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On the Dynamic Effects of Fiscal Policy

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Résumé

Dans le sillage de la récession mondiale de 2008-09, plusieurs questions ont été soulevées dans la littérature économique sur les effets à court et à long terme de la politique budgétaire sur l'activité économique par rapport à son signe, sa taille et sa durée. Ceux-ci ont des implications importantes pour mieux comprendre les canaux de transmission et l'efficacité des politiques budgétaires, avec la politique monétaire étant poursuivi, ainsi que pour leurs retombées économiques.

Cette thèse fait partie de ce regain d'intérêt de la littérature d'examiner comment les changements dans la politique budgétaire affectent l'activité économique. Elle repose alors sur trois essais: les effets macroéconomiques des chocs de dépenses publiques et des recettes fiscales, les résultats macroéconomiques de l'interaction entre les politiques budgétaire et monétaire et le lien entre la politique budgétaire et la répartition des revenus.

Le premier chapitre examine les effets des chocs de politique budgétaire (chocs de dépenses publiques et chocs de recettes fiscales) sur l'économie canadienne au cours de la période 1970-2010, en s'appuyant sur la méthode d'identification des restrictions de signe développée par Mountford and Uhlig [2009]. En réponse à la récession mondiale, les autorités fiscales dans les économies avancées, dont le Canada ont généralement mis en œuvre une approche en deux phases pour la politique budgétaire. Tout d'abord, ils ont introduit des plans de relance sans précédent pour relancer leurs économies. Par exemple, les mesures de relance au Canada, introduites à travers le Plan d'action économique du Canada, ont été projetées à 3.2 pour cent du PIB dans le budget fédéral de 2009 tandis que l' "American Recovery and Reinvestment Act"(ARRA) a été estimé à 7 pour cent du PIB. Par la suite, ils ont mis en place des plans d'ajustement en vue de réduire la dette publique et en assurer la soutenabilité à long terme. Dans ce contexte, évaluer les effets multiplicateurs de la politique budgétaire est important en vue d'informer sur

l'efficacité de telles mesures dans la relance ou non de l'activité économique. Les résultats montrent que les multiplicateurs d'impôt varient entre 0.2 et 0.5, tandis que les multiplicateurs de dépenses varient entre 0.2 et 1.1. Les multiplicateurs des dépenses ont tendance à être plus grand que les multiplicateurs des recettes fiscales au cours des deux dernières décennies.

Comme implications de politique économique, ces résultats tendent à suggérer que les ajustements budgétaires par le biais de grandes réductions de dépenses publiques pourraient être plus dommageable pour l'économie que des ajustements budgétaires par la hausse des impôts.

Le deuxième chapitre, co-écrit avec Constant Lonkeng Ngouana, estime les effets multiplicateurs des dépenses publiques aux Etats-Unis en fonction du cycle de la politique monétaire. Les chocs de dépenses publiques sont identifiés comme étant des erreurs de prévision du taux de croissance des dépenses publiques à partir des données d'Enquêtes des prévisionnistes professionnels et des informations contenues dans le "Greenbook". L'état de la politique monétaire est déduite à partir de la déviation du taux des fonds fédéraux du taux cible de la Réserve Fédérale, en faisant recours à une fonction lisse de transition. L'application de la méthode des «projections locales» aux données trimestrielles américaines au cours de la période 1965-2012 suggère que les effets multiplicateurs des dépenses fédérales sont sensiblement plus élevées quand la politique monétaire est accommodante que lorsqu'elle ne l'est pas. Les résultats suggèrent aussi que les dépenses fédérales peuvent stimuler ou non la consommation privée, dépendamment du degré d' accommodation de la politique monétaire. Ce dernier résultat réconcilie ainsi, sur la base d' un cadre unifié des résultats autrement contradictoires à première vue dans la littérature.

Ces résultats ont d'importantes implications de politique économique. Ils suggèrent globalement que la politique budgétaire est plus efficace lorsqu'on en a le plus besoin (par exemple, lorsque le taux de chômage est élevé), si elle est soutenue par la politique monétaire. Ils ont également des implications pour la normalisation des conditions monétaires dans les pays avancés: la sortie des politiques monétaires non-conventionnelles conduirait à des multiplicateurs de dépenses fédérales beaucoup plus faibles qu'autrement, même si le niveau de chômage restait élevé. Ceci renforce la nécessité d'une calibration prudente du calendrier de sortie des politiques monétaires non-conventionnelles.

Le troisième chapitre examine l'impact des mesures d'expansion et de contraction budgétaire sur la distribution des revenus dans un panel de 18 pays d'Amérique latine au cours de la période 1990-2010, avec un accent sur les deniers 40 pour cent. Il explore alors comment ces mesures fiscales ainsi que leur composition affectent la croissance des revenus des dernier 40 pour cent, la croissance de leur part de revenu ainsi que la croissance économique. Les mesures d'expansion et de contraction budgétaire sont identifiées par des périodes au cours desquels il existe une variation significative du déficit primaire corrigé des variations conjoncturelles en pourcentage du PIB.

Les résultats montrent qu'en moyenne l'expansion budgétaire par la hausse des dépenses publiques est plus favorable à la croissance des revenus des moins bien-nantis que celle par la baisse des impôts. Ce résultat est principalement soutenu par la hausse des dépenses gouvernementales de consommation courante, les transferts et subventions. En outre ces mesures d' expansion budgétaire sont favorables à la réduction des inégalités car elle permettent d'améliorer la part des revenus des moins bien-nantis tout en réduisant la part des revenus des mieux-nantis de la distribution des revenus. En outre ces mesures d' expansion budgétaire sont favorables à la réduction des inégalités car elle permettent d'améliorer la part des revenus des moins bien-nantis tout en réduisant la part des revenus des mieux-nantis de la distribution des revenus. Cependant, l'expansion budgétaire pourrait soit n'avoir aucun effet sur la croissance économique ou entraver cette dernière à travers la hausse des dépenses en capital. Les résultats relatifs à la contraction budgétaire sont quelque peu mitigés. Parfois, les mesures de contraction budgétaire sont associées à une baisse de la croissance des revenus des moins bien nantis et à une hausse des inégalités, parfois l'impact de ces mesures est non significatif. Par ailleurs, aucune des mesures n' affecte de manière significative la croissance du PIB.

Comme implications de politique économique, les pays avec une certaine marge de manœuvre budgétaire pourraient entamer ou continuer à mettre en œuvre des programmes de "filets de sauvetage"–par exemple les programmes de transfert monétaire conditionnel–permettant aux segments vulnérables de la population de faire face à des chocs négatifs et aussi d'améliorer leur conditions de vie. Avec un potentiel de stimuler l'emploi peu qualifié, une relance budgétaire sage par les dépenses publique courantes pourrait également jouer un rôle important pour la réduction des inégalités. Aussi, pour éviter que les dépenses en capital freinent la croissance économique, les projets

d'investissements publics efficients devraient être prioritaires dans le processus d'élaboration des politiques. Ce qui passe par la mise en œuvre des projets d'investissement avec une productivité plus élevée capable de générer la croissance économique nécessaire pour réduire les inégalités.

Mots-clés : Politique budgétaire, effets multiplicateurs de la politique budgétaire, restrictions de signe, déficits jumeaux, politique monétaire accommodante, projections locales, inégalité des revenus.

Abstract

In the wake of the 2008-09 Global Recession, several issues have been raised in the economic literature about the short and long-run effects of fiscal policy on economic activity with respect to its signs, its size and its duration. These have important implications to better understand the transmission channels and the effectiveness of fiscal policies, along with the monetary policy being pursued, as well as for their economic fallouts.

This dissertation is part of this renewed strand of literature to assess how changes in fiscal policy affect economic activity. It therefore relies on three essays: the macroeconomic effects of government spending and tax revenue shocks, the economic outcomes of the interaction between fiscal and monetary policies and the nexus between fiscal policy and income distribution.

The first chapter examines the effects of fiscal policy shocks (government spending and tax revenue shocks) on the Canadian economy, building on the sign-restrictions-VAR approach developed by Mountford and Uhlig [2009]. In response to the Global Recession, fiscal authorities in advanced economies including Canada typically implemented a two-phase approach to fiscal policy. First, they introduced unprecedented stimulus packages to revive their economies. For instance, stimulus measures in Canada, introduced through Canada's Economic Action Plan, were projected at 3.2 percent of GDP in the 2009 federal budget while the American Recovery and Reinvestment Act(ARRA) was estimated at 7 percent of GDP. Following the stimulus, they shifted gears, adopting adjustment plans to reduce public debt and ensure long-term fiscal sustainability. Against this backdrop, examining the size of fiscal multiplier is important to informing the effectiveness of such policy measures in reviving or not economic activity. I find that tax-cut multipliers vary between 0.2 and 0.5, while spending multipliers range between 0.2 and 1.1. Spending multipliers tend to be larger than tax-cut multipliers over the last two decades.

For policy implications, these results tend to suggest that fiscal consolidations through large spending cuts could be more harmful to the economy than tax-based fiscal adjustments.

The second chapter, co-written with Constant Lonkeng Ngouana, provides estimates of the US government spending multiplier over the monetary policy cycle. Government spending shocks are identified as forecast errors of the growth rate of government spending from the Survey of Professional Forecasters (SPF) and from the Greenbook record, further stripped from their predictable components. The state of monetary policy is inferred from the deviation of the Fed funds rate from the target rate, using a smooth transition function. Applying the local projections method to quarterly US data over the period 1965-2012, results show that the federal government spending multiplier is substantially higher under accommodative than non-accommodative monetary policy. The estimations also suggest that federal government spending may crowd-in or crowd-out private consumption, depending on the extent of monetary policy accommodation. The latter result reconciles—in a unified framework—apparently contradictory findings in the literature.

These findings have important policy implications. They broadly suggest that fiscal policy is more effective when needed the most (e.g., at times of slack), if supported by monetary policy. They also have implications for the normalization of monetary conditions in advanced economies: the exit from UMP would lead to much lower federal government spending multipliers than otherwise, even if some amount of slack was to remain in the economy. This further highlights the need for a careful calibration of the timing of exit from unconventional monetary policy.

The third chapter examines the impact of fiscal expansion and fiscal contraction measures on income distribution in a panel of 18 Latin American countries over the period 1990-2010, with a focus on the bottom 40 percent. It therefore explores how these fiscal measures and their composition have affected the income growth of the bottom 40 percent, their income share growth and economic growth. Fiscal expansions and fiscal consolidations are identified by periods for which there is a significant change in the cyclically-adjusted primary deficit as share of GDP. I find that on average, expenditures-based fiscal expansion are more likely to increase the income of the bottom 40 percent than revenues-based fiscal expansion. This result is mainly driven by government current consumption, transfers and subsidies.

In addition, these fiscal expansion measures help to reduce income inequality by improving the income share of the bottom segments of the population while reducing the top income share. However, fiscal expansion could either have no effect on economic growth or prevent the latter through capital expenditures increases. Results for fiscal consolidation are somewhat mixed. Sometime, fiscal consolidation is associated with a decline of the income growth of the less well-off and rising inequality, sometime the impact is non-significant. None of the fiscal contraction measures affects significantly GDP growth.

These findings have important policy implications. Countries with some fiscal space could initiate or continue to implement safety nets program–like conditional cash transfer programs–necessary to prevent the vulnerable segment of the population to adverse shocks and to improve their living standards. With a potential of stimulating low-skill employment, a wise fiscal stimulus through government current consumption increases could also play a significant role to reduce income inequality. Also, to avoid capital expenditures that hinder economic growth, efficient public investment projects should be prioritized in the policy making process. This consists of implementing investment projects with higher productivity that can enhance economic growth necessary to reduce inequality.

Keywords : Fiscal policy, fiscal multipliers, sign restrictions, twin deficits, accommodative monetary policy, local projection, income inequality, income growth of the bottom 40 percent.

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Chapter 1

Effects of Fiscal Policy Shocks on a Small Open Economy: Evidence from Canada

1.1 Introduction

The aftermath of the 2008-09 Great Recession triggered renewed interest on the impact of fiscal policy changes on the economy. In response to the global recession, countries typically implemented a two-phase approach to fiscal policy. First, the sudden economic collapse led fiscal authorities in many advanced economies, including Canada, to introduce stimulus packages to revive their economies. Following the stimulus, fiscal authorities shifted gears, adopting adjustment plans to reduce public debt and ensure long-term fiscal sustainability and sustained growth.

Stimulus measures in Canada, introduced through Canada's Economic Action Plan, were projected at 3.2 percent of GDP in the 2009 federal budget while the ARRA was estimated at 7 percent of GDP. As a result, the federal net debt-to-GDP ratio was expected to increase from 28.6 percent in the 2008-09 fiscal year to 32.1 percent by 2010-11. As the economy started to recover, the Canadian government introduced adjustment plans to tackle high deficits and increased public debt. The federal expenditures-to-GDP ratio, which rose from about 13 percent before the crisis to 16 percent in 2009-10, declined to 14 percent in 2011 and was projected in the 2012 budget to return to the pre-crisis level by 2014-15. The 2012 budget also projected that adjustment measures would bring the federal net debt-to-GDP ratio back to the pre-crisis level by 2014-15, while the consolidated net debt-to-GDP ratio (including federal, provincial and local administrations) was projected to fall to 36.3 percent of GDP (IMF Fiscal Monitor, April 2013). [1] Therefore, examining the size of fiscal multiplier is important to informing the effectiveness of such policy measures in reviving or not economic activity.

While extensive analysis has been conducted on the U.S. economy, only a few studies (Perotti [2004], Corsetti and Müller [2006], Ravn et al. [2007] and Monacelli and Perotti [2010]) have investigated the impact of fiscal policy changes in Canada. One challenge when studying the effects of fiscal policy changes is to disentangle the automatic fiscal stabilizers to business cycle fluctuations from changes attributed to discretionary policy decisions.

1. The total net debt, according to the IMF's Fiscal Monitor, rose from 22.4 percent of GDP in 2008 to 34.6 in 2012, and is projected to start falling in 2016 from 36.3 percent. Meanwhile, the total gross debt rose from 71.3 percent of GDP in 2008 to 85.6 percent in 2012, and was projected to fall in 2014 to 84.6 percent of GDP, reaching 78.2 percent in 2018.

This is even more important in a small open economy such as Canada, which is subject to foreign shocks that affect key macroeconomic variables as well as fiscal variables. To identify exogenous changes in fiscal policy, it is important to control for the effects of foreign shocks. Canada is highly integrated with the U.S. through trade and financial links. The U.S. accounts for about 75 percent of total Canadian exports, and American ownership of Canadian assets was valued at more than 50 percent of Canadian GDP in 2009. [2] Any demand shock affecting the U.S. may have a spillover effect on the Canadian economy due to the importance of U.S.-Canada trade. The induced changes in exports may affect corporate tax revenues and GDP. As a net oil exporter, [3] Canada is susceptible to changes in the world oil price. The Canadian economy produces about 4.1 percent of the world's crude oil and petroleum products. Any increase in oil prices may induce a rise in nominal oil exports, and subsequently result in an increase in tax revenue through corporate income taxes. Consequently, the observed change in Canadian fiscal variables and their possible effects on the economy should not be attributed solely to domestic fiscal policy changes.

The existing literature (e.g. Perotti [2004], Corsetti and Müller [2006], Ravn et al. [2007], Monacelli and Perotti [2010] and Owyang et al. [2013]) does not explicitly take into account spillovers from the U.S. economy and the effects of oil prices. Thus, this paper contributes to the literature by examining the impact of government spending and net tax revenue shocks on key Canadian macroeconomic variables, conditional on U.S. economic developments and fluctuations in the world oil price.

