by Ramey (2011a) and Romer and Romer (2010). We use quarterly data that span 1983:Q4-2008:Q4 for our government spending shock analysis, and 1983:Q4-2007:Q4 in our tax policy shock analysis. The starting date of the sample is determined by the availability of CEX data, whereas the end date is determined by the availability of data on the government spending and tax policy shocks.[7] Here we provide a detailed description of the data as well as preliminary data analyses that establish the usefulness of the CEX database for our purposes. In particular, we demonstrate that existing empirical results in the literature are consistent with those based on aggregate CEX data. However, CEX data have the important advantage of being suitable for more disaggregate analyses, which we undertake in the following sections.

Regarding CEX data, the interview survey follows a given household for five quarters, but gathers data on consumption for the last four interviews. Following Lusardi (1996), we focus on nondurable consumption defined as expenditures on food, alcoholic beverages, tobacco, utilities, personal care, household operations, public transportation, gas and motor oil, and miscellaneous expenses. We focus on nondurable consumption rather than durable because the latter is more similar to an investment decision. For our measure of income, we use the household's income after taxes for the 12 months before the survey is taken. We drop households with missing data or non-positive consumption or income data. Also, we drop the 1986:Q1 observation due to missing data. An additional concern is the presence of measurement error in the data, in particular for income data reported in the CEX (Lusardi, 1996). Our procedure involves constructing pseudo-panels by averaging individuals belonging to groups identified by individual-specific characteristics; thus, our procedure

[7] Although it is possible to find CEX data back to 1980Q1, there are issues regarding the quality and the treatment of the additional data, so we decided to use data starting in 1983Q4.

attenuates idiosyncratic measurement error by averaging individual-level consumption data. Individual-level income data, which are subject to stronger measurement error, are used only to construct income quintiles in our main paper, thus not raising strong concerns about the effects of measurement error in income in our main results.

Our measure of consumption is the log of real per capita consumption expenditures. To construct this measure, we first transform CEX consumption in real terms using non-seasonally adjusted CPI data (since the CEX data are initially non-seasonally adjusted) from the St. Louis Federal Reserve's FRED database. Then, we seasonally adjust the data by taking a centered moving average of 5 quarters. Finally, we divide CEX household data by the number of family members for each household to get a measure of per capita consumption.

We study the effects of government spending and tax policy shocks identified via a narrative approach. The main advantage of using the narrative approach relative to identifying shocks via a Structural VAR is that the shock is directly identified by using information outside the VAR estimation, and hence does not depend on which variables are included in the VAR or which identifying assumptions are made. The disadvantage of the narrative approach is that it requires judgment calls when creating the shock variable. To mitigate the latter concern, we use already established measures and we include the shocks measures in a Structural VAR to ensure that the shock we use in the empirical analysis is uncorrelated with past values of the other macroeconomic variables we consider.

The measure of government spending policy shocks we use is developed by Ramey (2011a). Typically, when studying government spending policy researchers use defense news shocks since they are the least likely to crowd out private consumption and be affected by demographic changes or the state of the economy. Ramey (2011a) does provide a narrative time series of defense spending news shocks based on studying articles in news sources such as *Business Week* magazine. Unfortunately, Ramey (2011a) shows that the defense news shock does not have good explanatory power for real government spending in the sample period we are working with, which is constrained by the availability of data in the CEX. Ramey (2011a) develops an alternative narrative measure of government defense spending

shocks based on the Survey of Professional Forecasters (SPF). The SPF shock is the difference between actual real government spending growth and the SPF's forecasted growth. She shows that this measure does have good explanatory power for government spending in the time period that we consider, so we focus on this measure in our paper.

We also use the tax policy shock measure developed by Romer and Romer (2010). The measure is constructed by using records of presidential speeches and Congressional reports. Using the latter sources, Romer and Romer (2010) identified the size, timing and principal motivations behind all major post-war tax policy innovations. By identifying the motivations for the tax change based on the legislation, they derive an exogenous tax shock that only contains tax changes affecting the long run state of the economy, instead of short term fluctuations. An example of an exogenous tax change is one that is motivated by the need to improve output growth in the long run, rather than to return output to its trend level when fighting a recession. The tax shock we focus on is the exogenous tax series measured as the change in tax liabilities as a percentage of GDP, labeled "EXOGENRRATIO" in Romer and Romer (2010), which is the same measure that they use in their empirical analysis. If the shocks were truly exogenous to short term fluctuations of output, one could proceed with a simple univariate regression. However, Romer and Romer (2010) recognize that identifying the motivation behind the legislated tax changes can be difficult, so they estimate a Structural VAR (SVAR) model, and we follow the same approach.

It is important to verify that CEX data are appropriate for our analysis, and that using aggregate CEX data does not invalidate fundamental empirical findings in the existing literature. It is also important to verify that our VAR specification is suitable for the analysis even though it includes fewer variables than in Ramey (2011a) and Romer and Romer (2010), due to concerns about parameter proliferation and its negative effects in small samples on VAR estimation with a large number of endogenous variables. We demonstrate that this is the case by comparing aggregate CEX data results with those in Ramey (2011a) and Romer and Romer (2010), which are based on the National Income and Product Accounts (NIPA) data.[8]

[8] Ramey's (2010) sample period is 1969-2008, while ours is 1983-2008. Romer and Romer's (2010) sample period is 1950-2007. We cannot extend our sample further back due to shorter sample of data available for CEX data.

Although Slesnick (1992, 1998) offers some empirical evidence that the CEX data and the personal consumption expenditure data from the NIPA do not necessarily measure the same quantities, their correlation is substantial (Attanasio, 1998). Furthermore, we are concerned mainly about responses to policy shocks, which might be less affected by differences in the levels of the variables.

We start by replicating Ramey's (2011a) and Romer and Romer's (2010) results with their databases.[9] For aggregate consumption data we use several components of personal consumption expenditure (PCE) from the NIPA database including: nondurable, durables, and services consumption. In order to ensure that a similar seasonal adjustment procedure is applied to both CEX and NIPA data, and since NIPA data are already seasonally adjusted, we do not make any other seasonal adjustment, and use the seasonally adjusted CPI series from FRED (instead of the non-seasonally adjusted series we used for the seasonally unadjusted CEX data). To transform aggregate consumption and government spending data in per capita terms, we use population data from the United States Census.[10]

In a first exercise, we consider a basic Structural VAR (SVAR) specification inspired by Ramey (2011a):

$$A(L)Z_t = K + D_1 t + D_2 t^2 + U_t \tag{1}$$

where Z_t is a vector containing the SPF shock, the log of real per capita total government spending and the log of real per capita aggregate consumption, $A(L) = A_0 + A_1 L + ... + A_4 L^4$, L is the lag operator, K is a vector of constansts and U_t is a vector of shocks identified via the recursive ordering procedure, where the SPF shock is ordered first, and consumption last. This VAR is similar to Ramey (2011a) except that she also includes an average tax rate variable and an interest rate variable (we do not include the latter in order to keep our VAR parsimonious, due to small sample concerns).[11] By using a Structural VAR model where the shock is ordered first, we ensure that the shock series is orthogonal to past infor-

[9] Note that Romer and Romer (2010) use monthly industrial production and PPI while we use GDP and CPI in order to keep the empirical analysis consistent across specifications.

[10] The NIPA defines the population as the total population of the United States including the Armed Forces overseas and the institutionalized population. See page 14 in the *A Guide to the National Income and Product Accounts of the United States* located at http://www.bea.gov/national/pdf/nipaguid.pdf.

[11] The objective of this exercise is to verify that, even in parsimonious VARs, we obtain results similar to

mation contained in the other variables included in the VAR; at the same time, we allow variables other than the shock to contemporaneously react to the shock itself. We replicate the analysis in Ramey (2011a) by using exactly her aggregate variables, time periods and number of lags (four). The main difference is that we replace her measures of aggregate nondurable consumption from NIPA with our measure of CEX aggregate nondurable consumption. Figure 1 reports impulse responses of nondurables consumption (Panel A) to a government spending shock estimated from eq. (1) using aggregate NIPA data. The impulse response for nondurables has a very similar shape to Ramey (2011a, Fig. XII). Both responses are negative on impact as well as a few quarters after the shock. Thus, our results match Ramey's (2011a) results fairly well.[12] Panel B in Figure 1 considers instead Ramey's specification using aggregate CEX consumption data in place of consumption from NIPA. CEX aggregate consumption is constructed the same way as the NIPA consumption aggregate, that is:

$$C_t \equiv ln\left(\frac{1}{H_t}\sum_{i=1}^{H_t} c_{i,t}\right), \tag{2}$$

where $c_{i,t}$ is consumption attributed to individual i at time t in the CEX survey, and H_t is the number of individuals in the survey at time t. It is clear that the responses are both negative and significant, and very similar in magnitude.

Furthermore, we report multipliers. The multipliers are calculated as follows. The peak multiplier is $max_h \left|\frac{\partial \ln C_{t+h}}{\partial \ln G_t}\frac{\overline{G}}{\overline{C}}\right| sign\left(\frac{\partial \ln C_{t+h}}{\partial \ln G_t}\right)$, where C_t is aggregate consumption at time t,

Ramey (2011a). In particular, Ramey (2011a) includes taxes in her VAR; however, the disaggregate data that we will consider in the main part of our paper are available only for a shorter sample than Ramey's, which will require a more parsimonious VAR. For the same reasons we do not include a measure of monetary policy even though it might be important in principle – see Rossi and Zubairy (2011) and Davig and Leeper (2011).

[12] Unreported results show that the response of durables is instead quite different from Ramey's (2011a), who finds an (insignificant) negative impact response while we have a positive impact response. We also find a significant positive response one quarter after the shock whereas Ramey (2011a) instead finds a negative significant response in quarters 2-8. For nondurables and services, our response has a shape similar to Ramey (2011a, Fig. XII), except for the fact that we find a short positive response on impact. Services consumption shows a negative (although insignificant) impact response similar to Ramey's (2011a), except that ours is smaller in magnitude.

G_t is government spending and $\overline{G}$ and $\overline{C}$ are the average government spending and consumption values over the entire time series. The cumulative multiplier is instead calculated as $\sum_{h=0}^{20}\left(\frac{\partial \ln C_{t+h}}{\partial \ln G_t}\frac{\overline{G}}{\overline{C}}\right)$. The multiplier definition is similar to that commonly used in the literature. Furthermore, we normalize the impact response of G_t to the fiscal policy shock to be unity, so we can interpret the impulse-responses of consumption at horizon h (reported in the figures) to be h-period multiplier (although not rescaled by the long-run values of G_t and C_t). Panel A in Table 1 reports both peak and cumulative impulse responses (multipliers) for the various measures of consumption, including the CEX (first column) as well as Nondurables and Services (column labeled "ND and Services"), Nondurables (labeled "ND"), Services (labeled "Services"), and Durables (labeled "Durables").[13] In all cases, the cumulative responses are negative. Panel B reports statistical tests on the pairwise differences between the groups; asterisks denote significantly different cumulative responses: one asterisk denotes significance at the 68% level, two asterisks denote significance at the 90% level, and three asterisks denote significance at the 95% level.[14] Although the tests do find quantitatively different cumulative and peak responses for the various measures, the responses are qualitatively very similar and, overall, their shapes are also very similar, which increases our confidence in using CEX consumption data in our analysis.

In a second exercise, we consider the SVAR in Romer and Romer (2010):

$$A(L)Z_t = C + U_t, \tag{3}$$

where Z_t is a vector containing the Romer and Romer's (2010) tax policy shock and the log of real per capita consumption. The VAR is identified with a recursive ordering procedure, where the shock is ordered first and consumption last. The number of lags is 4. Figure 2 reports impulse responses of nondurables consumption to a tax policy shock using aggregate NIPA data (Panel A); Panel B in Figure 2 reports instead the response to a tax policy shock using CEX aggregate consumption data in place of NIPA consumption data. The medium-

[13]Note that the peak and cumulative multipliers for nondurables and services are not simply obtained as the sum of their respective multipliers.

[14]Note that we also report 68% confidence intervals as they have been widely used in the literature on fiscal policy, so that we can compare our results with those in the existing literature.

to long-run responses are negative and similar in magnitude, although the CEX response is (not-significantly) positive on impact and the NIPA response is larger in magnitude, and more significant. Panel A in Table 2 reports both peak and cumulative impulse responses for the various measures of consumption that we consider. All are negative and very similar in magnitude. Panel B shows that they are also not statistically significantly different from each other.

To summarize our results, we conclude that empirical results based on aggregate CEX data are very similar to those currently reported in the literature, even in our simple VARs with fewer variables than in the literature (driven by the small sample constraints in CEX data). Thus, we can use CEX data in our analysis and focus on small VAR without being too concerned about the potential misspecification induced by the parsimonious number of variables that we consider. However, CEX data have an important advantage relative to NIPA data: they can be disaggregated across individuals, and used to evaluate the extent of heterogeneity in individual consumption responses to policy shocks. The next two sections provide such analysis.