I use a VAR model with block exogeneity: a Canadian block including key macroeconomic and fiscal variables, and a U.S. block including U.S. real GDP to capture economic activity in the U.S. and the real oil price. I allow the Canadian block to depend on the U.S. block, which is assumed to be exogenous to the Canadian economy. As a small oil producer with a minor contribution to the global economy, I assume that changes in the Canadian economy do not affect international oil prices and U.S. GDP. However, I allow for an interdependency between U.S. GDP and oil prices. Indeed, as the main driver of the global activity, changes to U.S. oil demand may affect

2. According to Statistics Canada.

3. According to Energy Canada in 2013, Canada produces about 2.5 million barrels of oil per day and consumes about 1.85 million barrels per day, and imports about 930,000 barrels per day and exports about 1.63 million barrels per day.

international oil prices, and vice-versa. International oil prices may also be affected by the supply of U.S. oil with the exploitation of shale oil.

My study examines the period from 1970:Q1 to 2010:Q4. [4] Structural shocks are identified using the Mountford and Uhlig [2009] sign restrictions approach. I identify a *generic business cycle shock* and two fiscal shocks: a *government spending shock* and a *net tax revenue shock*, each orthogonal to the business cycle shock. [5]

A number of exercises are performed to test the robustness of my findings. After examining the impulse response functions (IRFs) for the identified shocks, I assess GDP multipliers associated with net taxes and spending increases with different specifications of the model: using only Canadian variables, controlling only for the impact of U.S. GDP or oil prices, and controlling for both. I split the sample at the fourth quarter of 1990 to test the stability of the impact of fiscal policy shocks before and after the fourth quarter of 1990. [6] Then, I compare my results to the existing literature, and conclude by comparing net tax multipliers and spending multipliers to draw some policy conclusions.

The analysis of IRFs over the entire study period shows that output, consumption and investment decline in response to an increase in net tax revenue. Output and private consumption increase following a government spending shock, while private investment falls. Net exports decline in response to both spending and net tax increases (with a short delay for the decline in response to a net increase in taxes) as a consequence of a real exchange rate appreciation.

With respect to the estimated multipliers across different specifications, the sign and statistical significance of estimated multipliers depend on whether exogenous factors are controlled for. At the time of a shock, multipliers associated with spending increases are positive and tend to have similar magnitudes across various model specifications. One quarter after a shock, multipliers associated with spending increases tend to be negative, but are

4. I choose this sample period because Canada employed a fixed exchange rate regime before 1970 and a flexible exchange rate after 1970. Given that government spending multiplier tend to vary according to the exchange rate regime(see Ilzetzki et al. [2013]), I prefer to limit the study on the flexible exchange rate regime period.

5. The methodology section details how these shocks are identified.

6. The Bank of Canada introduced an inflation-targeting regime in the first quarter of 1991. This structural reform could have some implications for the size of fiscal multipliers.

not statistically significant if both the U.S. GDP and world oil prices are controlled for.

For the multipliers associated with net tax increases, the negative effects of net taxes on GDP tend be larger when exogenous controls are included in the VAR (except for the first quarter). [7]

With respect to sub-period analysis, the impact of spending increases on GDP and net exports [8] tends to be larger after the fourth quarter of 1990, while the reverse holds true for investment and consumption. For the impact of net taxes, the decline in GDP is more important in the first sub-period, while the reverse holds true for private investment in the second sub-period; the impact on consumption tends to be stable. The positive co-movement of net exports with the real effective exchange rate (REER) in response to a net tax shock in the first sub-period seems counterintuitive.

Quantitatively, I find that the multipliers associated with spending increases are comparable with the findings of some existing Canadian studies, such as the linear VAR estimates in Owyang et al. [2013]. My results are less comparable with the multipliers estimated by Perotti [2004]. My findings of increased private consumption and decreased private investment in response to a government spending shock are consistent with the findings of Ravn et al. [2007] and Perotti [2004]. The decline of net exports in response to spending increases is in line with Corsetti and Müller [2006] and Monacelli and Perotti [2010]. My findings with respect to the effects of both tax and spending increases on GDP, consumption and investment are qualitatively similar to some U.S. studies, including Blanchard and Perotti [2002] and Mountford and Uhlig [2009]. However, the magnitude of the impact of fiscal shocks in their studies tends to be larger as the U.S. is relatively a closed

7. Several explanations are possible for the behavior of fiscal multipliers across different specifications. While it is not clear why the spending multipliers behave in this manner, for net taxes, one possible explanation is the following. When there is no exogenous effect on the VAR, a one-dollar increase in tax revenue might come from changes in tax policy and oil prices, and/or from U.S. GDP fluctuations. Since changes in net tax revenue coming from oil price variations and U.S. GDP variations are not a result of changes in tax rates, they might not have consistent effects on GDP. Therefore, the portion of the impact coming from changes in tax rates might be underestimated. Controlling for these exogenous changes might therefore exacerbate the negative effects of an increase in net tax revenue on GDP, as this increase results entirely from the change in tax policy.

8. While an increase in net exports following a government spending shock is somewhat surprising, this results from a depreciation of the real effective exchange rate.

economy.

A comparison of tax-cut and spending multipliers shows that tax-cut multipliers vary between 0.21 and 0.51. Meanwhile, spending multipliers range between 0.21 and 1.09. Spending multipliers tend to be larger than tax-cut multipliers, particularly after 1990. These results tend to suggest that fiscal adjustments through large spending cuts could be more harmful to the economy than tax-based fiscal adjustments.

The remainder of the paper is organized as follows: section 1.2 briefly reviews other identification strategies, develops the empirical methodology and describes the data; section 1.3 reports and analyzes the results; and section 1.4 concludes.

1.2 Methodology and data

As outlined by Leeper et al. [2013], a difficulty when using a VAR model to study fiscal policy is the model's potential non-invertibility, as changes in fiscal policy can be anticipated in advance. [9] One way to address this issue is to incorporate forecasts of fiscal variables in the VAR, as has been done in recent papers by Auerbach and Gorodnichenko [2012] and Born et al. [2012]. Unfortunately, these forecasts have only been available since 1985, and in a semi-annual frequency, rather than quarterly. Therefore, I have assumed as in existing studies (for example Mountford and Uhlig [2009], Ilzetzki et al. [2013]) that my VAR model is invertible.

Before describing the methodology and the data used in the paper, here is a brief review of some common alternative approaches to identifying fiscal policy shocks.

9. Leeper et al. [2013] argue that conventional method can lead the econometrician to label as 'tax shocks' objects that are linear combinations of all the exogenous disturbances at various leads and lags. [...] Fiscal foresight poses a formidable challenge because [...] it generates an equilibrium with a non fundamental representation, [...] in which the equilibrium time series contains a moving average component that is not invertible in current and past observables.

1.2.1 Alternative approaches of identification of fiscal policy shocks

The narrative approach of Ramey and Shapiro [1998] and Romer and Romer [2010] is a major innovation in identifying fiscal policy shocks. Ramey and Shapiro [1998] identify an exogenous government spending shock using a news variable that captures episodes that led to large military buildups in the U.S..[10] More recently, Owyang et al. [2013] use the same approach to estimate spending multipliers contingent on the state of the economy in Canada and in the U.S.. However, this approach is limited by the number of observations of the news variable for countries such as Canada, which rarely participate in large military operations. Romer and Romer [2010] use narrative records, such as Congressional reports and presidential speeches, to identify the main motivations for all major post-war tax policy changes in the U.S.. Although this approach is more appropriate for identifying exogenous changes in tax revenue, its implementation remains in practice more cumbersome.

Another common technique is the recursive approach. It consists of imposing the condition that government spending or tax revenue is not responsive to business cycle shocks for at least one quarter (this approach is used by Blanchard and Perotti [2002], Perotti [2004], Monacelli and Perotti [2010], Auerbach and Gorodnichenko [2012]). The logic behind this assumption is that fiscal variables need more than one quarter to adjust in response to unexpected changes in GDP. However, this assumption is often criticized.

1.2.2 The sign restrictions method

I extend the methodology employed by Mountford and Uhlig [2009] in the case of a small open economy by assuming a block exogeneity in the VAR model. Sign restrictions are imposed on the IRFs of a set of variables to identify structural shocks. The advantage of this approach is that it does not assume a lack of contemporaneous effects of unexpected changes in GDP on fiscal variables. This strategy is also used to identify exogenous technology shocks (see, for example, Dedola and Neri [2007], Enders et al. [2011]) and

10. These episodes correspond to the Korean war, the Vietnam war, the Carter-Reagan fiscal expansion and, more recently, the aftermath of the Sept. 11, 2001 terrorist attacks (see Ramey [2011]).

monetary policy shocks (see Uhlig [2005], Mallick and Rafiq [2008]).

1.2.2.1 The sign restrictions assumptions

Table 1.1 summarizes the minimal assumptions imposed to identify structural shocks. Following Mountford and Uhlig [2009], a *generic business cycle shock* is defined as a shock that increases Canadian GDP, private consumption, private investment and net tax revenues for four quarters following the shock.

Table 1.1 – Identifying sign restrictions assumptions

	Generic business-cycle shock	*Government spending shock*	*Net tax revenue shock*
Government spending		+	
Net tax revenue	+		+
Private consumption	+		
Private investment	+		
GDP	+		
Net-exports-to-GDP ratio			
GDP deflator			
3-month T-bill rate			
REER			
U.S. GDP	**0**	**0**	**0**
Oil prices	**0**	**0**	**0**

Notes: The sign "+" means that the variable responds positively for 4 quarters following the shock; the "0" means that the impulse responses of the variable are restricted to zero in perpetuity after the shock.

Once the business cycle is identified, each fiscal policy shock is identified as following: a *net tax revenue shock* is a shock that increases only the net tax revenue for four quarters following the shock and is orthogonal to the business cycle shock, while a *government spending shock* is a shock that only increases government spending for four quarters following the shock and is orthogonal to the business cycle shock. Since I assume that Canada is a small open economy, U.S. GDP and oil prices do not respond to the shocks that hit the Canadian economy. The signs of the main macroeconomic variables are agnostic to the fiscal policy shocks. Note that, I choose 4 quarters because a fiscal year corresponds to 4 quarters.

1.2.2.2 The VAR model and the identification procedure

The VAR model is specified as:

$$A(L)y_t = \epsilon_t \tag{1.1}$$

where y_t is a $m \times 1$ vector of observations, $A(L)$ is an $m \times m$ lag polynomial matrix, and L is the lag operator with the non-negative powers. ϵ_t is an $m \times 1$ vector of structural shocks with:

$$y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} \; ; \quad A(L) = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ 0 & A_{22}(L) \end{bmatrix} \quad \epsilon_t = \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix} \quad \text{and } E[\epsilon\epsilon'] = I_m$$

y_{1t} is an $m_1 \times 1$ vector of Canadian economic variables, and y_{2t} is a $m_2 \times 1$ vector including U.S. GDP and oil prices, where $m_1 + m_2 = m$; ϵ_{1t} and ϵ_{2t} are, respectively, $m_1 \times 1$ and $m_2 \times 1$ vectors of structural disturbances. The dimensions of $A_{11}(L)$, $A_{12}(L)$ and $A_{22}(L)$ are $m_1 \times m_1$, $m_1 \times m_2$ and $m_2 \times m_2$ respectively.
The restriction $A_{21}(L) = 0$ follows from the assumption that the Canadian block variable y_{1t} does not enter into the second block y_{2t} either contemporaneously, or with lagged values in the structural form (1.1). The reduced-form version of the structural model (1.1) can be written as follows:

$$y_t = \sum_{i=1}^{P} B_i y_{t-i} + u_t \tag{1.2}$$

$$\text{where } B_i = \begin{bmatrix} B_{11}^i & B_{12}^i \\ 0 & B_{22}^i \end{bmatrix} \; ; \quad u_t = \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix}; \quad \text{with } E[uu'] = \Omega = \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{12}{}' & \Omega_{22} \end{bmatrix}$$

Because the right-hand-side variables of the previous reduced form differ across equations due to the block exogeneity, the estimation of each equation using ordinary least squares (OLS) is inefficient. For this reason, I follow the methodology developed by Hamilton [1994], [11] transforming the model such that OLS remains efficient. The reduced form model is then transformed as follows:

$$y_{1t} = \sum_{i=1}^{P} B_{11}^i y_{1t-i} + \sum_{i=0}^{P} G_i y_{2t-i} + v_t \tag{1.3}$$

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with

$$E[vv'] = H$$

$$y_{2t} = \sum_{i=1}^{P} B_{22}^{i} y_{2t-i} + u_{2t} \tag{1.4}$$

with

$$E[u_2 {u_2}'] = \Omega_{22}$$

The previous equations are then estimated equation by equation using OLS. Thereafter, the coefficients of original reduced form (1.2) are recovered using the following relationships:

$$\hat{\Omega}_{12} = \hat{G}_0 \hat{\Omega}_{22}, \qquad \hat{B}_{12}^{i} = \hat{G}_i + \hat{G}_0 \hat{B}_{22}^{i}, \;\; i = 1, .., P \quad \text{and} \quad \hat{\Omega}_{11} = \hat{H} + \hat{G}_0 \hat{\Omega}_{22}^{'}$$

To identify structural shocks ϵ_t, it is necessary to find a matrix A such that $u_t = A\epsilon_t$ and $\Omega = AA^{'}$, with

$$A = \begin{bmatrix} A_{11} & A_{12} \\ 0 & A_{22} \end{bmatrix}$$

Let n be the number of structural shocks to be identified. Mountford and Uhlig [2009] show that identification of these shocks is equivalent to identifying an impulse matrix of size $m \times n$, that is a sub matrix $[a^{(1)}, ..., a^{(n)}]$ of the matrix A such that

$$[a^{(1)}, ..., a^{(n)}] = \tilde{A} Q \tag{1.5}$$

for any $m \times m$ matrix $\tilde{A}^{'}$ satisfying the following relationship

$$\Omega = AA' = \tilde{A}\tilde{A}^{'} \tag{1.6}$$

where $Q = [q^{(1)}, ..., q^{(n)}]$ is a $m \times n$ orthonormal matrix, that is $QQ' = I_m$. The previous authors identify $\tilde{A}$ as the Cholesky factor of Ω. However, with the block exogeneity, the procedure is different. Appendix 1 shows in details how $\tilde{A}$ is identified.

Once $\tilde{A}$ is identified, Mountford and Uhlig [2009] show that the IRF to a structural shock $s = 1, ..., n$ (i.e. the IRF to the impulse vector $a = a^{(s)}$) is given as the linear combination of the impulse responses obtained under the $\tilde{A}$ decomposition of Ω. Consider $r_{ji}(k)$ as the impulse response of the j^{th}

variable at horizon k to the i^{th} shock (that is, the i^{th} column of $\tilde{A}$) under the $\tilde{A}$ decomposition of Ω and the $m \times 1$ dimensional column vector $r_i(k)$ as the vector response $[r_{1i}(k), ..., r_{mi}(k)]$', the $m \times 1$-dimensional impulse response $r_a(k)$ [12] at horizon k to the impulse vector a is given by:

$$r_a(k) = \sum_{i=1}^{m} q_i r_i(k) \tag{1.7}$$

where q_i is the i^{th} entry of q. Identification of the structural shock s, that is the impulse vector $a = a^{(s)}$ with sign restriction consists of selecting the right impulse vector $a = a^{(s)}$ that satisfies sign restrictions imposed on the IRFs. The procedure is explained in detail in Appendix 1.