3 Our Approach

Our disaggregate analysis focuses on CEX data. The CEX is not really a genuine panel, where the same individual is followed over time, but a rotating panel, where individuals remain in the sample only for a limited number of quarters. Deaton (1985) discusses methodologies for adapting the analysis of time series of cross section data to panel data using pseudo-panels identified by defining groups of individuals. For our main analysis, we construct a pseudo panel dataset from the CEX by grouping households according to either age, income, or education.[15] The challenge when picking the group definitions is to not aggregate the individuals too much, otherwise we would not observe heterogeneity. On the other hand, we

[15] In unreported results, we also consider groups based on age cohorts. In particular, we construct five cohorts with twenty years of data (e.g. the first cohort contains individuals born between 1895 and 1914, the second contains individuals born between 1915 and 1934, and so forth). We again find significant differences in the effects of fiscal shocks on individuals depending on their age cohort.

cannot study individuals since each household is only in the survey for four quarters. Thus, we choose group sizes that maintain the heterogeneity while keeping enough households in each group. Households fall into one of five possible age groups, defined as: 15-24, 25-34, 35-44, 45-70, and 71-90 year-old individuals. Sometimes, researchers drop students and retired households to study consumption inequality over the workforce portion of the life cycle: see for instance Attanasio (1998) and Attanasio and Weber (1993). We do not follow this convention since our goal is to study differences in consumption responses across groups, where students and retirees could be potentially interesting groups. Income groups are based on income quintiles. Finally, education groups are broken into four categories: "no high school degree", "high school degree", "some college", and "college degree or more".[16] Table 3 contains the average cell size for each group category. In general, we have cell sizes similar to Attanasio and Weber (1993, 1995).[17]

In order to examine the consequences of a government spending policy shock, we consider a three variable VAR inspired by Ramey (2011a) and eq. (1), with SPF fiscal shock, government spending, and consumption. As previously discussed, the VAR is identified with a recursive ordering procedure where the shock is ordered first and consumption last. We estimate the VAR separately for individuals belonging to each group j, $j = 1, ..., J$, where J is the total number of groups. The household groups are identified based on the individual characteristics previously discussed (income, age and education). We also include a constant and a quadratic time trend. Specifically, our VAR is:

$$A^j(L) Z_t^j = K^j + D_1^j t + D_2^j t^2 + U_t^j \tag{4}$$

where Z_t^j is a vector containing the SPF shock, the log of real per capita government spending and the log of real per capita consumption for individuals belonging to group j, $A^j(L) = A_0^j + A_1^j L + ... + A_4^j L^4$, K^j, D_1^j, D_2^j are vectors of parameters, and U_t^j is a vector of residuals.

[16] As an alternative, one might consider cohort analysis, but the small size we have available does not provide sufficiently precise estimates in that case.

[17] Note that the 45-70 age group contains more households, on average, than other age groups. While we could potentially split this group further, we are interested in this age group because it contains working-age individuals.

Our choice of lag length, time trend, and per capita consumption is based on Ramey (2011a). We estimate eq. (4) separately for each of the J groups of households.

In order to examine the consequences of a tax policy shock, we consider a bivariate SVAR similar to Romer and Romer (2010), with the tax policy shock and consumption. Our measure of tax policy shock is Romer and Romer's (2010) exogenous tax shock, EXOGENRRATIO.[18] We estimate the VAR separately for individuals belonging to each group j, $j = 1, ..., J$. Specifically, our equation is:

$$B^j(L) Z_t^j = K^j + \xi_t^j \tag{5}$$

where Z_t^j is a vector containing the Romer and Romer's (2010) shock and the log of real per capita consumption for individuals belonging to group j, $B^j(L) = B_0^j + B_1^j L + ... + B_4^j L^4$, K^j is a vector of constants, and ξ_t^j is a vector of residuals.[19] The SVAR is identified with a recursive ordering procedure, with the shock ordered first and consumption ordered last.[20]

The next two sections report estimated impulse responses (IRFs) to either a positive government spending policy shock or a positive tax policy shock, as well as standard error bands calculated using a parametric bootstrap (Berkowitz and Kilian, 2000). The standard error bands have 68% coverage rate, as is common practice in the fiscal policy literature (see Ramey, 2011a, and Romer and Romer, 2010). We also calculate peak and cumulative responses that measure the cumulative effect of the policy shock and can be interpreted as a multiplier measure – see Spilimbergo et al. (2009). We report statistical tests on the pairwise differences between peak responses among the various groups; asterisks denote statistical significance: one asterisk denotes significance at the 68% level, two asterisks denote significance at the 90% level, and three asterisks denote significance at the 95% level. We also consider significance for cumulative responses, denoted by daggers: one dagger denotes significance at the 68% level, two daggers denote significance at the 90% level, and three

[18] The empirical results reported in the paper are robust to using EXOGENR instead of EXOGENRRATIO.

[19] Romer and Romer (2010) use 3 years of lags in their model, but our more limited sample period prevents using that many lags.

[20] Note that we do not include government spending shocks in eq. (5) and we do not include tax shocks in eq. (4) due to the fact that our sample is too short to include many variables in the VAR. We also do not include a deterministic trend following Romer and romer (2010).

daggers denote significance at the 95% level.

4 Heterogeneity in Individuals' Responses to Government Spending Policy Shocks

This section presents the main empirical results for the responses to a government spending shock. We discuss results for groups of individuals sorted by either income levels or age. Additional results for individuals sorted by education level are reported in Appendix A.

To preview our results, in general we find substantial empirical evidence in favor of heterogeneity across consumers' responses to an aggregate positive government spending policy shock. In particular, we find that the poorest and the oldest individuals' consumption levels are the most positively affected by the shock. Consumption of the middle-age, the youngest and the wealthiest groups is the most negatively affected by the government spending policy shock.[21]

4.1 IRFs and Multipliers by Income Groups

Impulse responses for consumption of individuals grouped by income quintiles are displayed in Figure 3. The figure also reports the aggregate response calculated as the response of the average individual's log consumption.[22] That is, the aggregate consumption response is defined to be the response of $\frac{1}{H_t}\sum_{i=1}^{H_t} ln\left(c_{i,t}\right)$. Note that aggregate consumption (last panel) overall significantly increases on impact by about 0.5%, then increases even more for about two additional quarters, and finally reverts back to zero, with a peak response of about 0.7% two years after the shock; the cumulative multiplier is about 0.05 in the five years following the shock. Most of the individual responses have a positive and significant response

[21] Note that it is unlikely that our results are driven by a homogeneous response to a heterogeneous fiscal policy shock rather than being heterogeneous responses to a homogeneous fiscal policy shock (as we argue) since CEX is a random sample and since the fiscal shock measure we use is an aggregate measure.

[22] Note that this is different from the aggregate response calculated as the response of the log of average consumption reported in Figure 1. We provide more discussion on the differences between the two in Section 6.

with the exception of the richest quintile, whose response is significantly negative. It is noteworthy that the richest quintiles are hurt the most in terms of consumption by the increase in government spending. Table 4 reports multipliers (Panel A) and tests of statistical significance (Panel B) for pairwise groups of consumers, as well as relative to aggregate consumption. Interestingly, the richest group is statistically significantly different from the third, fourth and fifth poorest quantiles. Note that the poorest quantile's responses are statistically significantly different from those of the richest groups as well. These results point to the existence of substantial heterogeneity in the responses to government spending shocks of consumers that differ by income.

Our results have important implications for the existing debate of the effects of government spending shocks – see Engemann, Owyang and Zubairy (2008) for a survey of the debate. In fact, theoretical models have very different implications regarding the effects of government spending shocks on consumption. According to standard RBC models, consumption should decrease after a permanent positive government spending shock, whereas consumption should increase in the textbook IS-LM model. In fact, according to the standard RBC model, households anticipate the higher taxes that are necessary to repay the (non-productive) government spending, which lowers the net present value of after tax income, and thus would be affected by a negative wealth effect. Therefore, they react to the increase in government spending by lowering their consumption and their leisure. On the other hand, in the IS-LM model, consumers behave in a non-Ricardian fashion and real disposable income is the most important variable affecting consumption. This is because individuals' consumption is a function of their current income and not of their life-time resources. For example, in the presence of credit constraints, we should observe that the increase in government spending causes consumption to increase. Gali et al. (2007) show that a New Keynesian model where a fraction of households consume all their income in every period can explain how consumption increases after a government spending shock.[23] In our analysis, we are able to disentangle the consequences of government spending shocks

[23] Gali et al. (2007) show that another necessary condition for consumption to rise in response to a fiscal expansion is price stickiness in goods markets as well as, in one version of their model, imperfectly competitive labor markets.

on consumers with different levels of income, and therefore, facing different levels of credit constraints.[24] Consumers in the poorest income quantiles, which are more likely to be credit constrained, end up increasing consumption. On the other hand, consumers in the richest income quantiles, which are less likely to be credit constrained, end up decreasing consumption, as the theory predicts.

The reason why we can claim that poorest individuals are more likely to be credit constrained is the empirical evidence discussed in Attanasio et al. (2008), according to which low income consumers are substantially more credit constrained than high income consumers. Interestingly, we find that approximately 20% of consumers (the wealthiest) increase their consumption after a government spending shock, and hence are estimated not to be credit constrained. This estimate is very similar to that reported in Attanasio et al. (2008) for CEX data, according to which approximately 15% of the population with the highest income is not liquidity constrained.[25]

We also verify in Appendix B that income of the poorer individuals does significantly increase, following an unexpected increase in government spending. We do so by including income as an additional variable in the SVAR. This is important to verify because the mechanism that leads to the increase in consumption for rule-of-thumb consumers is exactly an increase in income. Indeed, income of all groups increases following a positive government spending shock, including that of the poorer individuals, as the theory would predict.

Finally, note that, typically, the richest individuals would have higher consumption levels than poorer individuals. Fiscal shocks, by increasing consumption of the poorest and decreasing consumption of the richest, overall tend to decrease consumption heterogeneity.

[24] While income may not necessarily reflect the degree of liquidity constraints faced by an individual, in the next paragraph we discuss the empirical evidence that supports the interpretation that individuals with low income levels may face liquidity constraints.

[25] In their paper, Attanasio et al. (2008) identify consumers as being credit constrained if they are responsive to interest rates and loan maturity changes, since a longer debt maturity decreases the size of the monthly payment and allows consumers to sign up for a larger debt.

4.2 IRFs and Multipliers by Age Groups

Panel A in Figure 4 shows the impulse response of consumption to a positive government spending shock for individuals grouped by age. Most of the youngest groups experience a negative and statistically significant response at some point over the three years following the shock. The oldest category, instead, has a significantly positive increase in consumption for a few quarters after the shock.

Panel A in Table 5 provides additional results by reporting the peak and cumulative multiplier of consumption for each group. The middle age groups have the most negative peak multiplier, equal to -0.1 approximately,[26] closely followed by the youngest category, 15-24 years-old, with a consumption multiplier of -0.05. The oldest category is the only group with a positive peak response, about 0.15, which is statistically significantly different from the negative responses of the 45-70 year-old group.[27]

Overall, these results provide empirical evidence that age also matters in the response to a government spending shock, and that age groups have substantially heterogeneous multipliers.

5 Heterogeneity in Individuals' Responses to Tax Policy Shocks

This section presents the main empirical results for the tax policy shock. We focus on the SVAR model, eq. (5). We estimate both the impulse responses and the cumulative impulse responses of consumption to an increase in tax liabilities as a ratio of GDP. This section reports results for individuals sorted according to either income levels or age; Appendix A

[26] The multipliers are in unit terms. That is, a 1 dollar increase in government spending leads to a 0.10 dollars decrease in consumption for the middle-age group.

[27] Note that these results seem at odd with the finding in Attanasio et al. (2008) that there is no evidence that the younger groups are more credit constrained that the older groups. However, note that their oldest group includes individuals that are 55 year-old or older. If we group together individuals that are 45 to 70 year-old and individuals that are 71 or older, we also do not find empirical evidence that consumption increases.

discusses results when the source of heterogeneity is education.

To preview our results, we find that, after an unexpected increase in taxes, the wealthiest groups experience a significant increase in consumption, whereas the poorest quintiles have a significantly negative response. When looking at individual heterogeneity by age group, the youngest group experiences the most dramatic decrease in consumption, whereas the response of consumption of all the other groups is significantly positive on impact. The response of the youngest is significantly different from that of the other age groups. These results again highlight the importance of allowing for heterogeneity in the individuals' responses, which aggregate data would not be able to uncover.

5.1 IRFs and Multipliers by Income Quintiles

Figure 5, Panel A, shows the effect that increasing tax liabilities by 1% of GDP has on consumption when we group individuals by income quintiles. First, note that aggregate consumption significantly increases on impact, then decreases in a hump shape fashion, with a peak response of about -0.02 approximately one year after the shock; the cumulative response is about -0.03 in the five years following the shock.[28] When looking at individual responses, however, results are quite different from the aggregate. The wealthiest groups experience a significant increase in consumption (of about 0.02 at its peak response, on impact), then the effects decrease non-monotonically across income quintiles towards the significantly negative response of the second poorest quintile (which peaks at -0.04% approximately a year after the shock). It might be surprising that the income of the poorest quintile is negatively affected by the tax shock as these individuals may pay little or no federal taxes. We speculate that this effect may be caused by general equilibrium effects such as lay-off of workers in the poorest categories.

It is very interesting to compare the group's responses with those of the aggregate, which is mostly negative. It is again clear that studies that focus on the aggregate response will fail to notice the significant differences in the responses of the poorest and the wealthiest groups.

[28] Note that the increase in consumption on impact is different from Romer and Romer's (2010) results and might be due to the difference in the sample period we consider.

Some of the differences among the groups' cumulative responses are statistically significant, as Table 6, Panel A, shows. In particular, the responses of the richest groups (whose consumption cumulatively increases by 0.02% in the 5 years after the shock) are statistically significantly different from those of the other quintiles (whose consumption decreases by -0.07%, approximately) at the 68% significance level.

Overall, unexpected increases in taxes tend to hurt the poor and especially increase consumption of the wealthiest. Thus, tax shocks tend to increase consumption inequality. It is worthwhile to stress again how using only aggregate data would miss the heterogeneous effects that unexpected tax increases would have on consumption for the various categories.

5.2 IRFs and Multipliers by Age Groups

It is also interesting to analyze the effects of tax shocks on individuals sorted by age to evaluate whether the younger or older categories are mostly affected by tax shocks. This analysis provides further evidence on the redistributive effects of taxes, in particular relative to age. Panel A in Figure 6 reports impulse responses of consumption for individuals sorted according to their age. While aggregate consumption decreases, the figure shows that the decrease is mostly born by the youngest category (15-24 years-old): the response of consumption of all the other groups is insignificantly different from zero, except on impact, when it is significantly positive. Looking at the comparisons across groups, reported in Panel B of Table 7, the cumulative consumption response of the youngest category, whose consumption decreases by -0.05% over the five years following the shock, is statistically significantly different from that of all of the other groups as well as the aggregate. The results demonstrate that the heterogeneity in individuals' responses across age groups is not only confined to government spending shocks, but also holds for tax policy shocks.