1.2.3 Data description

The VAR-system is composed of two blocks y_{1t} and y_{2t} of quarterly data from the first quarter of 1970 to fourth quarter of 2010. The first block y_{1t} contains Canadian variables: (a) GDP, (b) private consumption, (c) private non-residential investment, (d) government spending, (e) net tax revenue, (f) GDP deflator, (g) REER, (h) net-exports-to-GDP ratio and (i) the 3-month T-bill rate. Variables (a) to (e) are presented in real per-capita terms by dividing each real variable by the labour force.

Except for the net-exports-to-GDP ratio and the 3-month T-bill rate, all the variables are expressed in log form. Private consumption is comprised of non-durable goods and services. Government spending is government purchases (i.e. the sum of current consumption and public investment). Net tax revenue is the sum of personal and corporate income tax revenues, social security contributions and taxes on production and imports, net of transfers to households and private corporations. Real net tax revenue is obtained by dividing the nominal tax revenue by the GDP deflator (2002 = 100). The definition of these variables is in line with previous studies, in order to facilitate consistent comparisons.

Except for the REER, all the variables in the Canadian block are from Statistics Canada's CANSIM database. The REER, based on relative unit labour costs in the manufacturing sector, is from the Federal Reserve Bank of St.

12. The j^{th} element $r_{ja}(k)$ of $r_a(k)$, $j = 1, .., m$ is the impulse response at horizon k of the j^{th} variable to the impulse vector a.

Louis (FRED) database. A rise in the index as shown in Figure A1 (the net-exports-to-GDP ratio declines with an increase of the REER) in Appendix represents a deterioration in the country's competitiveness. The second block, y_{2t}, includes the logarithm of U.S. real GDP (2005=100) per capita and real oil prices. U.S. GDP is from the U.S. National Income and Product Accounts database. Oil prices are expressed in real terms by dividing the West Texas Intermediate Oil Price (in U.S. current dollars per barrel) taken from the IMF-WEO database by the U.S. GDP deflator(2005 = 100). I choose the GDP deflator instead of the consumer price index in order to have the same base year as U.S. GDP. Following Ilzetzki et al. [2013], data used are deviations of non-stationary variables from their linear trend. Results remain unchanged using a quadratic trend. [13]

1.3 Results

I estimate a VAR with 2 lags, where the number of lags is chosen using the Bayesian information criterion. I test the exogeneity of y_{2t} with a likelihood ratio test. The results of the test, not shown here, do not reject the null hypothesis of a block exogeneity at the 5-percent level. The following subsection analyzes the IRFs to the identified shocks, assesses GDP multipliers associated with spending and tax increases without and including exogenous variables y_{2t} in the model, studies the impact of fiscal policy shocks over two sub-periods (before and after 1990:Q4), compares the results to existing estimates, and finally compares spending and tax multipliers in order to draw some policy conclusions.

1.3.1 IRFs to identified shocks

The IRFs to the identified shocks are displayed in the subsequent figures. The shaded areas around the median IRF are the 68 percent confidence regions constructed from 5,000 draws of parameters from the Normal-Wishart distribution. For each draw, the IRFs are computed at each horizon and the 16^{th}, 50^{th} and 84^{th} quantiles are chosen to construct the confidence intervals. The green bands represent the imposed sign restrictions.

13. Although keeping variables in level in the VAR-system would implicitly accounts for any existing cointegration relationship, variables are detrended because the VAR-system is not stationary with variables in level.

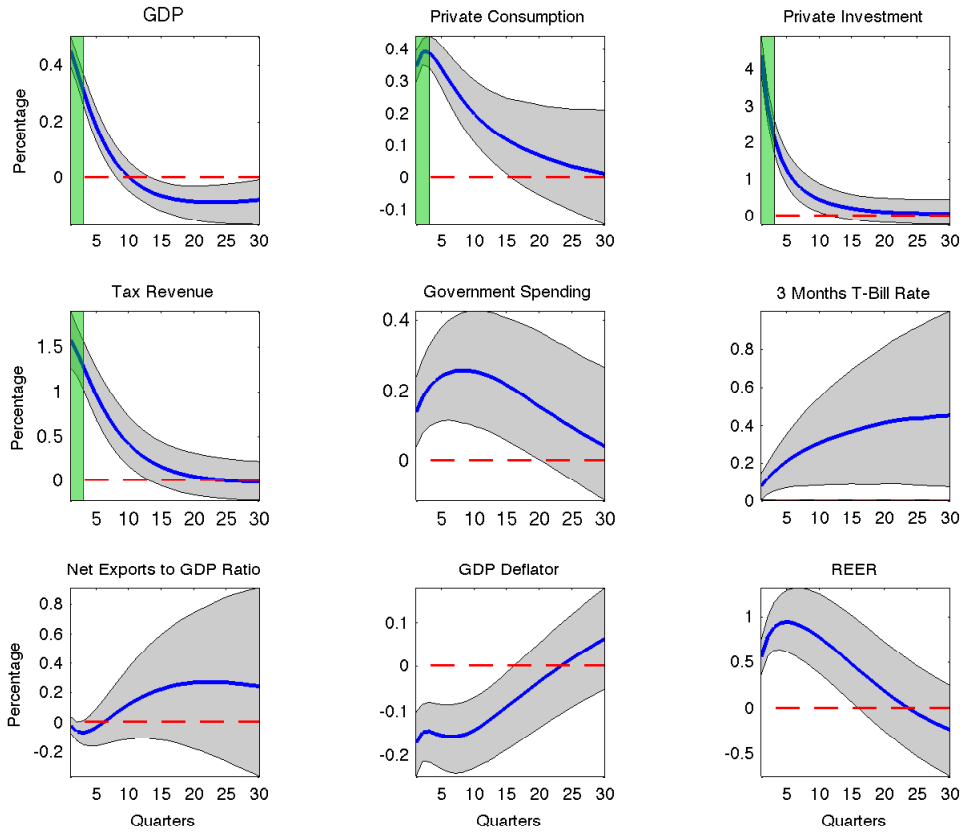
1.3.1.1 Effects of a business cycle shock

Defined as a shock for which Canadian GDP, private consumption, private investment and net tax revenue increase for four quarters following the shock, the IRFs to this shock are shown in Figure 1.1. The IRFs of these variables remain positive many quarters after the shock. In particular, the response of consumption tends to be highly persistent and behaves in a hump-shaped fashion. This behavior of consumption can be interpreted as a consequence of a higher degree of habit formation. The buoyant response of net tax revenue (net tax revenue increases at higher rate than GDP) can be interpreted as a result of progressive marginal income tax rates. Because government spending here does not incorporate transfers, the response of government purchases is not countercyclical. Instead, as the resources in the economy increase, public investment and current consumption increase too. The decline of the price level is less intuitive, since all components of aggregate demand increase. However, this response could be a result of a countercyclical response of monetary policy (the interest rate increases in response to the shock) to dampen the effect of aggregate demand on the price level. The response of the net-exports-to-GDP ratio behaves in the opposite direction of the REER. As the REER increases upon impact, net exports decline and increase when the REER starts to fall.

1.3.1.2 Effects of a government spending shock

The IRFs to the government spending shock are displayed in Figure 1.2. The response of government purchases is positive for four quarters following the shock as imposed by the identifying assumptions. The effect of the shock on GDP is weak upon impact and remains insignificant for many quarters. The response of net tax revenue follows the same pattern as the response of GDP, despite the slight decline upon impact. Private consumption is crowded-in by government spending. While this result is at odds with the standard real business cycle prediction, it is consistent with recent empirical findings regarding the effect of government shock on private consumption. By contrast, private investment is crowded out, as predicted by the standard real business cycle model. The slight increase in the response of the 3-month T-bill rate could explain this result. The government spending shock decreases the competitiveness of the country as the REER appreciates in the aftermath of the shock, subsequently causing a deterioration of the trade balance. This

Figure 1.1 – IRFs to a business cycle shock



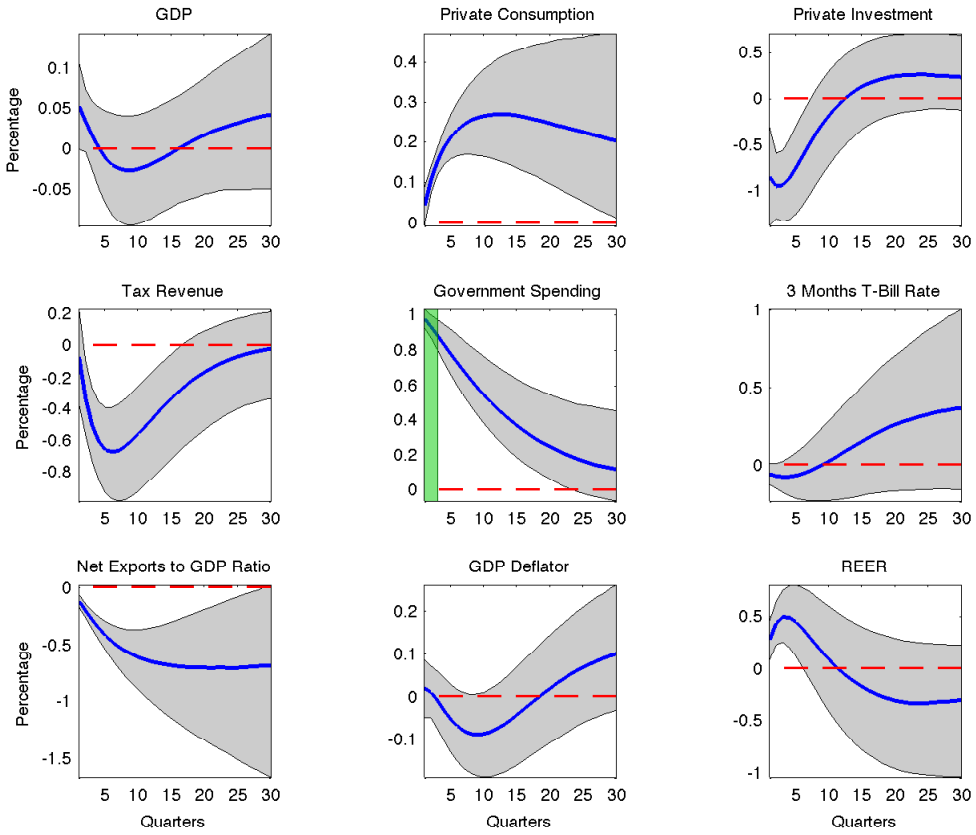
Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

result in the literature is known as "twin deficits," that is the coexistence of a trade deficit and budget deficit.

1.3.1.3 Effects of a net tax revenue shock

The IRFs to a net tax revenue shock are displayed in Figure 1.3. By construction, the response of net tax revenue is positive for four quarters following the shock. A net tax revenue shock has a negative impact on private activities, as private consumption and private investment fall upon impact. This decline persists for many quarters after the shock. As a result, GDP also

Figure 1.2 – IRFs to a government spending shock



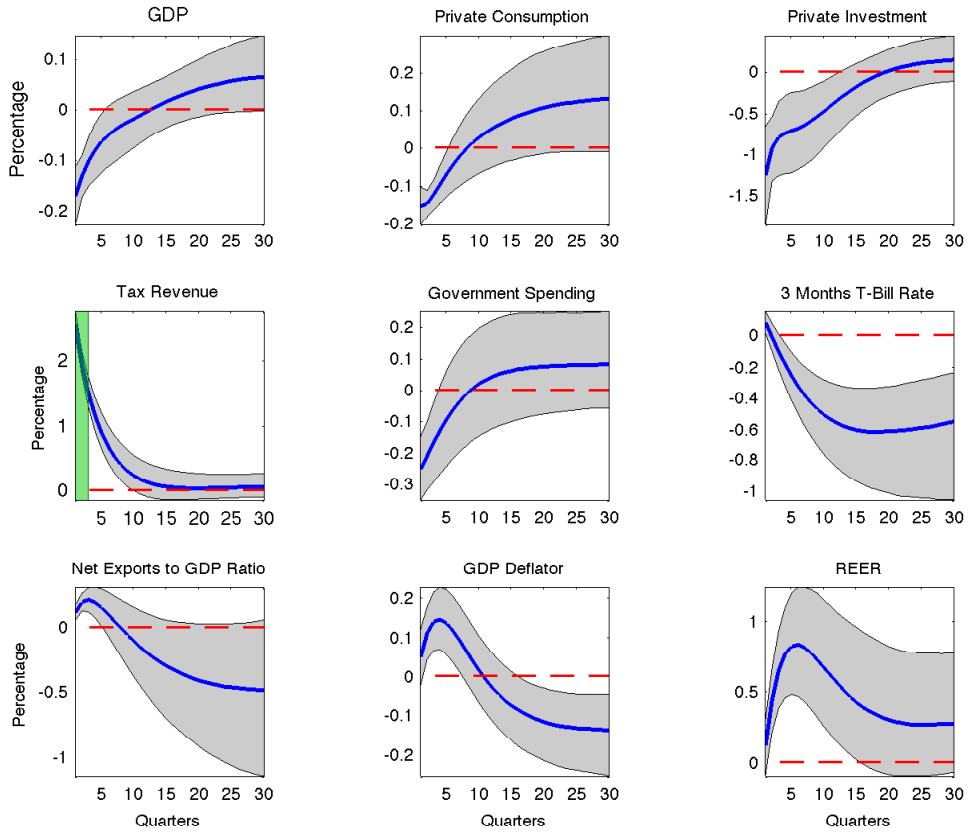
Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

declines. Because the impact of a shock on net tax revenue is not persistent, the three variables start to increase as net tax revenue decreases, although the impact remains negative. Government purchases behave procyclically, following the same pattern as the response of GDP. Monetary policy tends to behave countercyclically, where monetary authorities reduce the nominal interest rate to dampen the negative effect of the increase in taxes on the private sector.

The co-movement of net exports to GDP with REER in the short run in response to the shock seems less intuitive. While one might expect compet-

itiveness to be reduced due to an appreciation of the REER as the rise in taxes increases the country's production costs in the manufacturing sector, the increase of net exports in the first quarters after the shock is unexpected. However, in the long run, net exports fall as the competitiveness of the country declines. The rise of the price level in the short run might be a result of the effect on aggregate supply dominating the effect on aggregate demand. [14]

Figure 1.3 – IRFs to a net tax revenue shock



Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

14. The shift of the supply curve to the left as production costs rise with the increase in taxes is larger than the shift of the demand curve to the left.