6 Aggregate Responses

An additional benefit of using household level data besides analyzing heterogeneity is that we can control the aggregation process. This enables us to avoid the aggregation bias that might

be present when working with aggregate data. Specifically, Attanasio and Weber (1993, 1995) point out that an aggregation bias will be introduced if researchers use aggregate data by taking the logarithm of the mean (the common procedure used when working with aggregate data) instead of the mean of the logarithm. In order to construct our aggregate pseudo panel dataset we calculate:

$$\frac{1}{H_t}\sum_{i=1}^{H_t}\ln(c_{i,t}), \tag{6}$$

where $c_{i,t}$ represents individual i's consumption level, H_t is the total number of households at time t, and t is time. When only aggregate data is available, one would instead calculate:

$$\ln\left(\frac{1}{H_t}\sum_{i=1}^{H_t}c_t^i\right). \tag{7}$$

Note that the latter is the measure we discussed in Section 2. By comparing (6) and (7) we can compare average multipliers calculated across individual responses with the multiplier based on aggregate consumption data. Note that neither eq. (6) nor equation (7) are a better measure of consumption than the other: which is best depends on the scope of the analysis. Eq. (7) is useful to understand how (log) consumption responds on average (across individuals) to a shock; however, this does not necessarily provide a measure of how the average individual (log) consumption responds to the shock, which is instead what eq. (6) reports.

Another interesting exercise we perform is to compare our results based on the two alternative measures of CEX data, either (6) or (7), with those based on NIPA data for three different measures of Personal Consumption Expenditures (PCE): nondurables, services, and durables consumption.[29]

Figures 7 and 8 depict impulse responses using aggregate CEX consumption data (eq. (6), labeled "CEX"), CEX with aggregate data only (eq. (7), labeled "CEX biased"), nondurables and services consumption (labeled "ND and services"), services consumption (labeled "Services"), and durables consumption (labeled "Durables"). Figure 7 reports results for the response to a government spending shock in the SVAR model (4) and Figure 8 reports

[29]Note that, in order to be consistent with the literature, the CEX aggregate measure reported in Table 2 is eq. (7).

results for the tax policy shock in the SVAR model (3).

Panel A in Figure 7 shows that the responses of aggregate CEX consumption, eqs. (6) or (7), are very different from each other. The response of aggregate consumption calculated according to eq. (6) are positive on impact, reaching a peak one quarter after the shock, then slowly disappear over time. The response of aggregate consumption calculated according to eq. (7) are instead negative on impact, and they reach their peak after about a year. The latter are much more similar to the pattern found in the data by Ramey (2011a), among others. In fact, Panel B in Figure 7 shows that for both nondurables and services consumption as well as durables, the pattern of the response in NIPA data is very similar to that of eq. (7). Note that the response of services consumption (middle figure in panel B) is negative but mostly insignificant, while the response of durables and nondurables and services is negative *and* significant. The implication is that by using aggregate data that do not control for the aggregation bias, researchers might overestimate the negative effects of government spending shocks.[30]

On the other hand, Panel A in Figure 8 shows that the responses to a tax policy shock are very similar: positive on impact, and then negative after a few quarters until they reach a peak around a year after the shock. The increase in consumption that we observe in CEX data (Panel A) on impact is not present in NIPA data (Panel B).[31]

7 Robustness Analyses

While the government spending analysis relies on unanticipated shocks, the tax policy analysis relies on shocks that are a mixture of anticipated and unanticipated shocks; it is therefore be important to consider the case of unanticipated shocks only. Furthermore, it might matter which types of tax shocks are implemented (whether, for example, they concern individual

[30] Unreported results show that both the peak and the cumulative multipliers of the CEX measure in eq. (6) are significantly different from those of eq. (7), as well as those of Nondurables and Services, Nondurables and Durables.

[31] Unreported results show that both the peak and the cumulative multipliers of the CEX measure in eq. (6) are not significantly different from those of eq. (7), as well as those of Nondurables and Services, Nondurables and Durables.

income, corporate income or employment) or which political party was in power at the time of the implementation. We consider each of these concerns, and show that our main results are robust to considering unanticipated tax policy shocks, income or corporate income tax shocks. While some of the results might be different if one considers employment tax shocks, our main results for the wealthiest and the poorest quintiles are the same, and for the rest of the quintiles there is too much uncertainty in our sample to conclude that the responses in the employment tax case are different from those we discuss in the main part of the paper. Finally, the party in power may matter: the qualitative results are unaffected by focusing tax shocks implemented by Republicans, but the responses under the Democratic party are different although, again, there is too much uncertainty and the responses are not statistically different. A more detailed analysis follows.

First, we focus on unanticipated tax policy shocks. We replace the Romer and Romer's (2010) shock in eq. (5) with the unanticipated shock constructed by Merten and Ravn (2011); otherwise, the VAR remains as in eq. (5). Figure 9 reports the results for the individual responses by income quintiles whereas Figure 10 reports the results for the aggregate responses. Since Figure 9 is similar to Figure 5, and since Figure 10 is similar to Figure 8, we conclude that our main results are robust to using only unanticipated tax shocks.

Second, we separately classify tax shocks into corporate income tax liabilities, individual income liabilities and employment taxes following Merten and Ravn (2012).[32] Our main conclusions would be invalid should the responses be different across groups only because the nature of the tax shocks is different. Figures 11 and 12 report results for individual income liabilities (results are similar for corporate income tax liabilities, unreported), whereas Figure 13 reports results for employment taxes. The figures show that the main results in the paper are robust to focusing only on individual income; in the case of employment taxes only, the main message of the paper is qualitatively similar (i.e. the response of the wealthiest group is positive and the response of the poorest group is negative) although the responses are slightly quantitatively different. The latter typically induce an increase in consumption for a few income groups (the richest and the second richest quintiles as well as the second poorest

[32] See Merten and Ravn (2012) for details on the construction of their measure.

quintile) and a negative response of the third richest quintile as well as the poorest quintile (except on impact). However, all responses are measured very imprecisely and are never significantly different from zero since there are only two episodes of employment tax shocks in our sample.

Finally, we consider whether the political party in power affects the responses. This is an interesting question because the redistributive effects of tax shocks may differ depending on the philosophy of the party in power.[33] Figure 14 reports results for eq. (5) where we replace the Romer and Romer's (2010) shock with the shock interacted with a dummy variable that equals one if the Republican party is in power; similarly, Figure 15 reports results for eq. (5) where we replace the Romer and Romer's (2010) shock with the shock interacted with a dummy variable that equals one if the Democratic party is in power. The figures show that the results conditional on a Republican party regime are very similar to our main results, whereas those conditional on a Democratic party regime are not, however the latter are again very imprecisely estimated and never significantly different from zero. The reason is that we have many more episodes of tax shocks under Republican regimes (both positive and negative) than under the Democratic one, which help us identify the effects more precisely in the former case.

Overall, when the empirical findings differ from our main results, typically they are associated with insignificant differences. We therefore conclude that our main findings are robust to the political parties in power as well as the type of tax shock being implemented, at least based on our limited sample.

8 Conclusion

Our empirical results uncover significant differences in disaggregate individuals' consumption responses to government spending and tax policy shocks, which would not be possible to uncover with traditional analyses based on aggregate data.

In particular, unexpected increases in government spending policy hurt the young and

[33] Which political party is in power is determined by the date in which the president of that political party is elected until the date he/she resigns.

the wealthiest the most in terms of consumption. The wealthiest experience the highest cumulative drop in consumption whereas consumption of the poorest categories increases significantly. On the other hand, unexpected increases in taxes hurt especially the youngest and the poorer groups in terms of consumption, whereas the wealthiest experience a significant increase in consumption. Government spending policy shocks tend to decrease consumption inequality, whereas tax policy shocks tend to increase consumption inequality.

Another advantage of using disaggregate data is that it is possible to create aggregate data that are more suitable for economic analyses. We find that aggregation does not matter much when studying the effects of tax policy shocks. However, properly aggregated CEX data behave differently from traditional aggregate data in response to a government spending shock. In particular, traditionally aggregated CEX data show a delayed and significant decrease in aggregate consumption after a government spending shock, which is instead significantly positive for about a year after the initial shock according to our aggregate CEX measure.

These results suggest that it is important to allow for heterogeneity in individuals' behavior when studying the effects of fiscal policy shocks. Existing theoretical models suggest that fiscal shocks may have very different effects on consumption depending on whether consumers are credit constrained. Our empirical results show that indeed individuals respond to shocks differently depending on their wealth, education and age, highlighting the fact that, indeed, consumers who are most likely credit constrained do increase their consumption after an unexpected increase in government spending. As we show, these interesting results are in line with theoretical macroeconomic models that allow for a fraction of consumers to be credit constrained.

9 References

Attanasio, Orazio P. (1998), "Cohort Analysis of Saving Behavior by U.S. Households", *The Journal of Human Resources* 33(3)

Attanasio, Orazio P., and Guglielmo Weber (1993), "Consumption, the Interest Rate and Aggregation", *Review of Economic Studies.*

Attanasio, Orazio P., and Guglielmo Weber (1995), "Is Consumption Growth Consistent with Intertemporal Optimization? Evidence from the Consumer Expenditure Survey", *The Journal of Political Economy.* 103(6), 1121-1157.

Attanasio, Orazio P., Pinelopi K. Goldberg and Ekaterini Kyriazidou (2008), "Credit Constraints in the Market for Consumer Durables: Evidence from Micro Data on Car Loans", *International Economic Review* 49 (2), 401-436

Berkowitz, Jeremy, and Lutz Kilian (2000), "Recent Developments in Bootstrapping Time Series", *Econometric Reviews*, 19, 1-48.

Burnside, Craig, Martin Eichenbaum, and Jonas Fisher, "Fiscal Shocks and Their Consequences", *Journal of Economic Theory* 115 (2004), 89-117.

Cavallo, Michele (2005), "Government Employment Expenditure and the Effects of Fiscal Policy Shocks", *Federal Reserve Bank of San Francisco Working Paper* 2005-16.

Davig, Troy and Eric M. Leeper (2011), "Monetary-fiscal policy interactions and fiscal stimulus," *European Economic Review* 55(2), 211{227.

Deaton, Angus (1985), "Panel Data from Time Series of Cross Sections", *Journal of Econometrics* 30, 109-126.

De Giorgi, G. and L. Gambetti (2012), "The Effects of Government Spending on the Distribution of Consumption", *mimeo.*

Edelberg, Wendy, Martin Eichenbaum, and Jonas D.M. Fisher (1999), "Understanding the Effects of a Shock to Government Purchases", *Review of Economic Dynamics* 2, 166-206.

Engemann, K.M., M. Owyang and S. Zubairy (2008), "A Primer on the Empirical Identification of Government Spending Shocks", *Federal Reserve Bank of St. Louis Review* 90(2).

Gali, Jordi, J. David López-Salido and Javier Vallés (2007), "Understanding the Effects of Government Spending on Consumption", *Journal of the European Economic Association*

5, 227-270.

Giavazzi, Francesco and M. McMahon (2012), "The Household Effects of Government Consumption", in: *Fiscal Policy After the Crisis*, NBER.

Heathcote, Jonathan (2005), "Fiscal Policy with Heterogeneous Agents and Incomplete Markets", *Review of Economic Studies* 72(1):161–88.

Heathcote, J., K. Storesletten and G. Violante (2009), "Quantitative Macroeconomics with Heterogeneous Households", *Annual Review of Economics* 1(1), 319-354.

Inoue, Atsushi, Lutz Kilian and Fatma Burcu Kiraz (2009), "Do Actions Speak Louder Than Words? Household Expectations of Inflation Based on Micro Consumption Data", *Journal of Money, Credit and Banking* 41(7), 1331-1363.

Johnson, David S., Jonathan A. Parker and Nicholas S. Souleles (2006), "Household Expenditure and the Income Tax Rebates of 2001," *American Economic Review* 96(5), 1589-1610

Krusell, Per, and Anthony A. Smith (1998), "Income and Wealth Heterogeneity in the Macroeconomy", *Journal of Political Economy* 106(5), 867–96.

Lusardi, Annamaria (1996), "Permanent Income, Current Income, and Consumption: Evidence from Two Panel Data Sets", *Journal of Business and Economic Statistics* 14, 81-90.

Mertens, Karel and Morten O. Ravn (2011), "Understanding the aggregate effects of anticipated and unanticipated tax policy shocks", *Review of Economic Dynamics* 14, 27-54.

Mertens, Karel and Morten O. Ravn (2012), "The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States", *mimeo*, Cornell and UCL Universities.

Misra, K. and P. Surico (2011), "Heterogeneous Responses and Aggregate Impact of the 2001 Income Tax Rebates", *CEPR discussion paper* 8306.

Nekarda, Christopher J. and Valerie A. Ramey (2011), "Industry Evidence on the Effects of Government Spending", *American Economic Journal Macroeconomics* 3, 36–59.

Owyang, Michael and Sarah Zubairy (2009), "Who Benefits From Increased Government Spending? A State-Level Analysis", *Federal Reserve Bank of St. Louis Working Papers* 2009-006.

Perotti, Roberto (2005), "Estimating the Effects of Fiscal Policy in OECD Countries", *CEPR Discussion Paper* 4842.

Perotti, Roberto (2007), "In Search of the Transmission Mechanism of Fiscal Policy", *NBER Macroeconomics Annual* 22, 169-226.

Ramey, Valerie A. and Matthew Shapiro (1998), "Costly Capital Reallocation and the Effects of Government Spending", *Carnegie Rochester Conference on Public Policy.*

Ramey, Valerie A. (2009), "Defense News Shocks, 1939-2008: An Analysis Based on News Sources", *UCSD manuscript.*

Ramey, Valerie A. (2011a), "Identifying Government Spending Shocks: It's All in the Timing", *Quarterly Journal of Economics* 126(1), 1-50.

Ramey, Valerie A. (2011b), "Can Government Purchases Stimulate the Economy?", *Journal of Economic Literature* 49(3), 673–85.

Rios-Rull, Jose-Victor (1995), "Models with Heterogeneous Agents," in Thomas Cooley eds., *Frontiers of Business Cycles Research*, Princeton University Press: Princeton, NJ, Chapter IV.

Romer, Christina D. and David H. Romer (2010), "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks", *American Economic Review* 100, 763–801.

Rossi, Barbara and Sarah Zubairy (2011), "What is the Importance of Monetary and Fiscal Shocks in Explaining US Macroeconomic Fluctuations?", *Journal of Money, Credit and Banking* 43(6).

Schmitt-Grohe, Stephanie and Martin Uribe (2008), "What's News in Business Cycles", *NBER Working Paper* No. 14215.

Slesnick, Daniel (1992), "Aggregate Consumption and Saving in the Postwar United States", *The Review of Economics and Statistics* 74, 585-597.

Slesnick, Daniel (1998), "Are Our Data Relevant to the Theory? The Case of Aggregate Consumption", *The Journal of Business and Economic Statistics* 16(1), 52-61.

Spilimbergo, Antonio, Steve Symansky and Martin Schindler (2009), "Fiscal Multipliers", *IMF Staff Position Note* 09/11.

U.S. Dept. of Commerce, Bureau of Economic Analysis (2006), "A Guide to the National Income and Product Accounts of the United States", http://www.bea.gov/national/pdf/nipaguid.pdf, September.

Zubairy, Sarah (2011), "Explaining the Effects of Government Spending Shocks", *mimeo*, Bank of Canada.

10 Appendix A

This Appendix empirically analyzes the effects of government spending and tax shocks on individuals sorted according to their education level. Figures A.1-A.2 report the empirical results. Individuals are sorted in groups with either no high school degree ("<12 years"), high school graduates ("HS Grad"), individuals exposed to some college ("13-15 years"), and those with at least a college degree ("$\geq$ 16 years").

Figure A.1 reports the response of consumption to a government spending policy shock with individuals grouped by education levels. The figures show that the effects do again differ depending on the level of education: consumption of the lowest education groups are generally positively affected on impact and for a few quarters after the shock hits; on the other hand, the consumption of individuals with the highest education levels is negatively affected on impact and for a few quarters afterwards. Table A.1 reports the cumulative impulse response functions. Both the peak and the cumulative multipliers are negative for highly educated individuals and positive for individuals with low levels of education. The cumulative multipliers for the highly educated individuals are statistically significantly different from those of any of the other groups. Thus, these results indicate that an increase in government spending helps the least educated and hurts the college graduates in terms of consumption levels. They also indicate that college graduates behave according to New Keynesian models, whereas individuals with low education levels behave like rule-of-thumb consumers.[34]

INSERT FIGURES A.1, A.2 AND TABLES A.1, A.2 HERE

Figure A.2 reports the response of consumption to a tax policy shock. The figures show that the tax shock significantly increases consumption on impact for all education groups; however the effects become negative in the medium run for low education groups, whereas they are always positive for highly educated individuals. Table A.2 shows that most of the groups experience an overall increase in consumption and that there are only few statistically significant differences among education groups as well as relative to the aggregate.

[34] This is not surprising given the high correlation between income and education levels, and our results in Section 4.1.

11 Appendix B

We study more in detail the transmission mechanism of government spending shocks by including income in our SVAR. In particular, the theory predicts that rule-of-thumb consumers increase their consumption after an unexpected increase in government spending because the latter increases their income. In other words, since these individuals are not forward looking and instead decide their consumption as a fixed fraction of their income, their consumption should increase whenever their income increases. We verify the theory by including income as an additional variable in the SVAR, and modifying the identification accordingly, with the shock ordered first, then government spending, income and consumption. Although income reported in the CEX is subject to measurement error (see Lusardi, 1996), we nevertheless use it as a first approximation for our analysis.[35]

Figure A3 reports responses of consumption (Panel A) and income (Panel B) to an unexpected increase in government spending. Recall that we identify rule-of-thumb consumers with the poorest individuals in the survey. Indeed, the Figure shows that income of all groups increases, following the shock, and verifies that the mechanism that leads to the increase in consumption for rule-of-thumb consumers is exactly through an increase in income.

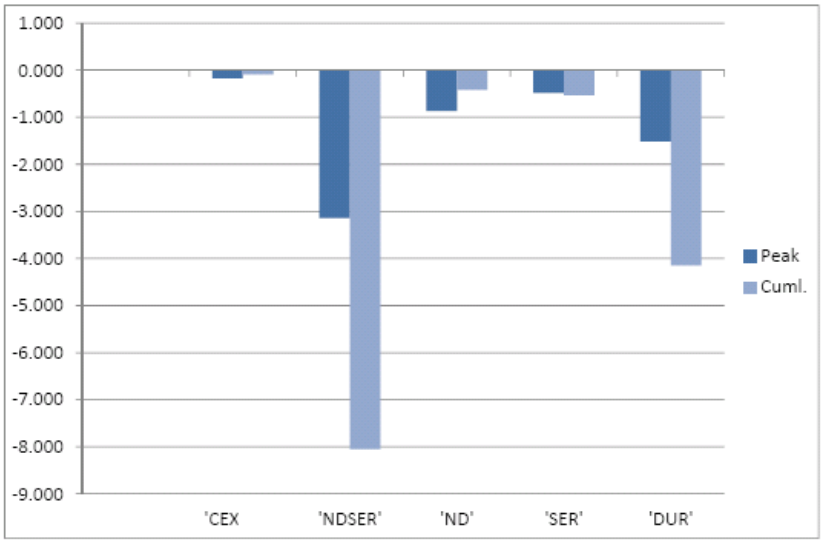
INSERT FIGURE A.3 HERE

[35] Alternative income measures that could be used are based on the Current Population Survey (CPS) data from the CBO. The advantage of using CPS data is that it is less subject to measurement error. The disadvantage is that it needs to be merged with the CEX data using the assumption that the poorest quintile in the CPS dataset is comparable to that in the CEX data. As it is not clear whether the advantages would overcome the disadvantages, we focus on CEX data.

12 Tables and Figures

Table 1. Cumulative Impulse Response of Aggregate Consumption to a Government Spending Policy Shock

Panel A. Multipliers Size



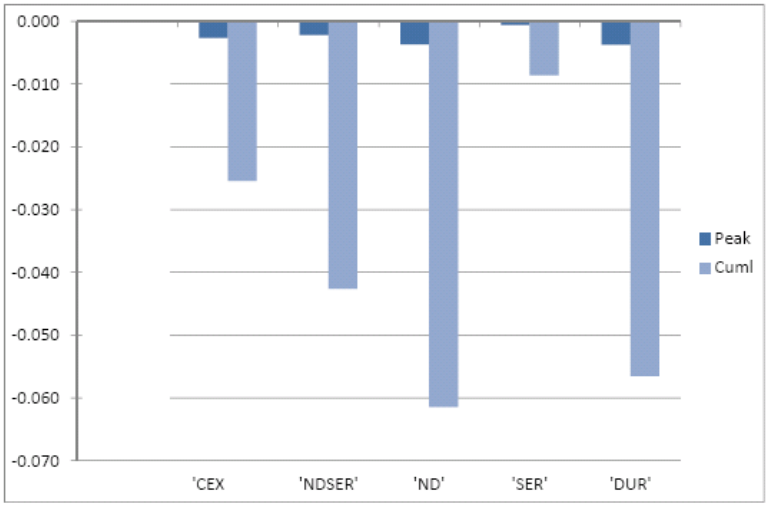
Panel B. Comparisons:

	CEX	ND and Services	ND	Services	Durables
CEX	–	***, †††	**		***, †††
ND and Services	–	–	**, †††	***, †††	*
ND	–	–	–		††
Services	–	–	–	–	*, †

Notes: The table reports the cumulative Impulse Response (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption to a government spending policy shock for several measures of consumption: the CEX (eq. 2) and NIPA aggregates: nondurables and services (labeled "ND and Services"), Non Durables (labeled "ND"), services, and durables. It also reports the statistical significance of comparing the multipliers across groups. Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Table 2. Cumulative Impulse Response of Aggregate Consumption to a Tax Policy Shock

Panel A. Multipliers Size



Panel B. Comparisons

	CEX	ND and Services	ND	Services	Durables
CEX	–				
ND and Services	–	–			
ND	–	–	–		
Services	–	–	–	–	

Notes: The table reports the cumulative Impulse Response (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption to a government spending policy shock for several measures of consumption: the CEX (eq. 2) and NIPA aggregates: nondurables and services (labeled "ND and Services"), Non Durables (labeled "ND"), services, and durables. It also reports the statistical significance of comparing the multipliers across groups. Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

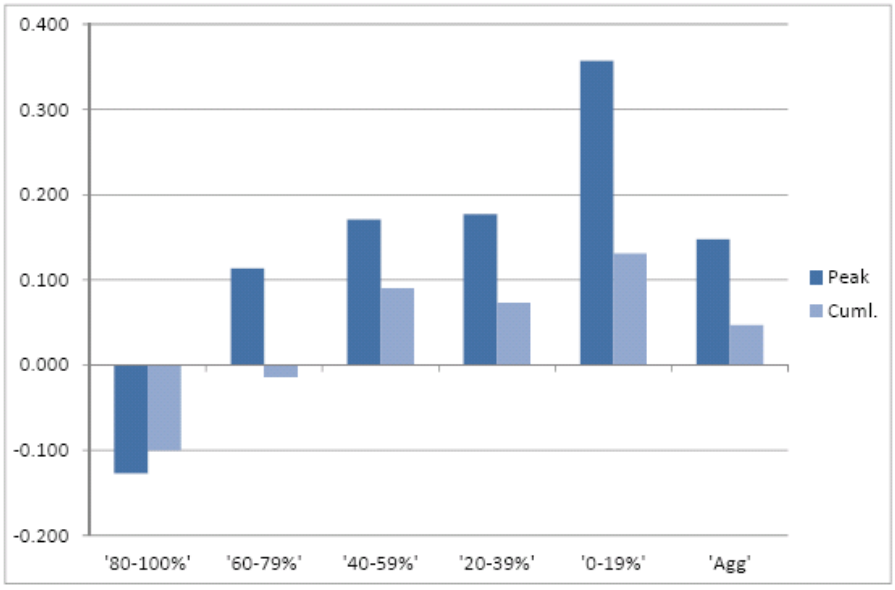
Table 3. Average Cell Size by Groups

Age Groups	15-24	25-34	35-44	45-70	71-90
Cell Size	121.97	404.89	469.17	845.83	285.82
Income Groups	80-100%	60-79%	40-59%	20-39%	0-19%
Cell Size	268.91	434.45	474.84	495.11	454.36
Education	<12 years	HS Grad	13-15 years	≥16 years	
Cell Size	429.69	632.96	550.43	533.45	

Notes: This table reports the average cell size for each group category where the cell size is how many households are used to make one quarterly observation.

Table 4. Cumulative Impulse Responses to a Government Spending Policy Shock, By Income Group

Panel A. Multipliers Size



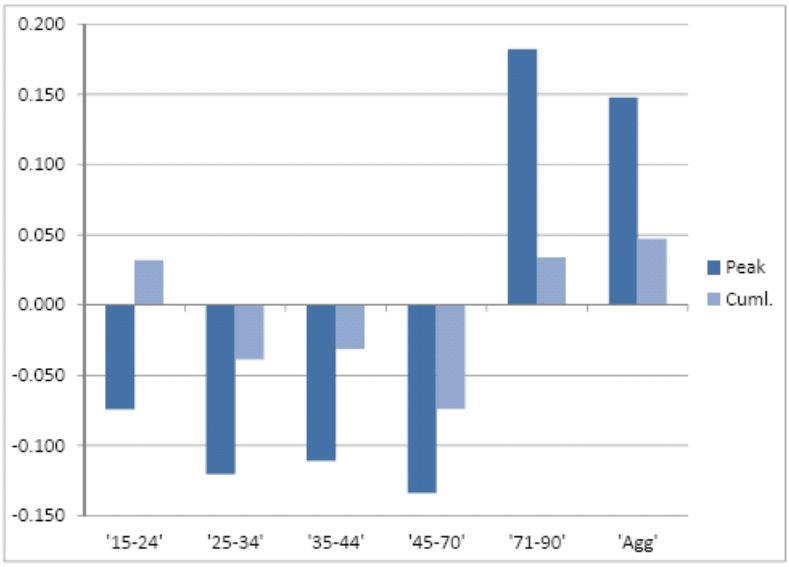
Panel B. Comparisons

Income Groups	80-100%	60-79%	40-59%	20-39%	0-19%	Agg.
80-100%	–		*, †	*, †	*, †	*, †
60-79%	–	–			*	
40-59%	–	–	–			*
20-39%	–	–	–	–		*
0-19%	–	–	–	–	–	

Notes: The table reports the cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a government spending policy shock for individuals sorted according to their income. It also reports the statistical significance of comparing the peak multipliers across groups. Statistical significance for peak multipliers is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively. The multipliers for aggregate CEX are listed under "Agg.".