1.3.2 Measuring GDP multipliers for fiscal policy shocks

GDP multipliers measure the impact on GDP in dollars induced by a variation of one dollar in particular fiscal variables. I report two measures of GDP multiplier: the impact multiplier and the cumulative multiplier. For each fiscal indicator, I also report the maximum response of GDP multiplier. The impact multiplier, $M^0_{Y,F}(k)$ measures the change in dollars in GDP at period k induced by a one-dollar change to a fiscal variable in the first period. This is the multiplier typically used in the literature, such as in Blanchard and Perotti [2002]. The cumulative multiplier, $CM_{Y,F}(k)$ allows for the analysis of the persistence of a shock, since, as noted by Auerbach and Gorodnichenko [2012], the size of the multiplier tends to depend on the persistence of the shock. It measures the impact in dollars of each shock along the entire path of the responses up to a given period k. The indicators are defined as follows:

$$M^0_{Y,F}(k) = \frac{r_{Y,F}(k)}{r_{F,F}(0)} \frac{1}{F/Y} \tag{1.8}$$

$$CM_{Y,F}(k) = \frac{\sum_{h=0}^{k} r_{Y,F}(h)}{\sum_{h=0}^{k} r_{F,F}(h)} \frac{1}{F/Y} \tag{1.9}$$

where $r_{j,F}(k)$ denotes the IRF of variable j to the fiscal shock F at period k. Because government purchases and net tax revenue are expressed in logs, the IRFs are scaled by the inverse of the sample average ratio of the fiscal variable over GDP, F/Y. For each of the fiscal policy shocks, I calculate the multipliers (i) using only Canadian variables, (ii) including only oil prices or the U.S. GDP, and (iii) treating both as exogenous variables.

1.3.2.1 GDP multipliers associated with spending increases

Table 1.2 reports the estimated multipliers associated with a one-dollar increase in government purchases within the first quarter. When using only Canadian variables, the multiplier within the first quarter is equal to \$0.26. After one year, both multiplier measures become negative. Qualitatively, these results are consistent with findings of Mountford and Uhlig [2009].

When I control only for oil prices, the size of the multipliers diminishes slightly upon impact, but for the rest of the period, the patterns are very similar with the first panel where I include only Canadian variables in the VAR. Controlling only for U.S. GDP or both exogenous variables changes the

patterns of the multipliers. Within the first quarter, the multiplier is equal to \$0.21, slightly less than in the previous case. After one year, the multipliers remain statistically insignificant, but they are not negative anymore. Overall, within the first quarter, the multiplier associated with spending increases is slightly larger when there is no exogenous control in the VAR model.

1.3.2.2 GDP multipliers associated with a net tax increase

Table 1.3 reports the estimated multipliers associated with a one-dollar increase in net tax revenue within the first quarter. Using only Canadian variables in the VAR, a one-dollar increase in net tax revenue leads to a decline in GDP of about \$0.35 upon impact. As net tax revenue declines, the multipliers gradually become positive.

Controlling for oil prices, GDP decreases by \$0.17 upon impact and reaches the minimum of \$0.26 dollars in the 2^{nd} quarter for the impact multiplier, and \$0.58 dollars for the cumulative multiplier in the 12^{th} quarter. The patterns are very similar when controlling only for U.S. GDP or for both oil prices and U.S. GDP. Upon impact, GDP declines by about \$0.32.

Overall, except the first quarter, the negative effects of net taxes on GDP tend be larger when exogenous controls are included in the VAR. These results are in line with the expectations. Indeed, when there is no exogenous control variable in the VAR, a one-dollar increase in tax revenue might come from changes in tax policy, oil prices, and/or U.S. GDP. Because changes in tax revenue coming from oil price and U.S. GDP fluctuations do not result from domestic changes to tax rates, they might not have significant effects on GDP. Therefore, the part of the impact coming from changes to tax rates might not be large enough. Controlling for these exogenous changes might therefore increase the negative effects of an increase in net tax revenue on GDP, as this increase results entirely from changes in tax policy.

1.3.3 Sub-period analysis

Sub-period analysis is an exercise that allows me to test the stability of the impact of a fiscal policy shock over time. I therefore split the sample at the 4^{th} quarter of 1990 in order to have two sub-periods with relatively the same size. This partition also corresponds to a change in monetary policy regime in Canada, as the Central Bank introduced an inflation targeting regime

Table 1.2 – GDP multiplier associated with spending increases

Quarters	1	4	8	12	20	Peak
	Canadian variables only					
Impact multiplier	0.26*	-0.50*	-1.02*	-1.19*	-1.03*	0.26*(1)
Govt. spending	1.00*	0.94*	0.79*	0.66*	0.44*	
Net tax revenue	0.02	-0.93*	-1.39*	-1.47*	-1.22*	
Cumulative multiplier	0.26*	-0.14*	-0.55*	-0.85*	-1.22*	0.26*(1)
	Controlling only for oil prices					
Impact multiplier	0.23*	-0.50*	-0.90*	-0.99*	-0.77*	0.23*(1)
Govt. spending	1.00*	0.94*	0.77*	0.61*	0.40*	
Net tax revenue	0.23*	-0.81*	-1.16*	-1.14*	-0.89*	
Cumulative multiplier	0.23*	-0.17*	-0.52*	-0.77*	-1.08*	0.23*(1)
	Controlling only for U.S. GDP					
Impact multiplier	0.21*	-0.08	-0.19	-0.14	0.05	0.23*(30)
Govt. spending	1.00*	0.85*	0.65*	0.48*	0.26*	
Net tax revenue	0.01	-0.46*	-0.51*	-0.36*	-0.06	
Cumulative multiplier	0.21*	0.06	-0.07	-0.13	-0.13	0.21*(1)
	Controlling for U.S. GDP and oil prices					
Impact multiplier	0.21*	0.00	-0.11	-0.08	0.07	0.21*(1)
Govt. spending	1.00*	0.85*	0.64*	0.48*	0.25*	
Net tax revenue	-0.07*	-0.63*	-0.66*	-0.48*	-0.17*	
Cumulative multiplier	0.21*	0.11	0.01	-0.04	-0.03	0.21*(1)

Notes: Each panel of this table provide the multipliers associated with a one-dollar increase in government spending in the first quarter. The first and fourth rows represent the impact multiplier and the cumulative multiplier, respectively, for each quarter. The multipliers given here are the medians and * denotes that 0 does not belong to the confidence region. The second and third rows represent the response of government spending and net tax revenue. The last column reports the maximum multipliers, and numbers in brackets denote the quarters in which these maximums are observed.

in 1991:Q1 to stabilize inflation. In the following, I study the impact of the government spending and net tax revenue shocks over both sub-periods while controlling for changes in the state of the U.S. economy and world oil price.

Table 1.3 – GDP multipliers associated with net tax increases

Quarters	1	4	8	12	20	Peak
	Canadian variables only					
Impact multiplier	-0.35*	-0.10*	0.16*	0.36*	0.59*	-0.35*(1)
Govt. spending	-0.10*	-0.07*	-0.07	-0.06	-0.05	
Net tax revenue	1.00*	0.82*	0.65*	0.55*	0.46*	
Cumulative multiplier	-0.35*	-0.25*	-0.09*	0.06*	0.36*	-0.35*(1)
	Controlling only for oil prices					
Impact multiplier	-0.17*	-0.26*	-0.15*	-0.02	0.14	-0.26*(4)
Govt. spending	-0.12*	-0.04*	0.00	0.01	0.02	
Net tax revenue	1.00*	0.36*	0.09	0.04	0.06	
Cumulative multiplier	-0.17*	-0.35*	-0.53*	-0.58*	-0.30*	-0.58*(12)
	Controlling only for U.S. GDP					
Impact multiplier	-0.31*	-0.28*	-0.21*	-0.09*	0.13*	-0.31*(1)
Govt. spending	-0.06*	-0.02*	0.01	0.02	0.03	
Net tax revenue	1.00*	0.63*	0.32*	0.15*	0.07	
Cumulative multiplier	-0.31*	-0.36*	-0.44*	-0.47*	-0.35*	-0.47*(13)
	Controlling for U.S. GDP and oil prices					
Impact multiplier	-0.32*	-0.15*	-0.06	-0.01	0.07	-0.32*(1)
Govt. spending	-0.10*	-0.05*	-0.01	0.02	0.03	
Net tax revenue	1.00*	0.46*	0.16*	0.05	0.01	
Cumulative multiplier	-0.32*	-0.33*	-0.34*	-0.33*	-0.24*	-0.34*(9)

Notes: Each panel of this table provide the multipliers associated with a one-dollar increase in net tax revenue in the first quarter. The first and fourth rows represent the impact multiplier and the cumulative multiplier, respectively at each quarter. The multipliers given here are the median and * denotes that 0 does not belong to the confidence region. The second and third quarters represent the response of government spending and net tax revenue. The last column reports the maximum multipliers (in absolute value) and numbers in brackets denote the quarters in which these maximums are observed.

1.3.3.1 Sub-period analysis of the effects of a government spending shock

Table 1.4 reports the multipliers associated with a one-dollar increase in government purchases within the first quarter over both sub-periods. The results suggest that the impact of a government spending shock on GDP tends to be larger in the second sub-period than in the first sub-period. Within the

first quarter, GDP increases by \$0.4 in the first sub-period, while it increases by \$0.70 in the second. The maximum effect for the impact multiplier is achieved upon impact for the first sub-period, while it is achieved with a short delay of two quarters in the second sub-period and equal to \$0.92.

For the cumulative multiplier, the maximum effect is equal to \$0.66 in the first sub-period, while it is equal to \$1.09 in the second. However, both effects are achieved after a long delay. Several quarters after the shock, tax revenue falls faster in the second sub-period than in the first sub-period. The persistent response of government spending coupled with this large drop in tax revenue may contribute to the larger impact of a government spending shock on output in the second sub-period.

The effects of spending increases on GDP components over both sub-periods are reported in the first two panels of Table 1.6. Consumption is crowded-in by a government spending shock during the first sub-period, while the reverse holds true in the second sub-period. Private investment declines over the two sub-periods, but the drop is larger in the second sub-period, as the three-month T-bill rate increases slightly. The responses of the net-exports-to-GDP ratio is somewhat surprising over both sub-periods. While a decrease in net exports in response to a government spending shock is expected, during the first sub-period, this decrease in net exports does not come from a real exchange rate appreciation as expected. Instead, in response to the shock, both variables co-move as shown in Figure A2 in Appendix. During the second sub-period, net exports decline within the first quarter as the real exchange rate increases. One quarter after the shock, the depreciation of the real exchange rate for the rest of the period as shown in Figure A3 in Appendix leads to a net increase in net exports. Overall, the impact of the spending shock on private consumption and private investment tends to decline over time.

1.3.3.2 Sub-period analysis of the effect of the net tax revenue shock

The impact of a net tax revenue shock on GDP over the two sub-periods is reported in Table 1.5. In response to an increase in net tax revenue of \$1, GDP declines by \$0.38 upon impact during the first sub-period and by \$0.21 during the second sub-period. The peak response in the second sub-period is equal to -\$0.51, while in the first sub-period, it is equal to the response upon

Table 1.4 – Multipliers associated with spending increases over both sub-periods

Quarters	1	4	8	12	20	Peak
			1970:Q1-1990:Q4			
Impact multiplier	0.44*	-0.07	0.11	0.17	0.09	0.44*(1)
Govt. spending	1.00*	0.40*	0.24*	0.18	0.13	
Net tax revenue	-0.64*	-1.18*	-0.50*	-0.08	0.07	
Cumulative multiplier	0.44*	0.10	0.12	0.23*	0.52	0.66(30)
			1991:Q1-2010:Q4			
Impact multiplier	0.70*	0.85*	0.80*	0.79*	0.40*	0.92*(2)
Govt. spending	1.00*	1.08*	0.89*	0.59*	0.26	
Net tax revenue	0.01	-1.08*	-1.33*	-1.02*	-0.46	
Cumulative multiplier	0.70*	0.80*	0.82*	0.91*	1.08*	1.09*(24)

Notes: This table reports GDP multipliers and responses of government spending and net tax revenue to a government spending shock over the two sub-periods. The multipliers are the median, and * denotes that 0 does not belong to the confidence region. The last column reports the maximum multipliers and numbers in brackets denote the quarters in which these maximums are observed.

impact.

For the cumulative multiplier, the same patterns are observed. The decline in GDP is larger in the first sub-period than in the second sub-period. The response of net tax revenue may explain this different impact on GDP. After the shock, net tax revenue declines steadily in the second sub-period, while the decline in the first sub-period tends to be faster.

The two last panels in Table 1.6 report the effects of a positive net tax revenue shock over both sub-periods on GDP components. These results suggest that, in response to a shock, private consumption and private investment decline over the two sub-periods, with a larger effect after 1990. For instance, within the first quarter, consumption and investment decline respectively by 0.10 and 0.90 percent during the inflation-targeting period, while they decline only by 0.07 and 0.42 percent before the new regime. The response of net exports is somewhat surprising during the first sub-period. Net exports increase slightly while the real exchange rate appreciates, as shown in Figure A4 in Appendix. During the second sub-period, net exports react as expected. As shown in Figure A5 in Appendix, the later decline is a result of a real exchange rate appreciation.

Table 1.5 – Multipliers associated with a net tax revenue shock over both sub-periods

Quarters	1	4	8	12	20	Peak
			1970:Q1-1990:Q4			
Impact multiplier	-0.38*	-0.23*	-0.14	-0.07	0.01	-0.38*(1)
Govt. spending	-0.19 *	-0.08*	-0.02	0.00	0.01	
Net tax revenue	1.00*	0.53*	0.16*	0.03	0.03	
Cumulative multiplier	-0.38*	-0.40*	-0.45*	-0.51*	-0.36	-0.51*(13)
			1991:Q1-2010:Q4			
Impact multiplier	-0.21*	-0.02	-0.10	-0.12	-0.03	-0.21*(1)
Govt. spending	-0.20*	-0.18*	-0.10	-0.02	0.04	
Net tax revenue	1.00*	0.36*	0.18*	0.06	-0.04	
Cumulative multiplier	-0.21*	-0.10	-0.17	-0.28*	-0.43*	-0.44*(22)

Notes: This table reports GDP multipliers and responses of government spending and net tax revenues to a government spending shock over the two sub-periods. The multipliers are the median, and * denotes that 0 does not belong to the confidence region. The last column reports the maximum multipliers (in absolute value) and numbers in brackets denote the quarters in which these maximums are observed.

1.3.4 Comparison of the results with existing estimates

Differences in my results compared with existing studies of the impact of fiscal policy in Canada may be explained by different time periods being considered and different methodologies (this study relies on sign restrictions and, importantly, controls for spillovers from the U.S. economy and for oil price fluctuations). To my knowledge, except for Perotti [2004] and Owyang et al. [2013], most other papers examining empirical evidence of the impact of fiscal policy shocks in Canada do not explicitly report numerical results. Rather, they report the IRFs on graphs, making any quantitative comparison difficult. Therefore, the quantitative comparison is limited to these two papers, as they use the same fiscal variables.