Table 5. Cumulative Impulse Responses to a Government Spending Policy Shock, By Age Group

Panel A. Multipliers Size



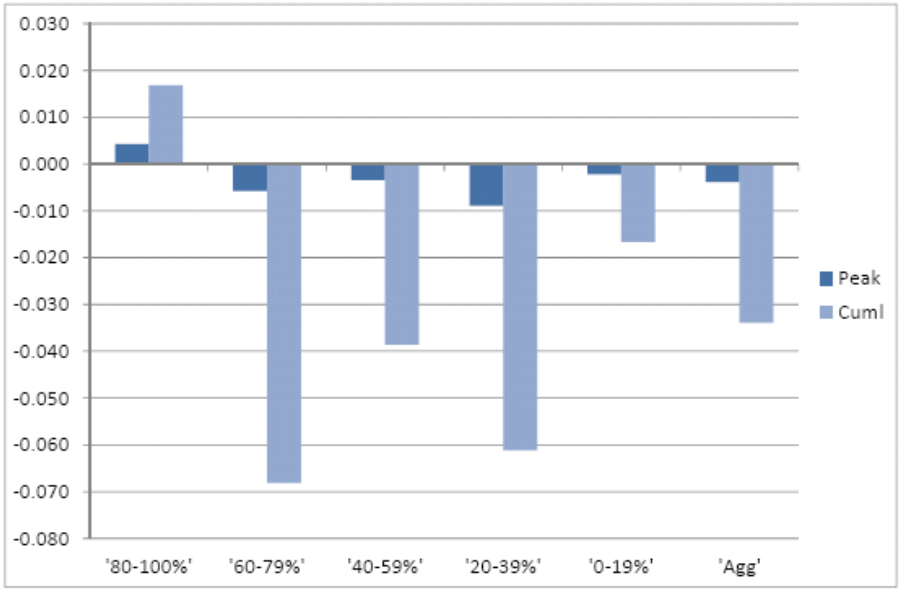
Panel B. Comparisons

Age Groups	15-24	25-34	35-44	45-70	71-90	Agg.
15-24	–					
25-34	–	–				
35-44	–	–	–			
45-70	–	–	–	–	†	*, †
71-90	–	–	–	–	–	

Notes. The table reports the cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a government spending policy shock for individuals sorted according to their age. Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. The multipliers for aggregate CEX are listed under "Agg." Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Table 6. Cumulative Impulse Responses to a Tax Policy Shock, By Income Group

Panel A. Multipliers Size



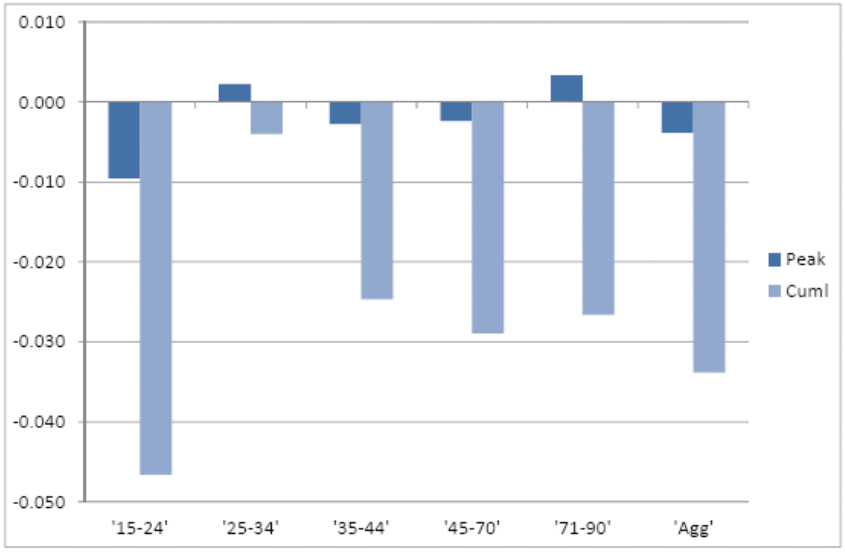
Panel B. Comparisons

Income Groups	80-100%	60-79%	40-59%	20-39%	0-19%	Agg.
80-100%	–	*, †		*, †		
60-79%	–	–				
40-59%	–	–	–			
20-39%	–	–	–	–		
0-19%	–	–	–	–	–	

Notes: The table reports the cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a government spending policy shock for individuals sorted according to their income. It also reports the statistical significance of comparing the multipliers across groups. Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. The multipliers for aggregate CEX are listed under "Agg.". Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Table 7. Cumulative Impulse Responses to a Tax Policy Shock, By Age Group

Panel A. Multipliers Size



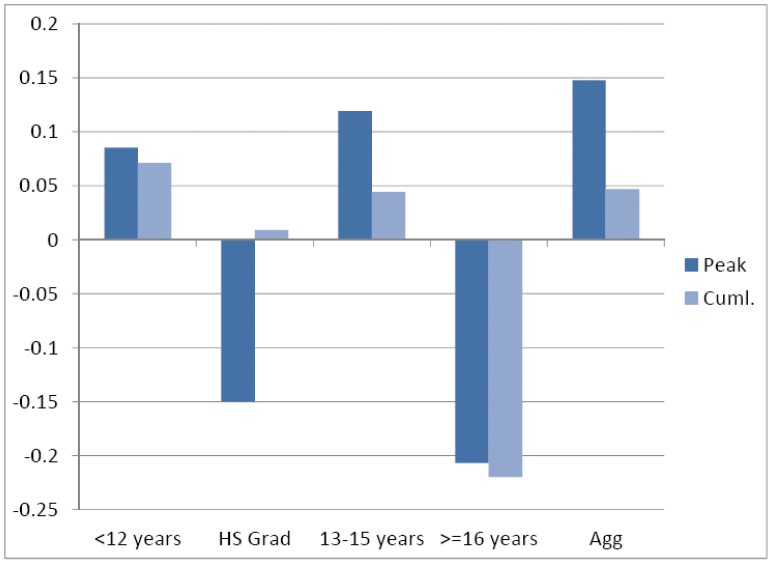
Panel B. Comparisons

Age Groups	15-24	25-34	35-44	45-70	71-90	Agg.
15-24	–	*	*	*	*	*
25-34	–	–				
35-44	–	–	–			
45-70	–	–	–	–		
71-90	–	–	–	–	–	

Notes: The table reports cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a tax policy shock for individuals sorted according to their education level. Individuals are sorted in groups with either no high school degree ("<12 years"), high school graduates ("HS Grad"), individuals exposed to some college ("13-15 years"), or those with at least a college degree ("≥16 years"). Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Table A.1. Cumulative Impulse Responses to a Government Spending Policy Shock By Education

Panel A. Multiplier Size



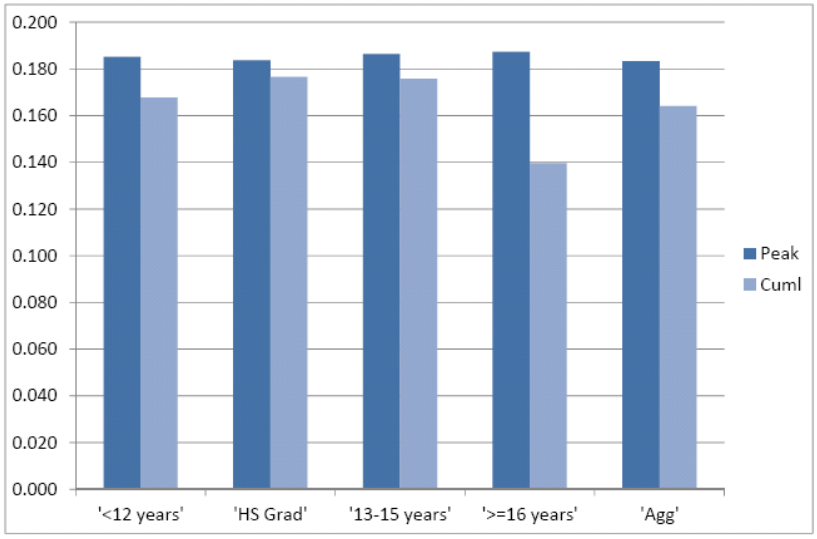
Panel B. Comparisons

Education Groups	<12 yrs	HS Grad	13-15 yrs	≥16 yrs	Agg.
<12 yrs	–			††	
HS Grad	–	–		†††	
13-15 yrs	–	–	–	*, ††	
≥16 yrs	–	–	–	–	***, †††

Notes: The table reports the cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a government spending policy shock for individuals sorted according to their education level. Individuals are sorted in groups with either no high school degree ("12 years"), high school graduates ("HS Grad"), individuals exposed to some college ("13-15 years"), or those with at least a college degree ("16 years"). Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Table A.2. Cumulative Impulse Responses to a Tax Policy Shock By Education

Panel A. Multipliers Size



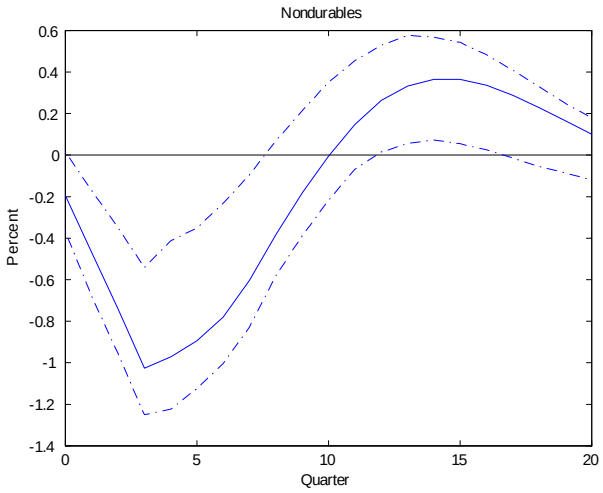
Panel B. Comparisons

Education Groups	<12 yrs	HS Grad	13-15 yrs	≥16 yrs	Agg.
<12 yrs	–				
HS Grad	–	–		†	
13-15 yrs	–	–	–	*, †	
≥16 yrs	–	–	–	–	

Notes: The table reports the cumulative Impulse Responses (that is, the sum of the responses at horizons from 1 to 20 quarters) of consumption (Panel A) to a government spending policy shock for individuals sorted according to their education level. Individuals are sorted in groups with either no high school degree ("12 years"), high school graduates ("HS Grad"), individuals exposed to some college ("13-15 years"), or those with at least a college degree ("16 years"). Statistical significance of the peak multiplier is indicated by asterisks: * , ** , and *** denote 68%, 90%, and 95% significance, respectively. Statistical significance of the cumulative multiplier is indicated by daggers: † , †† , and ††† denote 68%, 90%, and 95% significance, respectively.

Figure 1. Impulse-Responses to a Govt. Spending Shock in Aggregate Consumption Data.

Panel A. NIPA (Nondurables)



Panel B. CEX (Nondurables)

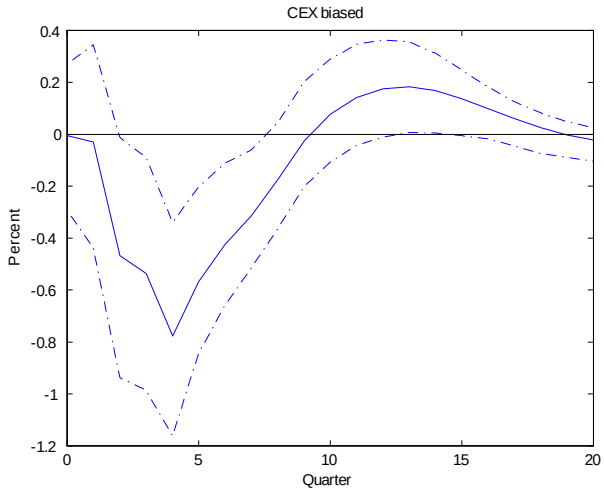
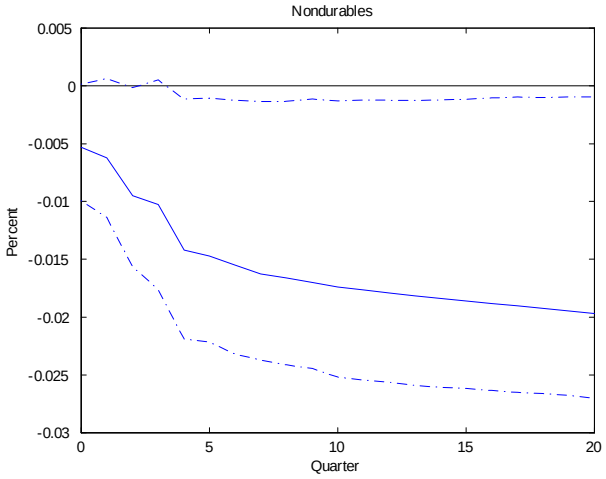


Figure 2. Impulse-Responses to a Tax Shock in Aggregate Consumption Data.

Panel A. NIPA (Nondurables)



Panel B. CEX (Nondurables)

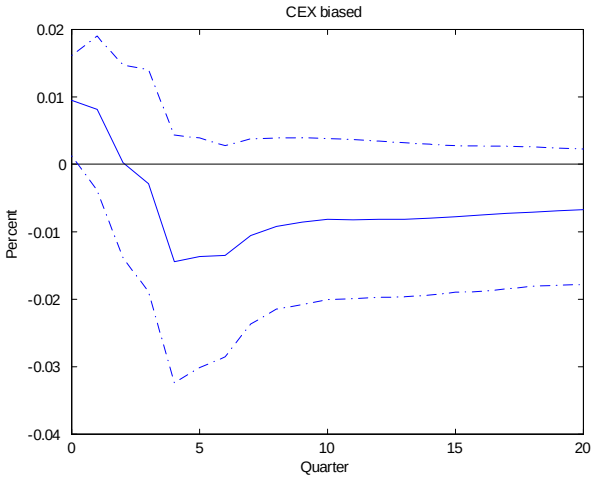


Figure 3. Impulse Responses of Consumption to a Government Spending Shock by Income Group (68% standard error bands)

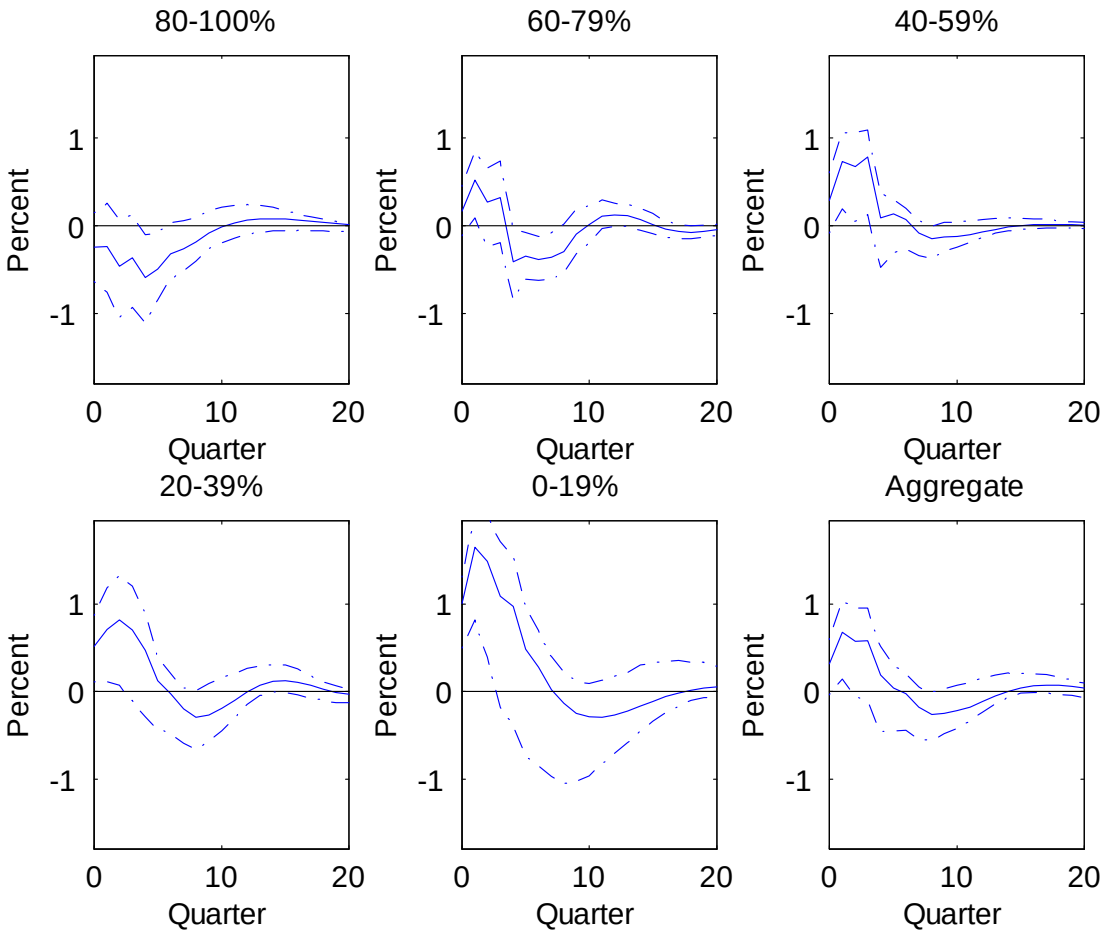


Figure 4. Impulse Responses of Consumption to a Government Spending Shock by Age Group (68% standard error bands)

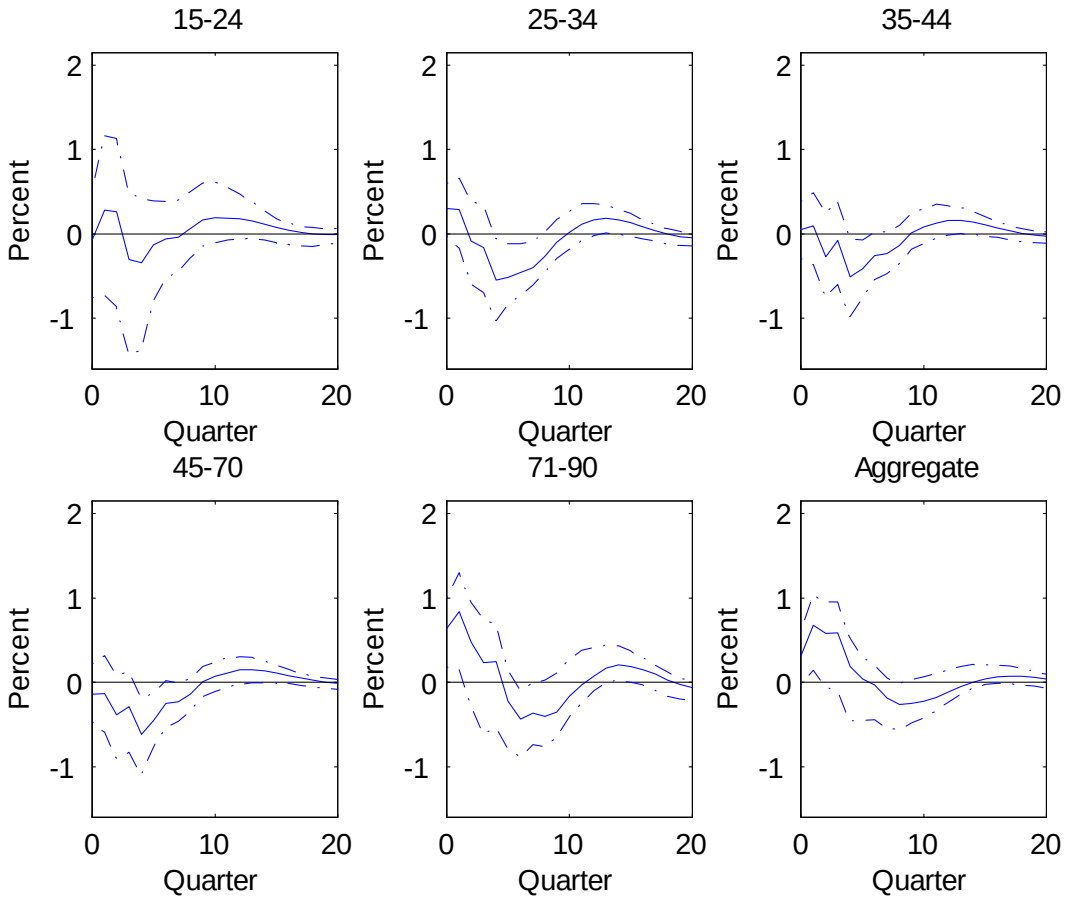


Figure 5. Impulse Responses of Consumption to a Tax Shock by Income Quintile (68% standard error bands)

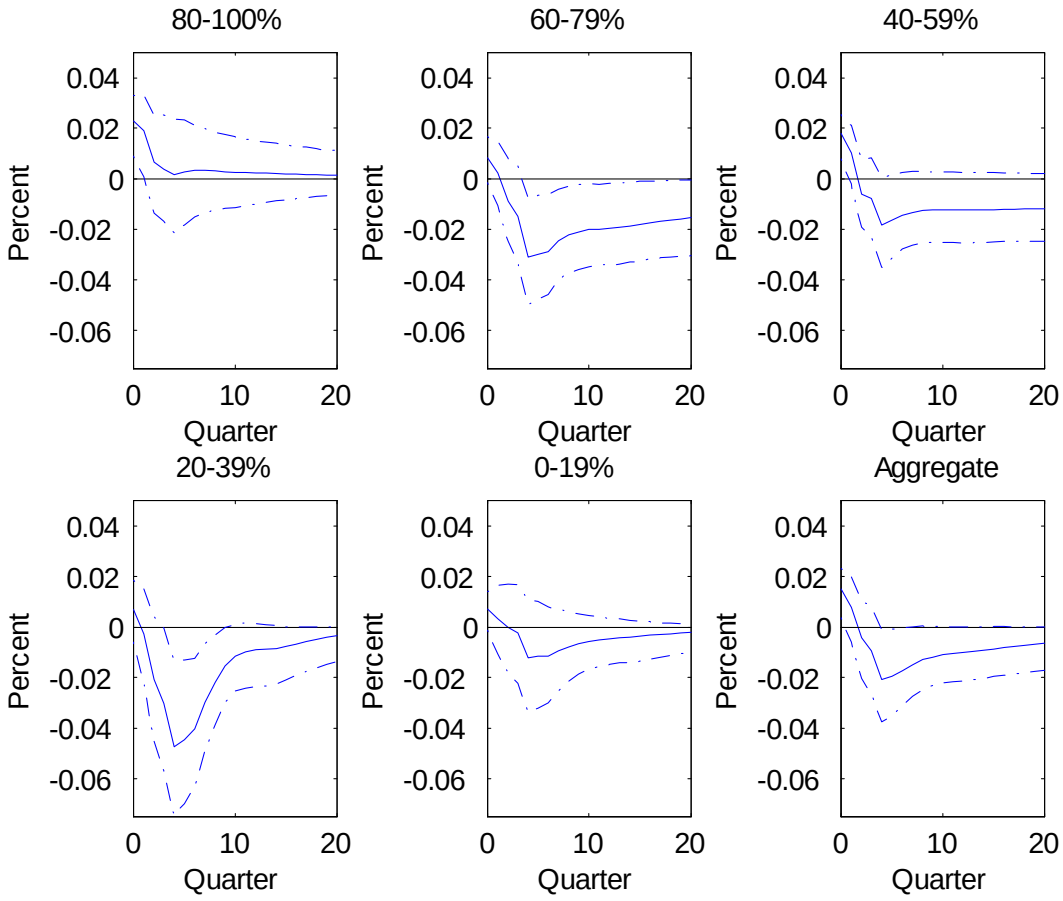


Figure 6. Impulse Responses of Consumption to a Tax Shock by Age Group (68% standard error bands)

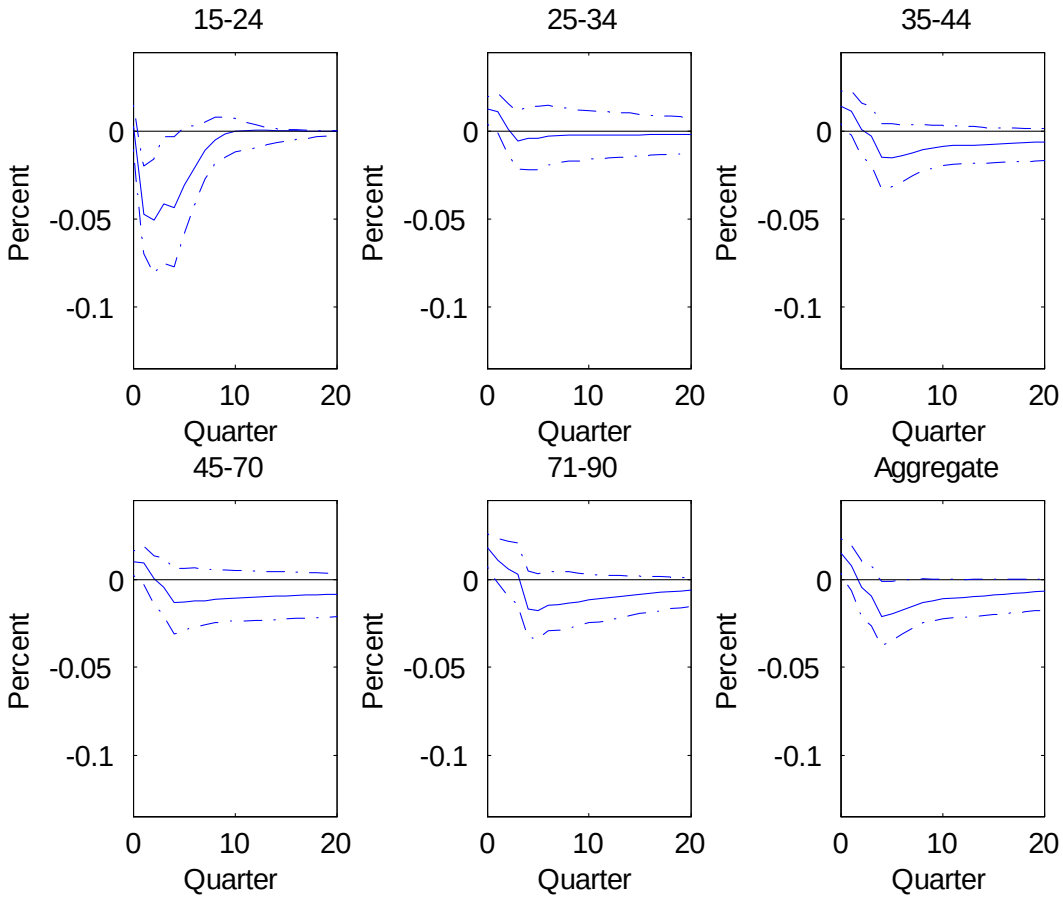
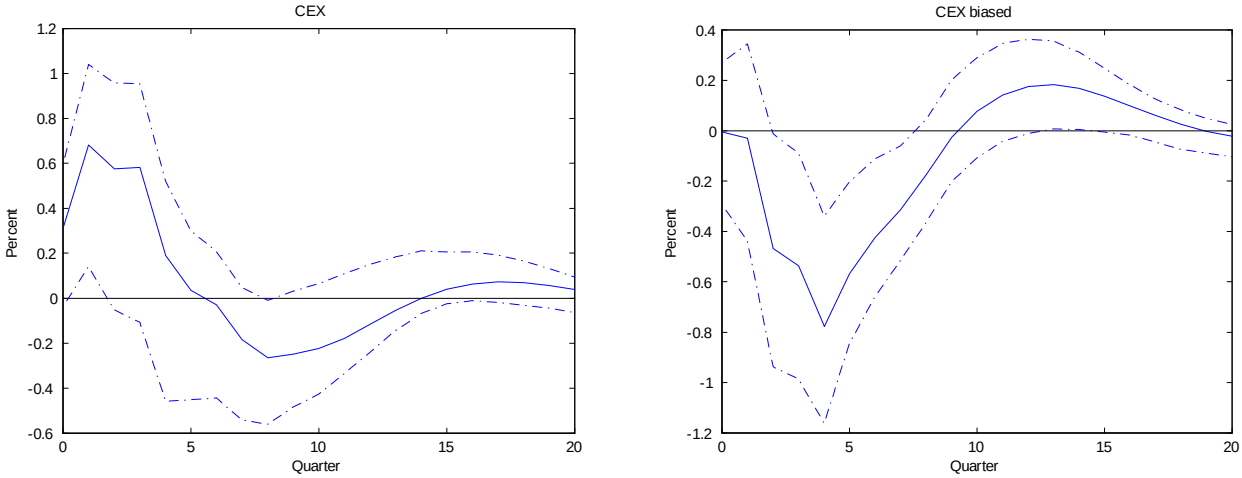


Figure 7. Aggregate Consumption Responses to a Government Spending Shock (68% bands)