1.3.4.1 Comparison with Owyang et al. [2013]

The cumulative multipliers associated with spending increases are compared to those of Owyang et al. [2013] for Canada in Table 1.7. They estimate GDP multipliers associated with government spending, contingent on the state of the economy (characterized by the unemployment rate). They identify

Table 1.6 – Effects of fiscal policy shocks on GDP components over both sub-periods

Quarters	1	4	8	12	20	Peak
Spending: 1970:Q1-1990:Q4						
Consumption	0.19*	0.21*	0.15*	0.11	0.08	0.21*(3)
Investment	-0.10	-0.49	-0.14	0.14	0.11	-0.49(4)
Net exports/GDP	-0.11*	-0.22*	-0.23*	-0.24*	-0.18*	-0.24*(11)
Spending: 1991:Q1-2010:Q4						
Consumption	0.07*	-0.01*	-0.17*	-0.22*	-0.17*	0.08*(2)
Investment	0.04	-2.56*	-2.76*	-2.15*	-1.17*	-2.87*(6)
Net exports/GDP	-0.06	0.18*	0.21*	0.21*	0.16*	-0.06(1)
Net taxes: 1970:Q1-1990:Q4						
Consumption	-0.07*	-0.05*	-0.02	-0.01	0.00	-0.07*(1)
Investment	-0.42*	-0.08	-0.14	-0.10	0.02	-0.42*(1)
Net exports/GDP	0.03*	0.06*	0.05*	0.03	0.00	-0.01(25)
Net taxes: 1991:Q1-2010:Q4						
Consumption	-0.10*	-0.04*	-0.01	0.00	0.00	-0.10*(1)
Investment	-0.90*	-0.07	0.10	0.06	-0.06	-0.90*(1)
Net exports/GDP	0.00	-0.06*	-0.09*	-0.10*	-0.09*	-0.10*(14)

Notes: This table reports the responses of GDP components to fiscal policy shocks over the two sub-periods.The first two panels are responses to the government spending shock, while the last two panels report responses to the net tax revenue shock.The responses are the medians, and * denotes that 0 does not belong to the confidence region. The last column reports the peak effects, and numbers in brackets denote the quarters in which these peak effects occur.

a government spending shock as a news shock using expected change in military spending. The comparison with their linear VAR specification shows that over the first sub-period, the multipliers in this study are below their multipliers, but over the second-period, they are slightly above. It should be noted that in both studies, the multipliers are increasing with the number of periods following the initial increase in spending.

Table 1.7 – Comparison with Owyang et al. [2013]

	2-year integral	4-year integral	Peak
My results			
Sub-sample 1	0.12	0.38	0.44
Sub-sample 2	0.82	1.01	0.85
Owyang et al. [2013]			
Linear VAR	0.67	0.79	0.57
High unemploment	1.60	1.16	0.65
Low unemployment	0.44	0.46	0.49

Notes: This table compares the multipliers associated with spending increases to Owyang et al. [2013]'s multipliers. The integral measures are computed as the cumulative multipliers. The peak measure is the ratio of the IRF of GDP and government purchases at their respective peaks scaled by the inverse of the average ratio of G/Y.

1.3.4.2 Comparison with Perotti [2004]

Perotti [2004] examines the impact of spending increases and tax cuts on OECD countries, including Canada. For the Canadian economy, Perotti uses two sub-periods, S1 and S2, corresponding to 1961:Q1-1980:Q4 and 1981Q1-2001:Q4, respectively. Perotti reports the cumulative multipliers after four quarters and 12 quarters. Although it would be more interesting to consider the same sub-periods, the lack of data for some variables, such as the real effective exchange rate before 1970, makes the exercise difficult. However, the sub-periods in both studies are similar in size and occur during roughly the same time period.

Table 1.8 compares the cumulative multipliers defined above with Perotti's measure of cumulative multipliers. There are some differences in our results. For spending increases, Perotti finds larger GDP multipliers in the first sub-period than in the second sub-period, while the reverse holds true in this study. The same pattern is observed for the multipliers associated with tax cuts. Perotti finds higher multipliers during the second sub-period, while the reverse holds true in this study. However, both studies do find that tax cuts do not necessarily result in higher GDP multipliers.

With respect to the responses of investment and consumption to a government spending shock, the two studies are similar. In both studies, consumption rises significantly during the first sub-period and declines in the second

sub-period. Private investment falls in both sub-periods, as well as over the whole sample.

Table 1.8 – Comparison with Perotti [2004]

	Spending		Net taxes	
Quarters	4	12	4	12
My results				
1970:Q1-1990:Q4	0.10	0.23	0.40	0.51
1991:Q1-2010:Q4	0.80	0.91	0.10	0.28
Perotti [2004]				
1960:Q1-1980:Q4	0.98	0.58	-0.04	-0.22
1981:Q1-2001:Q4	-0.32	-1.10	0.42	1.51

Notes: This table compares the multipliers of this study to Perotti [2004]'s multipliers. My measure of the multiplier here is the cumulative multiplier. Since the effects are symmetric, the multipliers associated with a net tax revenue increase are scaled by -1 to express them as responses to tax cuts.

1.3.4.3 Comparison with other studies

With respect to studies of the impact of fiscal policy in Canada, the rise of private consumption in response to a government spending shock is consistent with the findings of Ravn et al. [2007]. With respect to the effect of a government spending shock on net exports, while I do find an increase in net exports following the implementation of the inflation-targeting regime, my results are consistent with the twin deficits suggested by the results of Corsetti and Müller [2006] and Monacelli and Perotti [2010], when considering the first sub-period and the whole sample.

With respect to U.S. studies, my findings on the effects of both tax and spending increases on consumption and investment are similar to the results of Blanchard and Perotti [2002] and Mountford and Uhlig [2009]. In the whole sample and during the first sub-period, consumption rises sharply in response to a government spending shock, consistent with Blanchard and Perotti. During the second sub-period, consumption rises upon impact, but declines some periods after the shock; this is consistent with Mountford and Uhlig. I find, as do Blanchard and Perotti and Mountford and Uhlig, that investment declines in response to both tax and spending increases; consumption also

declines in response to tax increases. However, the size of the impact in this study is less than in Blanchard and Perotti and Mountford and Uhlig.

1.3.5 Policy implications: Spending vs. tax cuts

Table 1.9 reports the cumulative multipliers associated with spending increases and tax cuts over the whole sample and over each sub-period. The results suggest that (i) regardless of the period, the multipliers associated with net taxes vary between \$0.21 and \$0.51, while those associated with spending range between \$0.21 and \$1.09; (ii) taxes tend to have larger multipliers over the whole sample and during the first sub-period than during the second sub-period, but the difference with the multipliers associated with spending is not large enough (in absolute value); and (iii) over the second sub-period, GDP multipliers associated with spending tend to be larger than those associated with net tax revenue increases.

Table 1.9 – Cumulative multipliers associated with spending increases and net tax cuts

Quarters after shock	1	4	8	12	20	Peak
Whole sample						
Spending	0.21*	0.11	0.01	-0.04	-0.03	0.21*(1)
Net taxes	0.32*	0.33*	0.34*	0.33*	0.24*	0.34*(9)
Sub-period1						
Spending	0.44*	0.10	0.12	0.23*	0.52	0.66(30)
Net taxes	0.38*	0.40*	0.45*	0.51*	0.36	0.51*(13)
Sub-period2						
Spending	0.70*	0.80*	0.82*	0.91*	1.08*	1.09*(24)
Net taxes	0.21*	0.10	0.17	0.28*	0.43*	0.44*(22)

Notes: This table compares the cumulative multipliers associated with spending and tax increases. Since the effects are symmetric, the multipliers associated with net tax increases have been multiplied by -1 to be interpreted as responses to tax cuts.

These results suggest that given the size of the multipliers associated with spending increases over the last two decades, a large fiscal adjustment through spending cuts could be very harmful to the economy than tax-based fiscal adjustments.

1.4 Conclusion

In this paper, I use quarterly data from 1970 to 2010 to study the impact of government spending and net tax revenue shocks on key Canadian macroeconomic variables, employing sign restrictions as an identification strategy. I explicitly control for spillovers from the U.S. economy and for world oil price fluctuations. In addition, I examine the impact of fiscal shocks over two sub-periods: before and after the fourth quarter of 1990.

This paper has several key findings. The estimated value of both spending and tax multipliers is sensitive to the inclusion of relative oil price and U.S. GDP in the VAR model. Output, consumption and investment decline as a response to an increase in net taxes. Output and private consumption increase when government purchases increase, whereas private investment falls. Net exports decline in response to both spending and net tax increases (with a short delay for the decline in response to the net tax increase) as a result of real exchange rate appreciation. Tax-cut multipliers vary between \$0.20 and \$0.50, while spending multipliers range between \$0.20 and \$1.10. Spending multipliers tend to be particularly larger than tax-cut multipliers over the last two decades.

The composition of government spending is relevant for the size of the multipliers. For example, some theoretical and empirical findings suggest that government investment tend to have larger GDP multipliers. Since these issues are not addressed in this paper, they are left for future research.

Chapter 2

(Not)Dancing Together: Monetary Policy Stance and the Government Spending Multiplier

(joint with Constant Lonkeng Ngouana, IMF)

2.1 Introduction

The Great Recession has highlighted the role of fiscal policy as a countercyclical tool that can be deployed alongside monetary policy when the economy is hit by a particularly large shock. In the aftermath of the crisis, fiscal policy in advanced economies went from an expansionary phase (through a wave of stimulus packages) to a consolidation phase, the latter with a view to restoring fiscal sustainability. Monetary policy, however, was thought to have remained mostly "accommodative" until the Fed's "Taper Talk" in May 2013 and early signs of monetary policy normalization in United Kingdom. Although the exit from unconventional monetary policy is likely to be highly asynchronous across countries (with "Abenomics" [1] still unfolding in Japan and the Euro area maintaining monetary policy accommodation to support the recovery), fiscal policy will eventually confront the old monetary policy normal. Understanding how the stance of monetary policy affects the size of the government spending multiplier can therefore help inform our assessment of the effectiveness of fiscal policy in advanced economies going forward.

The strong interplay between monetary and fiscal policy poses a challenge to both policymakers and researchers as they try to disentangle the contribution of each type of policy shock on the economy. Traditional models of monetary and fiscal policy interaction, however, have focused mainly on policy coordination to provide a stable nominal anchor, in a non-cooperative game between a government and its central bank. More recently, however, a few papers have built on the new Keynesian Dynamic Stochastic General Equilibrium framework to examine the size of the fiscal multiplier when the Zero Lower Bound (ZLB) on the nominal interest rate binds. The equilibrium outcome of the interaction between active/passive monetary and fiscal policy has also been examined in the literature, also using the new Keynesian set-up.

Despite the above recent theoretical contributions, the empirics of how the response of output to government spending shocks varies with the stance of monetary policy remain limited at best. This paper is an attempt to fill some of that gap. We provide estimates of the government spending multiplier under accommodative and non-accommodative monetary policy.

1. Abenomics, the economic plan put forward by the Japanese Prime Minister, Shinzō Abe, since his re-election in December 2012, entails three (complementary) "arrows": (i) fiscal expansion (in the short-run); (ii) monetary easing (QE); and (iii) structural reforms.

Central to our analysis is the identification of the state of monetary policy, capturing the extent to which the Central Bank leans against the wind. More explicitly, we approximate the reaction function of the U.S. Fed to the output gap and inflation using a simple Taylor-type rule. [2] The extent of monetary policy accommodation is then inferred from the deviation of the actual Fed funds rate from the Taylor rule-implied rate, using a (smooth) transition distribution, calibrated to reflect the average historical frequency of monetary policy accommodation.

Following Auerbach and Gorodnichenko [2013], government spending shocks are identified as forecast errors of the growth rate of government spending from the Survey of Professional Forecasters (SPF) and from the Greenbook, further stripped from their predictable components. [3] We also identify government spending shocks using the Cholesky decomposition as in Blanchard and Perotti [2002], as a way to benchmarking our results, given the popularity of that approach in the empirical literature.

To estimate the fiscal multiplier across states of monetary policy, we apply the local projections method, pioneered by Jordà [2005] and applied recently by Auerbach and Gorodnichenko [2013] and Owyang et al. [2013], to U.S. quarterly data. The local projections method, among many other desirable features, does not impose the implicit dynamic restrictions inherent to Structural Vector Autoregressions (SVARs).

Our estimations suggest that the federal government spending multiplier is substantially higher under accommodative than non-accommodative monetary policy. Furthermore, our paper reconciles, within a unified frame-

2. This is broadly consistent with the "dual mandate" of the Fed, as articulated in Section 2A (on monetary policy objectives) of the 1977 amendment of the Federal Reserve Act: "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

3. The Greenbook—officially entitled "Current Economic and Financial Conditions"—provides an analysis of the U.S. and international economy. It is produced by the staff of the Federal Reserve Board (FRB) and distributed to Federal Open Market Committee (FOMC) meeting's participants one week prior to the meeting. We focus in this paper on federal government spending, in line with the fact that monetary policy (characterizing the state of the world in our framework) is conducted at the federal level. Also in the US, States' governments are fairly restricted to balanced budgets

work, apparently contradictory findings in the literature: federal government spending may crowd-in or crowd-out private consumption, depending on the extent of monetary policy accommodation. Our results are robust to alternative identification of the spending shock and of the state of monetary policy, and to more disaggregated categories of consumption expenditures. We explore two channels through which the stance of monetary policy may impact the effectiveness of fiscal policy: the "substitution effect" (via the real interest rate path) and the "wealth effect" (through the funding scheme for government spending).

The remainder of the paper proceeds as follows. We end this section with a brief review of the literature. Section 2.2 delineates our empirical strategy, including the local projections method and our identification of the state of monetary policy. Section 2.3 presents the estimation results on a sample ending 2008Q4 and explores transmission channels. Section 2.4 presents estimation results on an extended sample to cover the ZLB episode and the recent period where output has been below potential. Section 2.5 performs some sensitivity analyses. Section 2.6 concludes, draws policy implications, and explores possible extensions.

2.1.1 Related Literature

This paper is at the intersection of two strands of the literature: the theoretical literature that studies the interaction between fiscal and monetary policy, including when the ZLB on nominal interest rates binds; and the empirical literature that examines the effects of fiscal policy, including state-dependent fiscal multipliers.

Related to the theoretical strand of the literature, Davig and Leeper [2007] estimate regime-switching rules for monetary policy and tax policy—assumed to behave either actively or passively—over the post-war period in the United States and integrate the estimated policy process into a calibrated DSGE model with nominal rigidities. An active authority in the model pays no attention to the level of government debt while passive authority responds to shocks to government debt and is therefore constrained by the actions of the active authority. The authors then simulate the effects of a tax-cut on the U.S. economy across monetary and tax policy regimes. Davig and Leeper [2011] use Davig and Leeper [2007]'s setting to simulate the macroeconomic impact of changes in government spending when monetary and fiscal poli-

cies interact. They find that an increase in government purchases induces a stronger rise in consumption, output and inflation under a regime combining passive monetary policy and active tax policy than a regime combining active monetary policy and passive tax policy regime.

A few theoretical studies, building on the Keynesian DSGE framework, examine the effects of government spending when the ZLB on the nominal interest rate binds (see, e.g., Christiano et al. [2011], Woodford [2011], Mertens and Ravn [2014], among others). Simulations from these studies exhibit larger output multipliers from government spending when the ZLB on the nominal rates binds. The transmission channel, like in the case of passive monetary policy, is the real interest rate. Expansionary fiscal policy induces higher expectations for future inflation. Since the nominal interest rate is stuck at zero, the real rate declines, inducing an expansion of the aggregate demand. [4] This expansion of aggregate demand leads to a further increase in inflation expectations and depresses the real rate further. Increased government spending therefore breaks the deflationary spiral associated with the ZLB. More recently, Gaspar [2015] finds that monetary policy transmission is more uncertain when the interest rate is constrained by the ZLB (and unconventional monetary policy used), suggesting a potentially supportive role for fiscal policy. [5]

In connection with the empirical strand of the literature, an impressive volume of papers, using linear SVARs models have investigated the effects of fiscal policy changes on macroeconomic outcomes, output in particular. These studies mainly identify fiscal shocks either by the Cholesky decomposition complemented with institutional information (see the seminal paper by Blanchard and Perotti [2002], and Perotti [2004]), by the sign restrictions (see Mountford and Uhlig [2009]), or using the narrative approach pioneered by Romer and Romer [1989]. [6] While most papers find that government

4. The fact that the rate is stuck at zero of course does not prevent the monetary authority from raising it. The constraint comes from the fact that the "notional" target rate before the fiscal shock is already very negative and cannot be reached in practice because the nominal rate is bounded from below by zero. The monetary authority may therefore not be able to bring the rate up to the positive territory without running the risk of plunging the economy into a deep recession.