Panel A. Response of Aggregate CEX Consumption



Panel B. Responses of Personal Consumption Expenditure Components from NIPA

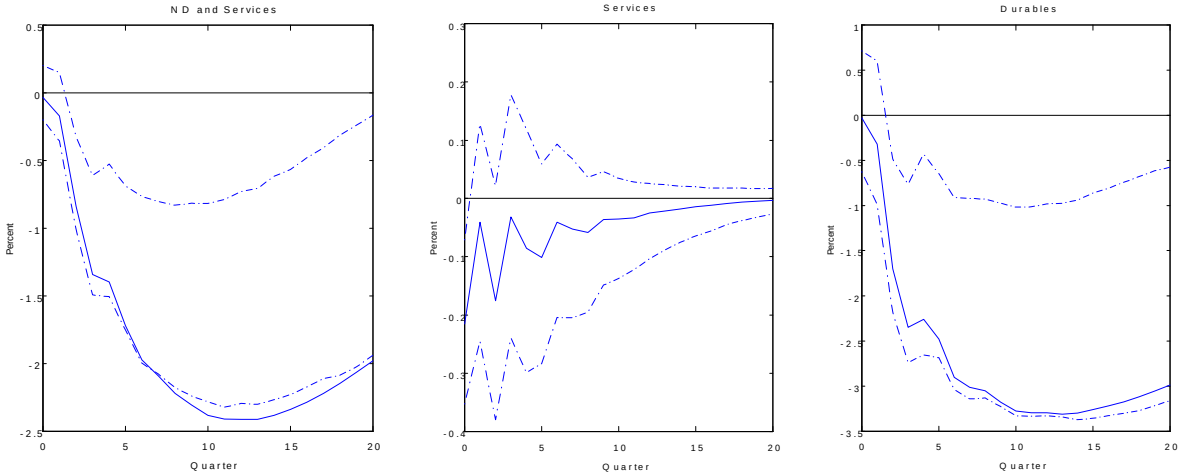
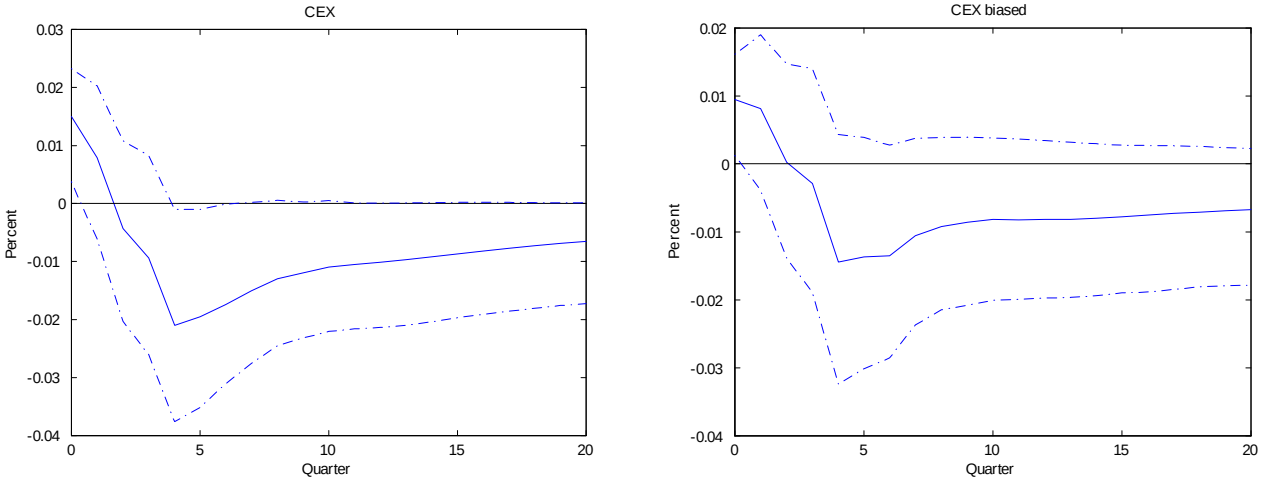


Figure 8. Aggregate Response of Consumption to a Tax Policy Shock (68% bands)

Panel A. Responses of Aggregate CEX Consumption



Panel B. Responses of Personal Consumption Expenditure Components from NIPA

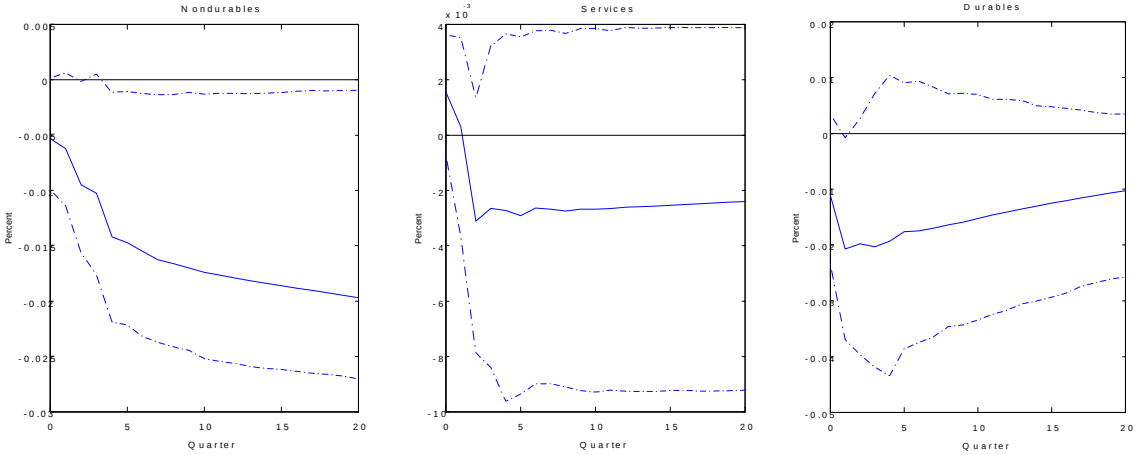


Figure 9. Impulse Responses of Consumption to an Unanticipated Tax Shock by Income Quintile (68% standard error bands)

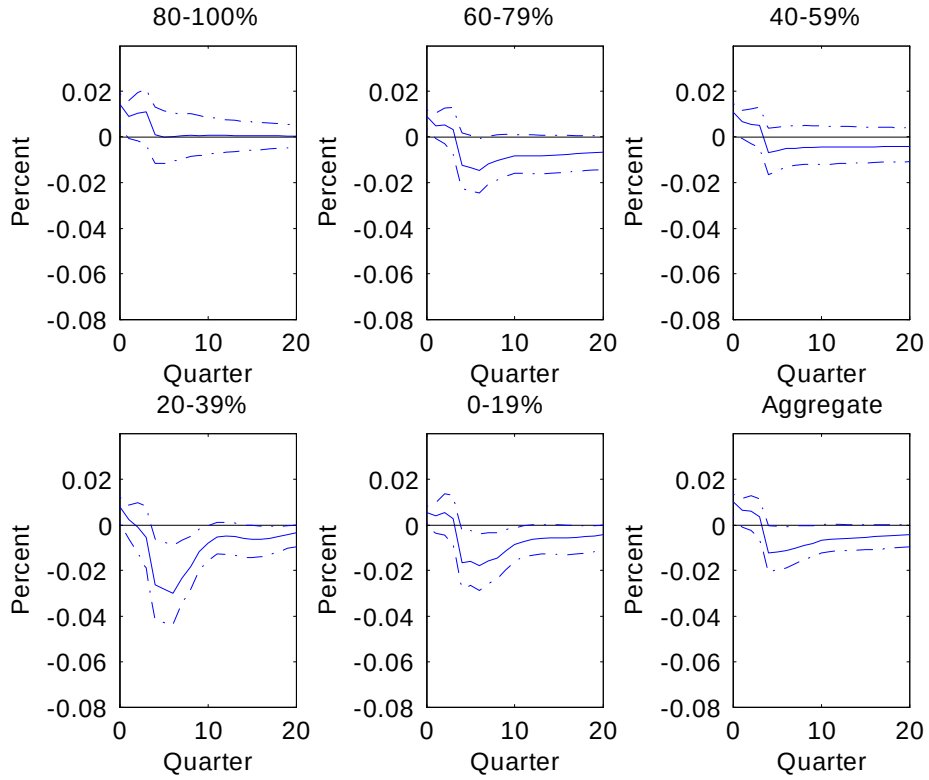
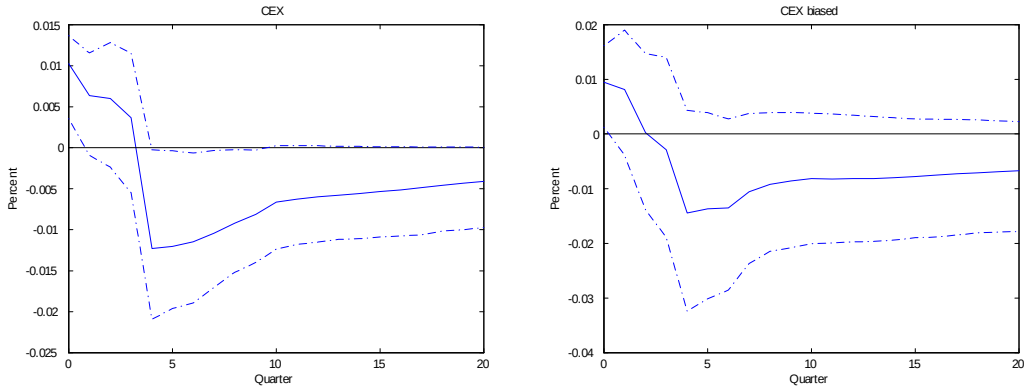


Figure 10. Aggregate Consumption Responses to an Unanticipated Tax Policy Shock

Panel A. Responses of CEX Consumption



Panel B. Responses of Personal Consumption Expenditure Components from NIPA

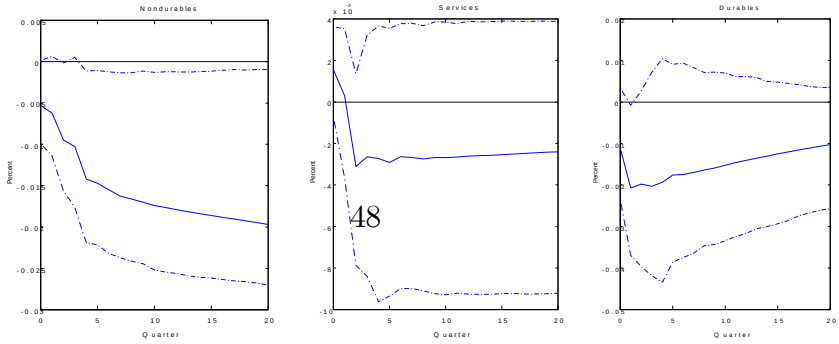


Figure 11. Impulse Responses of Consumption to a Tax Shock to Individual Income by Income Quintile (68% standard error bands)

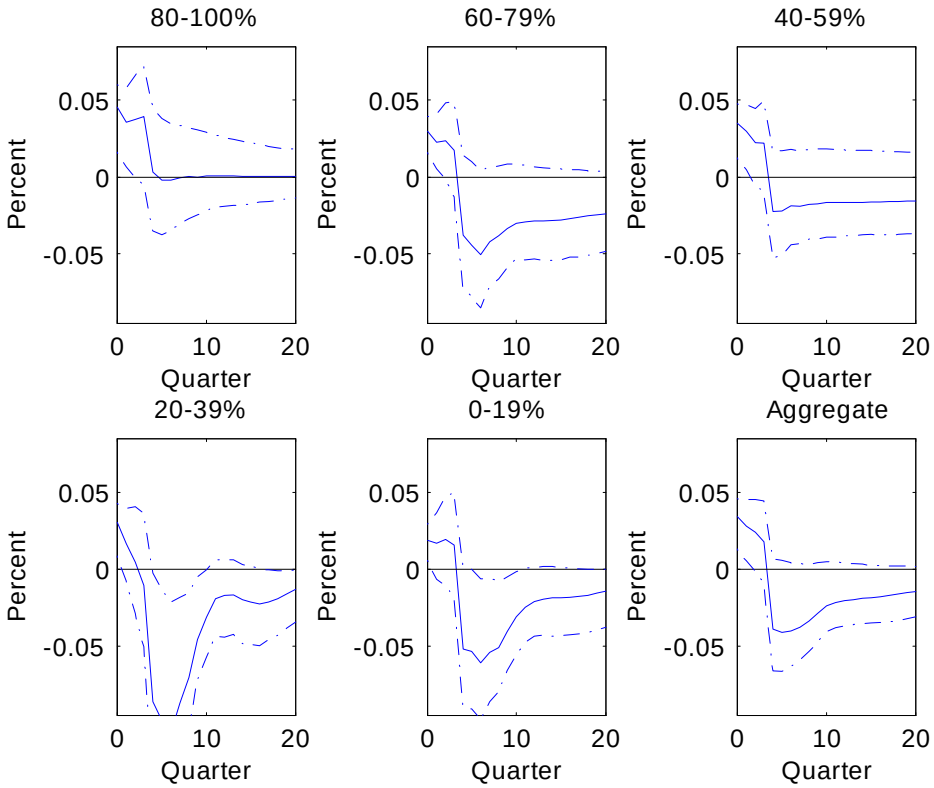
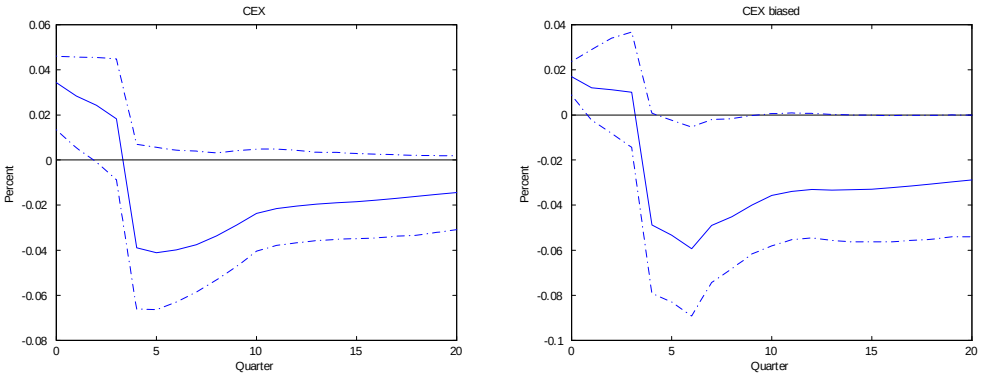