5. These findings, focused particularly on the Euro area, are based on simulations from the Global Integrated Monetary and Fiscal model (GIMF)—a multi-region DSGE model developed at the IMF (see Anderson et al. [2013])—and its subsequent extensions.

6. The authors use historical records to identify episodes during which large monetary

spending increases output and crowd-out private investment, the response of private consumption remains mixed. Some authors find that government spending crowds-in private consumption (see, e.g., Blanchard and Perotti [2002], Bouakez and Rebei [2007], Mountford and Uhlig [2009]), while others, using the narrative approach to identifying exogenous changes in government spending, find the opposite result (see, e.g., Ramey and Shapiro [1998], Ramey [2011]).

Some authors have considered the non-linear effects of government spending. Choi and Devereux [2006] investigate how changes in government purchases affect the U.S. economy at different levels of real interest rates. They find that expansionary government spending is more conductive to short-term growth when real rates are low. Indeed, the Ricardian effect is smaller at lower financing costs of fiscal policy. More recently, a number of papers have investigated how the fiscal multiplier varies with the state of the economy (see Auerbach and Gorodnichenko [2012], Auerbach and Gorodnichenko [2013], and Baum et al. [2012], among others). They generally find that an increase in government spending has a substantially higher impact on output during recessions than expansions. Recently, however, Owyang et al. [2013], using newly constructed historical data for the US and Canada, find evidence of higher multipliers during times of slack in Canada, but find no such evidence for the United States.

Our paper contributes to the existing literature along several important dimensions: First, the state of the world in our non-linear model is characterized by the stance of monetary policy, and not by the level of economic activity (recessions or expansions), which has been the focus of many recent papers on state-dependent fiscal multipliers. In fact, recessions and expansions may themselves be the outcome of combined monetary and fiscal policy actions—earlier findings that fiscal multipliers are higher in recessions might well reflect the fact that monetary policy is likely to be accommodative in recessions. Some papers have admittedly controlled for the level of the interest rate (e.g., Belinga [2013] and Canova and Pappa [2011]), but we argue that the level of the interest rate considered solely could be a poor proxy of the state of monetary policy, which should ultimately be defined in light of

disturbances were not caused by output fluctuations. The method has since been adapted to the fiscal realm to identify exogenous changes in tax policy and military spending based on news reports (see, e.g., Romer and Romer [2010], Ramey and Shapiro [1998], and Owyang et al. [2013], among others).

macroeconomic conditions. In fact, a relatively low interest rate, otherwise accommodative (in normal times), could be deemed non-accommodative if the economy is in a deep recession and inflation expectations well-anchored. The reverse could hold for a relatively high interest rate in an overheating economy. We account for the behavior of the interest rate over the business cycle, and explicitly characterize monetary policy by two states (accommodative and non-accommodative). Moreover, we ensure a smooth transition between the two states. More specifically, we infer the state of monetary policy from the deviation of the actual Fed funds rate from the Taylor rule-implied rate. The likelihood of being in either of the two states is higher in a given period if the actual nominal rate deviates "enough" from the rate implied by the "traditional" reaction function of the Fed to macroeconomic conditions. This approach captures high frequency changes in monetary policy, which is desirable, given the quite frequent occurrence of fiscal shocks (we use quarterly data).

Second, we provide evidence that the existing tension over the crowding-in/crowding-out effect of government spending on private consumption in the literature may stem from previous studies not controlling for the state of monetary policy. Also, we find that fiscal policy is more effective in the United States at times of slack when monetary policy accommodates. The latter result shades some light on Owyang et al. [2013] who, not controlling for the state of monetary policy, find no evidence that fiscal policy is more effective at times of slack in the United States.

Last but not least, the use of the local projections method allows us to relax the implicit dynamic restrictions on the Impulse Response Functions (IRFs) inherent to the alternative Structural Vector Autoregressions (SVARs) method.

2.2 Econometric Model

2.2.1 Model Specification

We estimate the impulse response functions (IRFs) of macroeconomic variables (and output in particular) to a government spending shock across monetary policy states, using the local projections method developed by Jordà [2005] and applied recently by Auerbach and Gorodnichenko [2013].

The (state-dependent) response of a variable (e.g., output) to a government spending shock ($Gshock_t$), h periods ahead, is given by β_A^h in the accommodative state and by β_N^h in the non-accommodative state. These responses are estimated directly for each horizon h ($h = 0, 1, 2, ..., H$) from the following sequence of regressions:

$$\begin{aligned} y_{j,t+h} =& F(z_{t-1}) \left[\psi_A^h(L)X_{t-1} + \beta_A^h Gshock_t\right] \\ &+ (1 - F(z_{t-1})) \left[\psi_N^h(L)X_{t-1} + \beta_N^h Gshock_t\right] + u_t \end{aligned} \tag{2.1}$$

$$u_t \sim N(0, \sigma_t^2), \tag{2.2}$$

$$F(z_t) = \frac{\exp(-\gamma z_t)}{1 + \exp(-\gamma z_t)}, \quad \gamma > 0, \tag{2.3}$$

$$\mathrm{E}(z_t) = 0, \mathrm{var}(z_t) = 1, \tag{2.4}$$

where y_{jt} is our variable of interest, $X_t = [G_t, T_t, Y_t]'$ is a set of controls, and L is the lag operator. z_t is an indicator of the stance of monetary policy, normalized to have unit variance, making γ scale-invariant. There is no clear-cut theoretical guidance in defining the index z. We compute z as the deviation of the actual Fed funds rate from the Taylor rule-implied rate, with large negative values (higher values of $F(z)$) signaling a higher likelihood of monetary policy accommodation.

$F(z)$ takes values between 0 and 1 and is decreasing in z. β_A represents the fiscal multiplier in a (sufficiently) deep monetary policy accommodation (i.e., $F(z_t) \approx 1$) and β_N represents the multiplier under non-accommodative monetary policy (i.e., $F(z_t) \approx 0$ or equivalently $1 - F(z_t) \approx 1$). Interestingly, $F(0) = 1/2$, which captures well the fact that it is equally likely to be in the accommodative or non-accommodative state when the Fed funds rate exactly matches the target rate. The parameter γ captures the speed at which one (smoothly) moves from the accommodative to the non-accommodative monetary policy state as z increases from large and negative values to positive ones. It is calibrated to match the frequency of monetary policy accommodation in the data (see below). Following Auerbach and Gorodnichenko [2013], we date the index z by $t-1$ in Equation 2.1 to avoid contemporaneous feedbacks from fiscal policy actions into the state of monetary policy. [7]

7. This is not too restrictive given that with local projections, the state of monetary could adjust over the next quarter.

The local projections approach has a number of advantages: First, it easily accommodates state dependence and does not impose the implicit dynamic restrictions on the IRFs inherent to SVARs. The fact that the response of each endogenous variable is estimated separately allows one to economize on the number of parameters to be pinned-down simultaneously, therefore increasing the available degrees of freedom. In fact, unlike the VAR model which requires several variables and lags to control for the effects of non-exogenous shocks, [8] and therefore a significant loss of degrees of freedom, one loses only up to H observations for the left-hand side variable in estimating Equation 2.1. [9] In addition, contrary to VARs, the lagged explanatory variables are not needed to describe the dynamics of the dependent variable conditional on the shock. [10] The parameters β_i^h, $i \in \{A, N\}$ describe the behavior of a variable at time $t+h$ in response to an exogenous government spending shock that occurred at time t. In fact, the response of each endogenous variable is estimated in isolation to other endogenous variable. The lag structure $\psi_A(L)X_{t-1}$ in Equation 2.1 does not represent an internal dynamic of the system, but is included simply to strip $Gshock$ from predictable components that would have been wiped-out had the professional Forecaster run a VAR. [11]

Second, the induced IRFs in a state-dependent VAR model implicitly assume no change in the state variable. For instance, monetary policy could remain accommodative even after a massive fiscal expansion. This assumption is difficult to reconcile with a shock which may push output above potential, overheating the economy. The local projections method does not constraint monetary policy to be stuck in a given state forever, given that IRFs are estimated directly at each horizon, rather than obtained recursively from an estimated system. The coefficient β_i^h, $i \in \{A, N\}$, directly captures the average effect of a government spending shock at horizon h when monetary

8. Including a large number of lags under the VAR allows the error term to be orthogonal to information contained in the past values of variables included in the VAR.

9. In fact, one loses no observation in estimating the impact multiplier and loses h $(h = 1, 2, ..., H)$ observations in estimating the h-periods ahead multiplier.

10. In VARs, the IRF that describes the dynamic of a variable following a shock is a combination of the estimated parameters of lagged endogenous variables and the parameters of the VAR-COV matrix of residuals.

11. The lag structure is indeed not indexed by h and therefore does not move with the estimation horizon of the impact of the shock that occurs at time t on output h-period ahead.

policy is in the state i.

Third, one limit associated with the VAR model is the way spending multipliers are computed. Real GDP and real government spending in the VAR-system are usually expressed in the log-form. Therefore, the computed IRFs give rise to elasticities but not spending multipliers *per se*. To convert the percent changes to dollar equivalents, the IRFs are scaled by the inverse of the sample average ratio of G/Y. This approach may bias the size of the spending multiplier since the ratio G/Y tends to move substantially over the sample period (see Figure A6 in the appendix). To allow the computed multiplier to be consistent with the variability in G/Y over time and following Barro and Redlick [2011] and Owyang et al. [2013] we define the dependent variable y_t as

$$y_{t+h} = \frac{Y_{t+h} - Y_{t-1}}{Y_{t-1}},$$

where Y is real GDP and

$$g_{t+h} = \frac{G_{t+h} - G_{t-1}}{Y_{t-1}} = \left(\frac{G_{t+h} - G_{t-1}}{G_{t-1}}\right) \times \frac{G_{t-1}}{Y_{t-1}},$$

where G is a measure of government spending. The multipliers are then derived directly from the estimates of β_i^h, $i \in \{A, N\}$ for government spending and real GDP, using Equation 2.1.

Furthermore, the function $F(z)$ induces a smooth transition between the two states of monetary policy. This approach has a number of advantages. First it allows one to control for the uncertainty surrounding an otherwise (arbitrary) cut-off value of z for defining monetary policy accommodation. Second, by discriminating across different values of the index z, the (smooth) transition function captures the extent of monetary policy accommodation in a continuous way—a minor deviation from the Taylor-rule implied rate would be associated with a very low likelihood of being in either of the two states; a large negative (positive) deviation would send a strong signal of monetary policy accommodation (non-accommodation). Third, it limits the risk of mis-classifying monetary policy states that may be brought about, e.g., by a mis-specified Taylor rule. The smooth transition method is indeed a sharp departure from the alternative of estimating the fiscal multiplier separately for each regime, which would reduce the number of degrees of freedom if the number of realizations of the accommodative state is limited. The threshold regression approach does not suffer from the latter drawback, but fails to

capture the uncertainty surrounding the turning point associated with the non-linear effects of fiscal policy across the states of monetary policy.

The smooth transition method, however, delivers estimates for extreme accommodation and non-accommodation, while the extent of monetary policy accommodation is likely to be somewhere in-between these two polar cases in reality. Also, the local projections approach requires that the shock be identified exogenously.

2.2.2 Data

We estimate the model using U.S. quarterly data over the period 1965Q4–2012Q4. Our sample does not go further back in time because our identification of (unanticipated) government spending shocks relies on data from the Survey of Professional Forecasters (SPF) and the Greenbook, which starts only in 1965.

The state of monetary policy in our baseline estimations is identified only through 2008Q4 because the Fed funds rate used in the identification has been constrained by the ZLB since December 2008 and therefore has (temporally) ceased to be an appropriate indicator of the Fed's monetary policy stance. Unconventional Monetary Policy (UMP) tools have since included assets purchases, with effects on the long end of the yield curve, and not on the Fed funds rate itself.[12] Also, the level of the potential output is currently surrounded by lot of uncertainty.[13] To account for these recent developments, we first run estimations on a sample through 2008Q4. We then present results on an extended sample that nests the ZLB episode. Because the ZLB constraint indeed became active only post-2008Q4, the sample is extended through 2012Q4, using estimates of the shadow Fed funds rate—the effective policy rate when UMP is accounted for (see sub-Section 2.4)—over 2009Q1–2012Q4.

The estimation of Equation 2.1 uses real GDP, a measure of real government

12. Our estimations, however, do include the contemporaneous impact of a government spending shock that occurred in 2009Q1 (e.g., the American Recovery and Reinvestment Act), conditional on the state of monetary policy in 2008Q4 (see Equation 2.1 above).

13. This is because our estimation of the Taylor-rule uses the output gap, obtained as the deviation of actual output from its potential level. There is indeed an extensive debate about whether the global financial crisis has had a permanent effect on output.

purchases [14] and real tax revenues (direct and indirect tax receipts and social security contributions) net of transfers payment, all expressed in log-form. Aggregate real GDP, aggregate real consumption and its components, real private fixed investment, and real federal government spending (all in billions of chained 2009 dollars) are from the historical database maintained by the Federal Reserve Bank of Philadelphia. Military spending, tax revenues net of transfers, and federal debt are from the National Income and Product Accounts (NIPA) or the Federal Reserve Economic Data (FRED) at the Federal Reserve Bank of St. Louis. Real net tax revenues and real federal debt are obtained by dividing their nominal values by the GDP deflator, expressed in the base year 2009. The Real value of each spending component is obtained by dividing the nominal value from NIPA by the (specific) price index of that component, expressed in the base year 2009. [15] The output gap—used in the estimation of the Taylor-type rule—is the deviation of the actual output from its potential, obtained from the Congressional Budget Office (CBO). Finally, the unemployment rate and the civilian employment-population ratio are from the FRED.

2.2.3 Determining the State of Monetary Policy

We qualify monetary policy as being accommodative when the Fed does not raise the policy rate more than it "traditionally" does in response to macroeconomic developments, based on its estimated (historical) reaction function. We capture the reaction function of the Fed to macroeconomic conditions by means of a Taylor-type rule (see Taylor [1993]), following Clarida et al. [1998]. These authors assume that within each period, the Central Bank has a target for the nominal short term interest rate, i_t^*, which depends on both the expected inflation and the deviation of output from potential.

$$i_t^\star = \bar{i} + \beta(E_t\pi_{t+n} - \pi^\star) + \gamma(E_t y_t - y_t^\star), \tag{2.5}$$

where $\bar{i}$ is the steady-state short term nominal interest rate, $\pi^\star$ is the inflation target of monetary authorities and $y_t^\star$ is the potential output.

To account for the observed autocorrelation in interest rates, it is assumed that the nominal rate adjusts to its target level only gradually. Abrupt policy

14. We use government purchases and government spending interchangeably in the paper.

15. We proceed this way because spending components expressed in real terms are available only since 1999Q1 in the NIPA or FRED database.

reversals could indeed disrupt capital markets or undermine credibility. The adjustment equation reads:

$$i_t = (1-\rho)i_t^\star + \rho i_{t-1} + \epsilon_t, \tag{2.6}$$

where $\rho \in (0,1)$ is the smoothing parameter.