Figure 12. Aggregate Consumption Responses to an Individual Income Tax Shock

Panel A. Response of CEX Consumption



Panel B. Responses of Personal Consumption Expenditure Components from NIPA

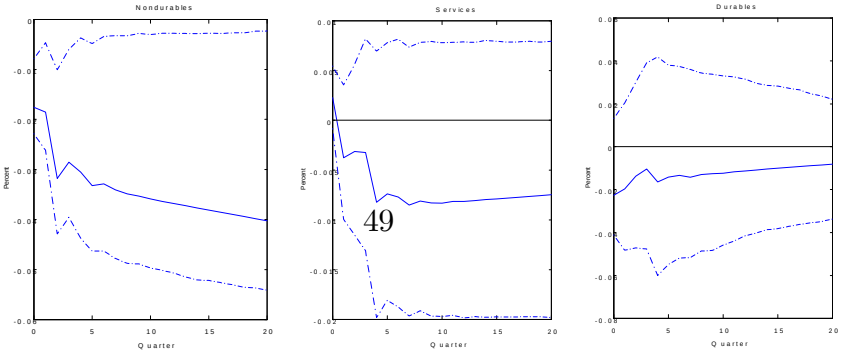


Figure 13. Impulse Responses of Consumption to a Tax Shock to Employment by Income Quintile (68% standard error bands)

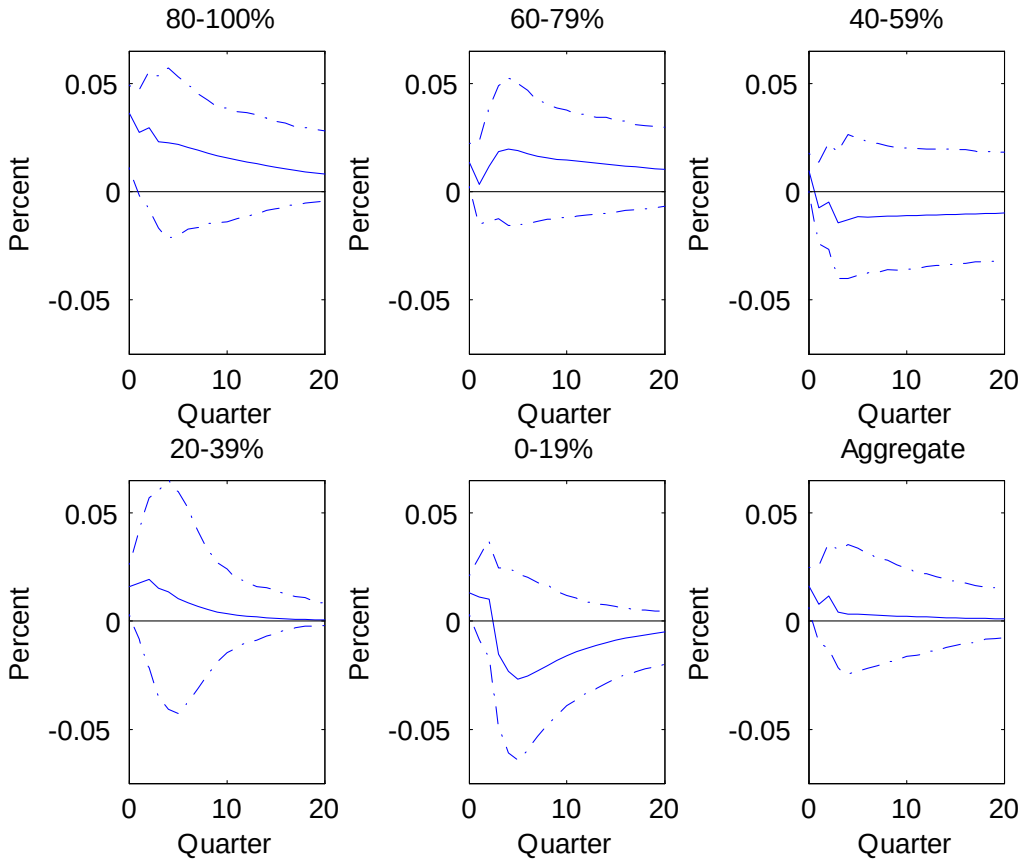


Figure 14. Impulse Responses of Consumption to a Tax Shock under Republican government by Income Quintile (68% standard error bands)

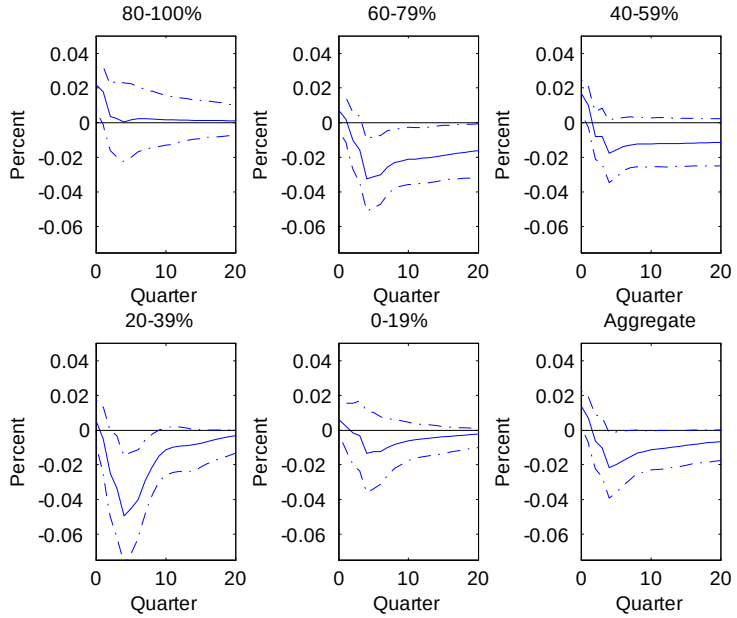


Figure 15. Impulse Responses of Consumption to a Tax Shock under Democratic government by Income Quintile (68% standard error bands)

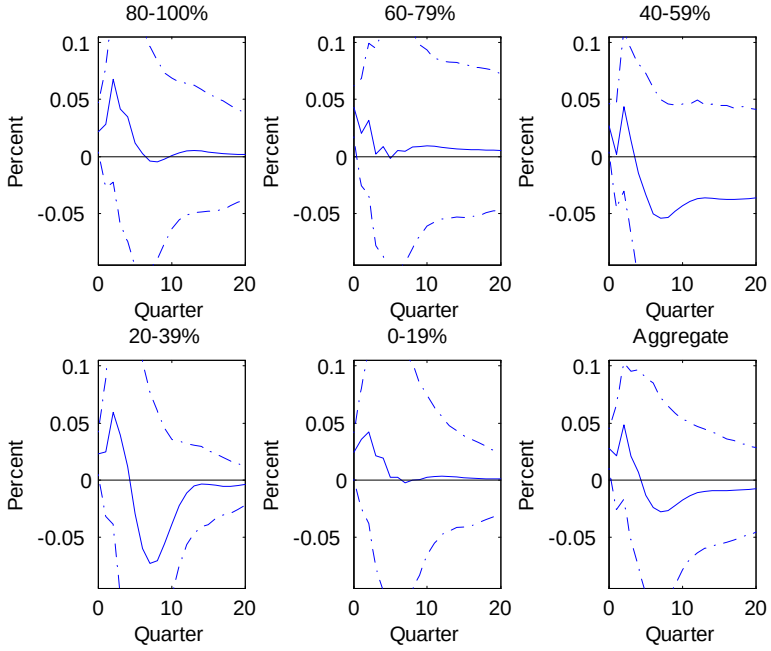


Figure A.1. Impulse Responses of Consumption to a Government Spending Shock by Education Group (68% standard error bands)

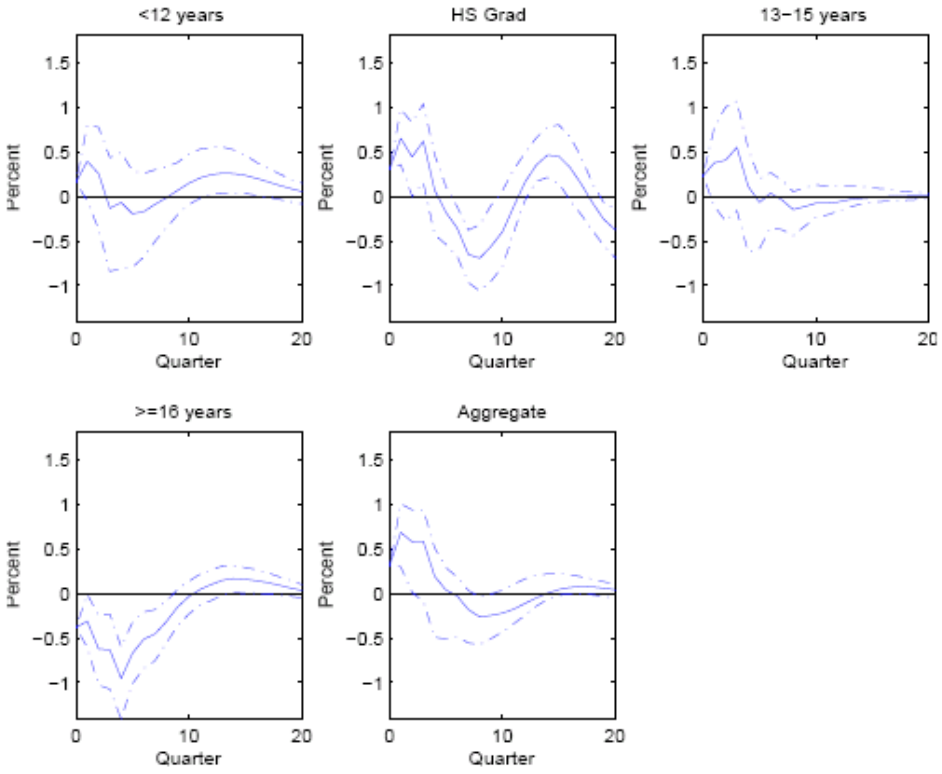


Figure A.2. Impulse Responses of Consumption to a Tax Policy Shock by Education Group (68% standard error bands)

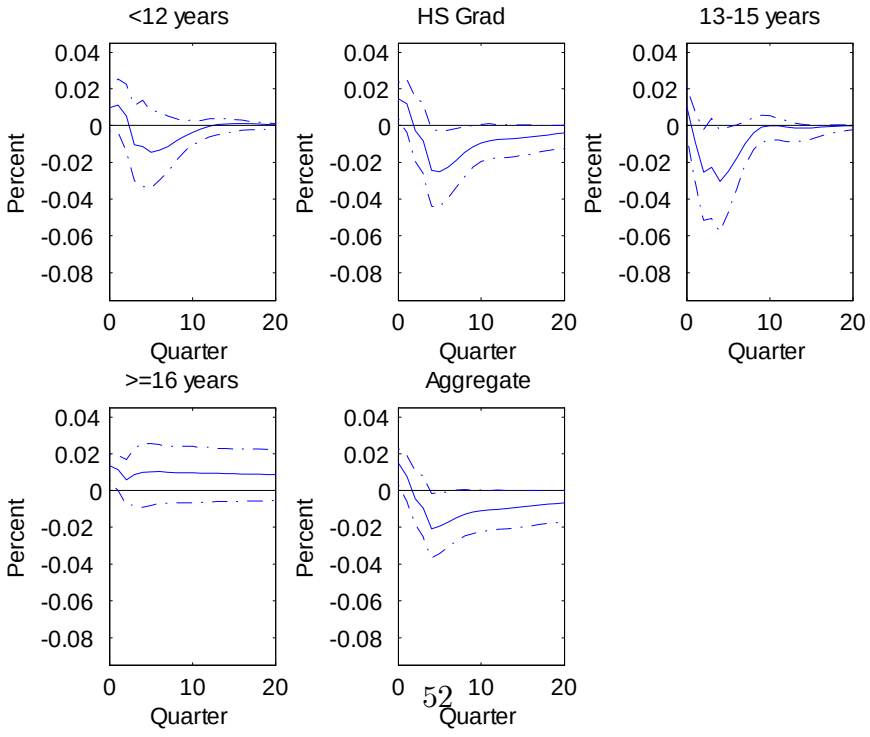
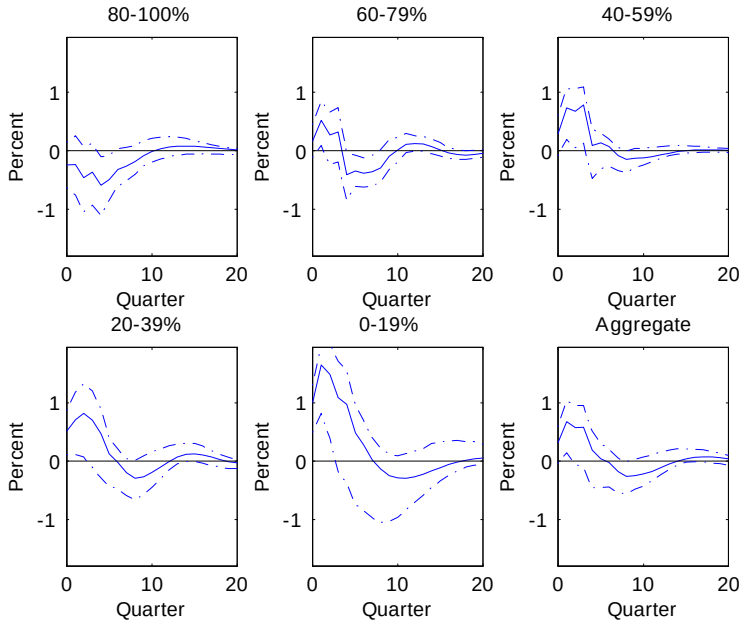


Figure A.3. Impulse Responses of Consumption to a Government Spending Policy Shock by Income Group (68% standard error bands)

Panel A. Responses of Consumption



Panel B. Responses of Income