From 2.5 and 2.7 and after some arrangements, one gets:

$$i_t = (1-\rho)(\bar{i} - \beta\pi^\star) + (1-\rho)\beta E_t\pi_{t+n} + (1-\rho)\gamma(E_t y_t - y_t^\star) + \rho i_{t-1} + \epsilon_t \tag{2.7}$$

For the empirical specification we use the Federal Funds Rate (FFR) as a measure of the short-term nominal interest rate, the one-quarter ahead projection of inflation π_t^a obtained from the SPF, [16] and a measure of the output-gap. It is standard practice in the literature to use the Fed funds rate as the monetary policy indicator, although the sample may include periods in which the Fed was not explicitly targeting the funds rate. This concern is mitigated by the fact that alternative monetary policy targets would arguably be correlated with the Fed funds rate.

We estimate the following reduced-from Taylor-rule equation:

$$FFR_t = \alpha + \rho FFR_{t-1} + \gamma_\pi \pi_t^a + \gamma_y(y_t - y_t^\star) + \epsilon_t, \tag{2.8}$$

with $\alpha = (1-\rho)(\bar{i} - \beta\pi^\star)$, $\gamma_\pi = (1-\rho)\beta$ and $\gamma_y = (1-\rho)\gamma$.

We then compute an index of the monetary policy stance, z, as the deviation of the actual Fed funds rate from its estimated level obtained from fitting the reaction function of the Fed to the expected inflation and the actual output gap:

$$z_t = (FFR_t - \widehat{FFR}_t) \tag{2.9}$$

z averages 0 by construction (estimation residual) and is normalized to have unit variance. [17]

16. We also use alternative measures of inflation, including the actual inflation rate, to estimate the Taylor rule and our results remain unaltered.

17. The estimated Taylor-type rule over 1965Q4–2008Q4 is given by the equation below, where standards errors are in parentheses:
$\widehat{FFR}_t = \underset{(0.167)}{-0.012} + \underset{(0.032)}{0.897} FFR_{t-1} + \underset{(0.080)}{0.179}\pi_t^a + \underset{(0.031)}{0.138}(y_t - y_t^*)$.
These estimates suggest that the Fed tends to put more emphasis on inflation, and there is quite some interest rate smoothing, both consistent with the existing literature.

Although the approximation of the Fed's reaction function by a Taylor-type rule is consistent with the Fed mandate under the Federal Reserve Act, the value of z could in principle also capture, in some instances, omitted variables (e.g., if the Fed did shift its focus to other aggregates than the output gap and inflation at a given point in time). For instance, unemployment became a major focus of policymaking in the aftermath of the great recession, on account of the jobless recovery. Also, the policy rate is unlikely to be orthogonal to (now) increased financial stability concerns. The risk that z may not reflect the stance of monetary policy is, however, mitigated by a number of factors: (i) we estimated the Fed's reaction function over a relatively long period of time (and the sample is limited to the pre-crisis episode); and (ii) our identification of the state of monetary policy during the crisis and post-crisis episodes, over which unemployment and financial stability concerns became more prominent, accounts for the zero lower bound on the nominal interest rate and the ensuing deployment of unconventional monetary policies tools (see Section 2.4). In addition, smooth transition between the two states of monetary policy (see below) further limits the risk that the stance of monetary policy be poorly identified—the value of z (simply) informs the likelihood of being in a given state.

It is worth emphasizing that our approach for identifying the state of monetary policy—unlike some existing studies on the non-linear effects of fiscal policy in relation to monetary policy—accounts for prevailing macroeconomic conditions. For instance, Freedman et al. [2010] define monetary accommodation as instances in which the interest rate is kept constant for one or two years. Our approach is consistent with Morgan [1993]'s who identifies monetary policy tightening/easing using residuals from the regression of the level of the Fed funds rate on its own lags, current and lagged values of output growth and inflation, in testing for the asymmetric effects of monetary policy in the U.S. economy.

Although the extent of monetary policy accommodation (z) is defined here in reference to macroeconomic conditions, z may also reflect the extent of monetary policy accommodation with respect to the fiscal shock, given that the Fed would arguably increase the interest rate following an increase in government spending only to the extend that the fiscal action feeds inflation expectations or push output above potential (see Romer and Romer [2014] for a similar issue). This conjecture is confirmed ex-post: we find that the Fed funds rate falls following a positive federal spending shock under accom-

modative monetary policy, though inflation rises. As a consequence, the real interest rate falls even sharper (see Section 2.3.3).

$F(z)$ denotes the probability of being in the accommodative state for a given value of z. [18] With this characterization, we can easily incorporate the fact that fiscal policy shocks, by affecting output, can alter the monetary policy stance. [19] We calibrate the parameter γ so that monetary policy remains accommodative for about 30 percent of time in our sample and perform some sensitivity analyses with respect to that frequency. Assuming that monetary policy is accommodative if $F(z_t) > 0.8$, γ is obtained as solution to the equation: $Pr(F(z) > 0.8) = 0.3$. Solving this equation—using the cumulative distribution of F—yields $\gamma = 5$. We choose this parametrisation because we are particularly interested in episodes which are very sharp and clearly indicative of a change in the Fed's monetary policy stance. Auerbach and Gorodnichenko [2012] obtained a smaller value for γ of 1.5, reflecting the fact that recessions (their focus) are less frequent in the data (they occur 20 percent of the time, based on NBER recession dating). Our higher value of γ is conservative as it implies a faster move from the accommodative to the non-accommodative monetary state. This would result in a smaller scope for discriminating between the two states—too "close" to each other—when it comes to the effectiveness of fiscal policy (the sensitivity analyses around the parametrization of γ is discussed in Section 2.5).

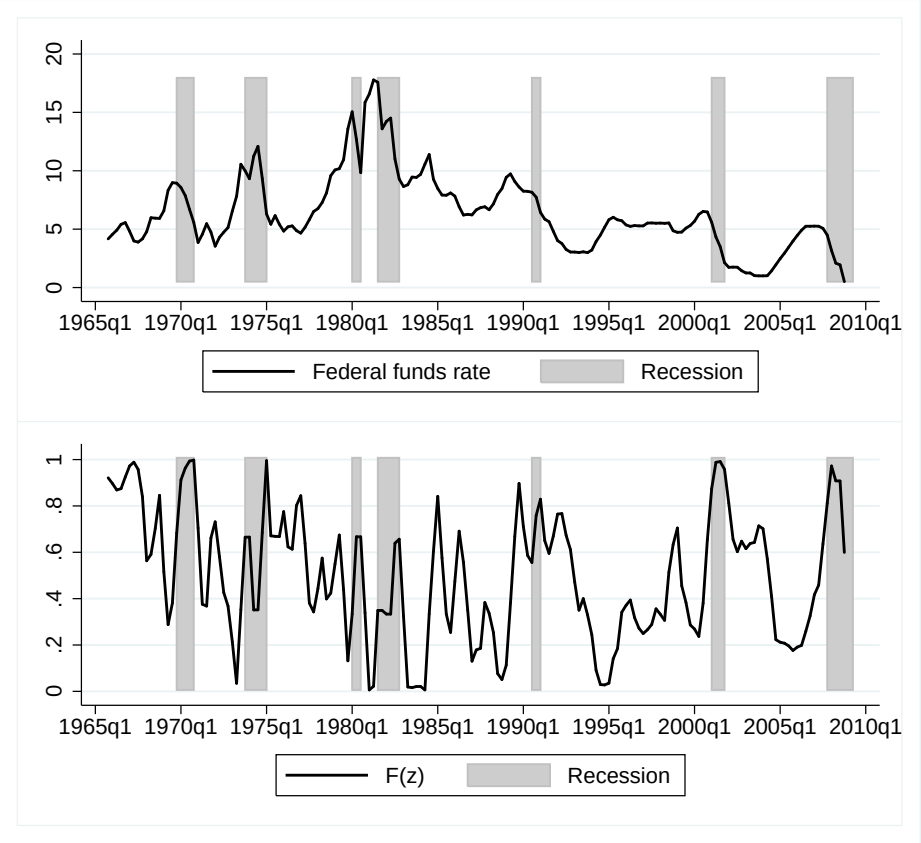
The estimated Taylor-rule delivers expected coefficients, with the Fed being more aggressive vis-a-vis inflation than towards the output gap. We also find strong evidence of interest rate smoothing, typical in the estimated of the Fed's reaction function—not surprisingly, the policy rate does not jump around. Figure 2.1 portrays the Fed funds rate and $F(z)$ over our sample period. The shared areas correspond to recessions, as identified by the NBER Business Cycles Dating Committee.

A number of observations can be drawn from Figure 2.1: (i) The post-war

18. Monetary policy is supposed to be in either of the accommodative or non-accommodative state at any point in time.

19. As an alternative to our approach, one could be tempted to define monetary policy accommodation as instances in which the deviation of the federal funds rate from the target rate is below a given threshold z_0 (i.e., $z_t \leq z_0$), with non-accommodation corresponding to the opposite case. We explore this approach by estimating z_0 by mean of a threshold regression. The results, however, tend to be highly sensitive to small perturbations to the estimated threshold, undermining confidence to that approach.

Figure 2.1 – The Fed Funds Rate and the Likelihood of Being in the Accommodative State



Notes: The first panel chart portrays the Federal funds rate and the second panel chart displays the probability of being in the accommodative state of monetary policy. Shaded bars represent NBER recession dates.

dynamics of the Fed funds rate display two broad phases: an episode of rising Fed funds rate through 1981, and an episode of declining rate post-1981. As such, controlling for the level of the interest rate as done in previous studies may not capture the full extent of changes that occurred in the U.S. monetary policy stance over time (first panel chart); (ii) Our identification scheme suggests a high likelihood of monetary policy being accommodative in some episodes of rising interest rate (second panel chart), a fact that would not be captured if one simply considers the level of the interest rate; and (iii) $F(z)$ is greater than 0.8 over the sample period in almost all the recession

dates, indicating an overall accommodative stance during recessions. Our identification may therefore nest the framework that examines the size of the fiscal multiplier over the business cycle. In fact, Robert Hall in his comments on Auerbach and Gorodnichenko [2013] (see Alesina and Giavazzi [2013]) notes that the state of the economy as identified by the authors may simply reflect various phases in US monetary policy. Interestingly, our identification suggests that monetary policy was at times accommodative outside recession episodes, making our framework broader in scope.

One challenge associated with our identification strategy is the treatment of the ZLB episode. In fact the index z is, by construction, biased upward when the nominal interest rate hits the ZLB. This is because the estimated Taylor-rule rate ($\widehat{FRR}_t$) is unbounded, while the actual interest rate is bounded from below. We extend the identification of the monetary policy state to the ZLB episode, using alternative methods in Section 2.4.

2.3 Estimation Results (sample ending in 2008Q4)

For each regression h ($h = 0, 1, 2, ..., H$) of Equation 2.1, we use 4 lags of $\mathbf{X}$, and following Owyang et al. [2013], we add a quartic trend. [20] Government spending shocks ($Gshock$) are identified using two approaches. We first examine the case in which government spending shocks are identified using the Cholesky decomposition (quite standard in the VAR-like approach). We subsequently turn to a measure of unanticipated government spending shocks which controls for expectations.

2.3.1 Government Spending Shocks Identified Using the Cholesky Decomposition

As a starting point, we identify shocks to government spending ($Gshock_t$) as residuals of the projection of log of G_t on the lagged values of log of $\mathbf{X_t} = [\mathbf{G_t}, \mathbf{T_t}, \mathbf{Y_t}]'$, common in the literature. Innovations from this projection are equivalent to those that would be generated by a SVAR in which shocks are identified using the Cholesky decomposition whereby the government spending variable is ranked first. Delays in adopting/implementating government spending measures (e.g., due to the parliamentarian process) are

20. The coefficients of the trend are not state-dependent.

indeed such that they may not affect output within a quarter (see the seminal paper by Blanchard and Perotti [2002]). Equation 2.1 is then estimated using the resulting series $Gshock_t$ employing the Newey-West estimator.

Estimation results suggest that federal government purchases are expansionary and have a highly persistent impact, [21] with output increasing for many quarters after the shocks (see appendix, Figure A8). It is worth noting that our linear model generates government spending multipliers that are well within the range of those found in the literature: the impact multiplier of U.S. federal government spending is around 1.7 upon impact (one-year cumulative). For comparison purposes, we also use military spending, and find that they tend to be more expansionary (the induced multiplier is around 2), consistent with earlier findings in the literature. The peak output multiplier is also the largest for military spending. [22] Our non-linear estimations also suggest that the response of output to the federal government spending shock depends on the state of monetary policy that prevails at the time of the shock—the increase in output is higher when monetary policy is accommodative and for many quarters after the shock (see detailed discussion below). [23]

2.3.2 Government Spending Shocks Identified as Forecast Errors

One criticism associated with the above identification strategy is that these shocks might be forecastable because fiscal policy changes are anticipated in advance due to the time lag between their adoption by the Legislative and their implementation—see Ramey [2011] on the critical role of the timing of

21. We also looked at the response of GDP to government investment spending versus government current consumption. Results, not reported suggest a highly persistent impact of government investment on GDP relative to the impact of government current consumption. When identifying government spending shocks as forecast errors, we only focus on aggregate federal spending because forecasts of government purchases are available only at the aggregate level.

22. detailed results associated with defense spending shocks are available upon request.

23. This result is consistent with Freedman et al. [2010] who find, using simulations from a multi-region DSGE model (see Anderson et al. [2013]), that multipliers of two-year fiscal stimulus are higher when the interest rate is kept constant for one or two years. It is also consistent with simulations in Coenen et al. [2010]. But our analysis differs from those studies in that it is empirical in nature and our identification of the state of monetary policy accounts for macroeconomic conditions (see discussion above).

fiscal shocks in pinning-down the effect of fiscal shocks. Even including a large number of lags could fail to capture these anticipated future changes in fiscal policy. For this reason, we use a measure of a surprise government spending shock. Following Auerbach and Gorodnichenko [2012], we identify unanticipated government spending shocks as forecasts errors of the growth rate of government purchases:

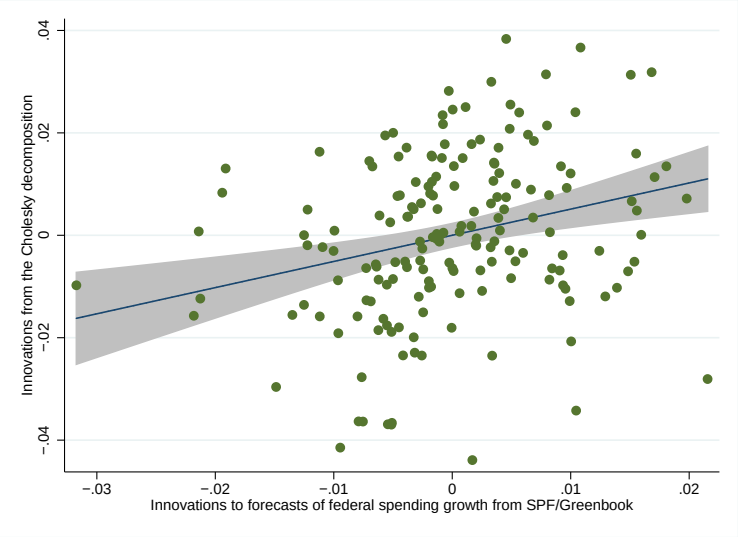
$$FE_t^G = \Delta logG_t - E_{t-1}\Delta logG_t$$

We construct our forecast series of real government spending growth from two sources: the Survey of Professional Forecasters (SPF) and the Greenbook record. SPF data is only available since 1981. We complement that source with the Greenbook record prepared by the staff of the Federal Reserve Board ahead of the meetings of the Federal Open Market Committee (FOMC) since 1965. Our series of government spending shocks therefore cover the period from 1965 to 2012. Because of many revisions in national accounts data, we follow Auerbach and Gorodnichenko [2012] in using growth rates (rather than levels) of real federal spending. More specifically, we first constitute series of forecasts of real federal spending from one-quarter-ahead projections available from the Greenbook up to 1984. We then take the one-quarter ahead forecast of federal spending from the SPF, available since 1981, from which we back out the real growth rate. Finally, to have a complete series of expected real growth of federal spending, we splice both series of expected growth of real spending. The series of forecast errors are then obtained as the difference between actual real growth of federal spending and their one-quarter ahead projection made in the previous quarter. Finally, to purify our series of government spending shocks from predictable changes in the growth rate of government spending that would have been foreseen by professional forecasters, we include lagged values of government spending, net taxes, and output to the local projections (Equation 2.1).

Is there any empirical case for using SPF/Greenbook as sources of identification of government spending shocks rather than relying on the (traditional) Cholesky decomposition? To provide an answer to that question, we project actual real federal spending growth and their forecasts on the lags of real federal spending, real GDP and real tax revenues expressed in log-term. As shown in Figure 2.2, the two series of residuals obtained from those projections are correlated, with a coefficient of correlation of about 0.3. When we regress the series of residuals from actual federal spending growth equation on

the series of residuals from the forecasts of federal spending growth equation, we find a coefficient of 0.5, significant at 5 percent significance level.

Figure 2.2 – Predictability of Innovations from the Cholesky Decomposition



Notes: This figure shows residuals of projecting actual real federal growth spending on lags of real federal spending, real GDP and real tax revenues expressed in log (vertical-axis) and residuals of the projection of forecasts of real federal spending growth on the same variables. The correlation between the two series of residuals is 0.3. The projection of the first series on the second delivers a coefficient of 0.5 with a standard error of 0.13. The grid area is the 95 percent confidence interval around the fitted values.

These findings suggest that innovations from the VAR-like approach are somewhat predictable (Auerbach and Gorodnichenko [2012] present a similar evidence). Our preferred approach is therefore one in which government spending shocks are identified as forecast errors of the growth rate of government spending from SPF/Greenbook.[24] This is the approach adopted in all the estimations presented below.

24. Government spending shocks identified with the VAR-like approach might be predictable in the sense that, the information set available to the econometrician is limited when running a VAR. Even including more lags should not purified the shocks from all their predictable components. By contrast, professional forecasters have a broader information set than the econometrician. Forecasts errors from SPF/Greenbook should therefore be more likely to be purified from any predictable changes that would have been foreseen by professional forecasters.

2.3.2.1 Results for aggregate output

Figure 2.3 displays the IRFs of output and federal spending to a "surprise" federal spending shock (as identified in sub-Section 2.3.2), in the linear case (first Column) and across the two states of monetary policy: accommodative state (second Column) and non-accommodative state (third Column). Gray shaded regions represent the 95 percent confidence bands around the estimates. Given the relatively small number of observations in the accommodative state (about 30 percent of the sample), the associated confidence bands are slightly wider than in the non-accommodative state.

Clearly, the response of output is conditional on the state of monetary policy: output increases to a large extent following a federal spending shock when monetary policy accommodates, while it falls, albeit not significantly, when monetary policy does not accommodate. This result holds over time and is consistent with the findings in Auerbach and Gorodnichenko [2012]. The authors find that government spending tend to be slightly recessionary during expansions when expectations are controlled for.

Because the response of output (and other aggregates) depends on the persistence of the response of government spending (different across the two states of monetary policy), we report in Table 2.1 and subsequent tables two measures of "normalized" spending multipliers: (i) the "cumulative multiplier" (one-year, two-year, and four-year integral), defined as the ratio of the sum of the response of output over the sum of the response of government spending through that period; and (ii) the "peak multiplier" defined as the ratio of the response of output and government spending at their respective peaks. These measures of spending multipliers are common in the literature (see Owyang et al. [2013] and Auerbach and Gorodnichenko [2013]).

Estimation results suggest that output increases by 2.5 dollars within a year for a dollar increase in federal spending when monetary policy is accommodative and decreases by 1.6 dollars when monetary policy is non-accommodative. The peak multiplier when the accommodative state prevails is equal 5.5 and only equals 2.8 under non-accommodative monetary policy.

The magnitude of our estimated multipliers under monetary policy accommodation are consistent with Christiano et al. [2011] who, using a DSGE framework, finds an output multiplier of 3.7 at the ZLB under their benchmark specification. We note that one should interpret the multipliers obtained here for the two states of monetary policy as polar values—they correspond to

sufficiently deep monetary policy accommodation and non-accommodation. The extent of monetary policy accommodation is likely to be in-between these two extremes in reality.

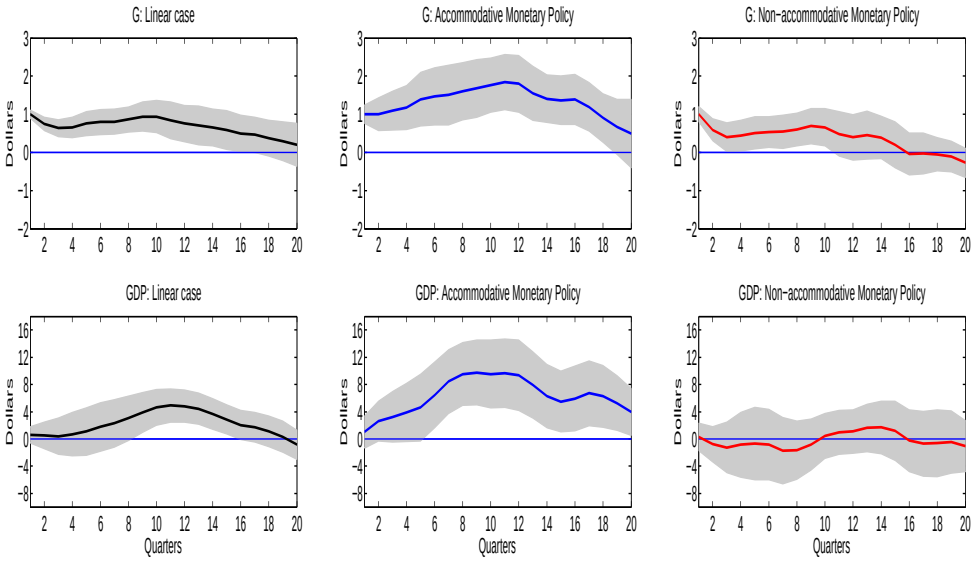
Although the patterns of the results are broadly similar across the two approaches to identifying fiscal shocks (see Table 2.1), two notable differences emerge: (i) The multiplier upon impact is much lower using our preferred measure of government spending shock (derived from forecast errors from SPF/Greenbook), estimated at 0.6, against 1.5 with the Cholesky decomposition, a result that is reversed over time; and (ii) controlling for the role of anticipations seems to increase the discriminatory role of monetary policy (fiscal multipliers across the accommodative and non-accommodative states are more apart with the measure of unanticipated shocks). These two elements highlight the need to control for anticipations in estimating fiscal multipliers.

2.3.2.2 Results for disaggregated output

Figure 2.4 portrays the response of total private consumption to a (surprise) federal government spending shock. Under accommodative monetary policy, federal government spending significantly and persistently crowds-in private consumption, while private consumption is somewhat crowded-out when monetary policy is non-accommodative. Surprisingly, the state of monetary policy does not seem to discriminate the response of private investment (see appendix, Figure A9). This result might be driven by the composition of federal government spending and how it is financed. It may also reflect the response of inventories over the business cycle.

We also examine the response of disaggregated private consumption into durable goods, and non-durable goods and services and the above finding on aggregate private consumption holds across its major components: federal government spending significantly and persistently crowds-in consumption of durable goods and non-durables goods and services under accommodative monetary policy, while these consumption components tend to be crowded-out under non-accommodative monetary policy. Table A3 in appendix presents the multipliers for aggregate and disaggregated private consumption and private investment at various horizons (cumulative multipliers) and at their maximum (peak multiplier).

Figure 2.3 – IRFs of Federal Government Spending and Output to Federal Government Spending Shocks



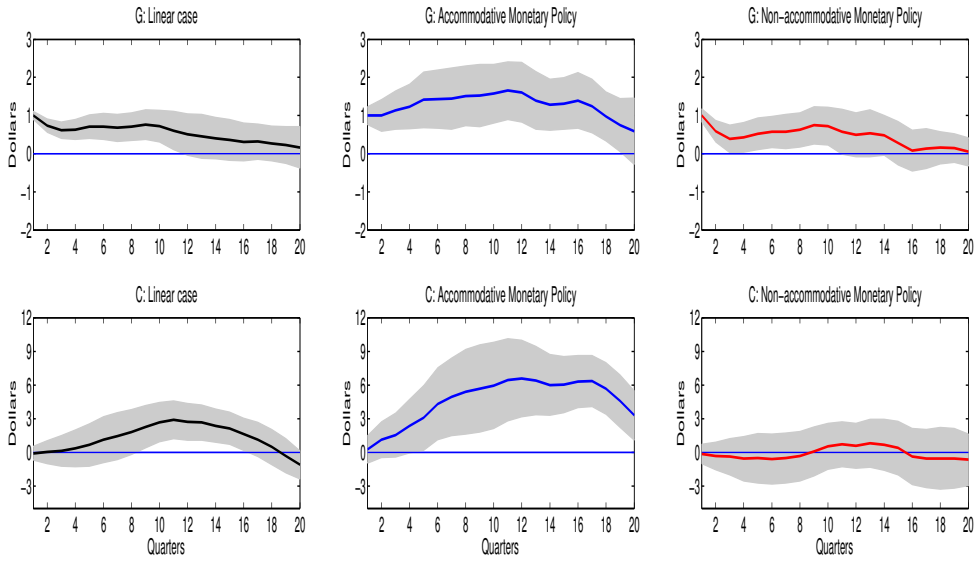
Notes: Shaded areas represent the 95 percent confidence bands around the estimates.

Table 2.1 – GDP Cumulative and Peak Multipliers: "Cholesky" vs. "SPF/Greenbook" Federal Spending Shocks

	1-year integral	2-year integral	4-year integral	Ratio of peak responses
Shocks identified with the Cholesky decomposition				
Linear	1.53	2.07	2.83	3.27
Non accommodative	0.60	1.46	2.12	2.59
Accommodative	2.46	2.79	3.41	4.19
Shocks identified with SPF/Greenbook forecast errors				
Linear	0.60	1.63	3.44	5.04
Non accommodative	-1.55	-1.97	-0.22	2.76
Accommodative	2.50	3.96	4.48	5.51

Notes: Cumulative multipliers are computed as the ratio of the sum of responses of GDP and government spending. The peak measure is the ratio of the IRFs at their respective peaks.

Figure 2.4 – IRFs of Private Consumption



Notes: Shaded areas represent the 95 percent confidence regions around the estimates.

2.3.3 Transmission Channels

We explore two channels that might explain our findings: (i) the "substitution effect" through the real interest rate path; and (ii) the "wealth effect" through the funding scheme for federal government spending.

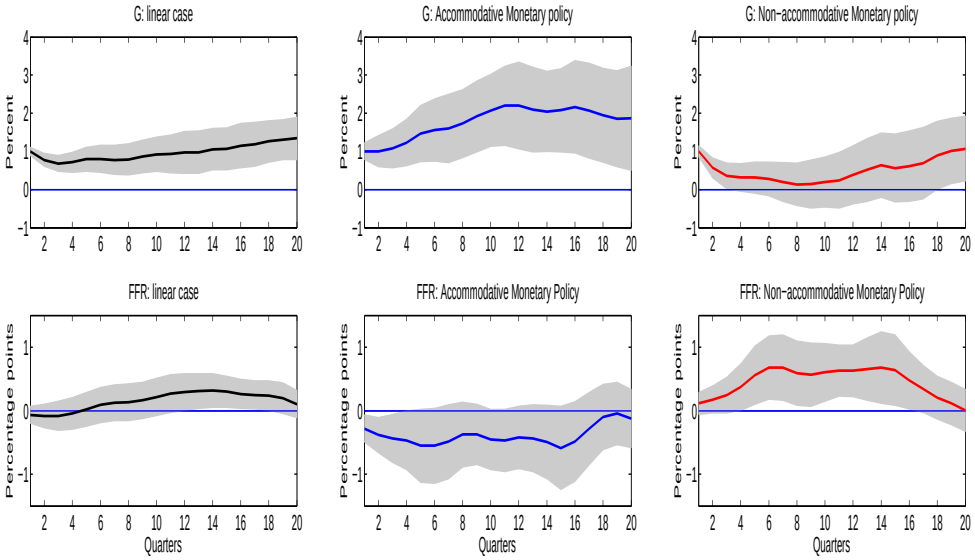
The path of the real interest rate conceptually matters for the effectiveness of fiscal policy. For instance, when the nominal interest rate hits the ZLB in New Keynesian models, an increase in government spending induces a decline in the real interest rate, as inflation rises and the nominal rate remains constant. The decline in the real rate in turns boosts private spending and aggregate demand. Even beyond the ZLB, the response of the short term nominal rate to inflation, reflecting the stance of monetary policy would affect the effectiveness of fiscal policy. Accommodative monetary authorities may for instance not necessarily increase the short term rate in response to the spending shock, which would prompt inflation to rise more than otherwise. As a consequence, the real interest rate declines, boosting aggregate demand. To test this conjecture, we compute the response to federal government spending shock of the Feds fund rate, inflation, and two measures

of the real interest rate across our monetary policy states (accommodative and non-accommodative): (i) the ex-ante real interest defined as the difference between actual nominal rate and the one-quarter ahead projection of inflation (from SPF): $rr_t^a = FFR_t - \pi_t^a$; and (ii) the ex-post real interest rate defined as the measure between actual nominal rate and the realized inflation rate $rr_t^p = FFR_t - \pi_{t+1}$. In this context, we estimate the local projections equation (see Equation 2.1), adding the interest rate or inflation to the set of variables X_t. We find that the nominal interest declines in response to the spending shock while inflation rises, under accommodative monetary policy. The opposite holds under non-accommodative monetary stance. As a consequence, the two measures of real interest rate decline in response to a federal spending shock under accommodative monetary and increase under non-accommodative monetary policy (see Figure 2.5 for the response of the (nominal) Fed funds rate and Figure 2.6 for the response of the ex-ante real rate). This, we believe, is a nice feature of our monetary policy states. In fact, although identified with respect to macroeconomic conditions (output gap and inflation) ex-ante, our monetary states mimic a direct reaction of monetary authorities to fiscal shocks ex-post—the nominal and real interest rates decline (increase) following a government spending shock under the accommodative (non-accommodative) state. The monetary and fiscal authorities may therefore dance together or not in practice.

Figure A10 in the Appendix displays the response of real federal debt to a shock to federal government spending. Real debt increases under accommodative monetary policy and decreases when monetary policy is not accommodative. Interestingly, we find that the response of real tax (not reported) does not depend on the state of monetary policy. These two results seem to suggest that federal spending are financed mostly with debt at lower financing costs (under accommodative monetary policy).[25] The decline in real interest rate, coupled with debt financing of spending may therefore explain the stronger response of output and private consumption under accommodative monetary policy.

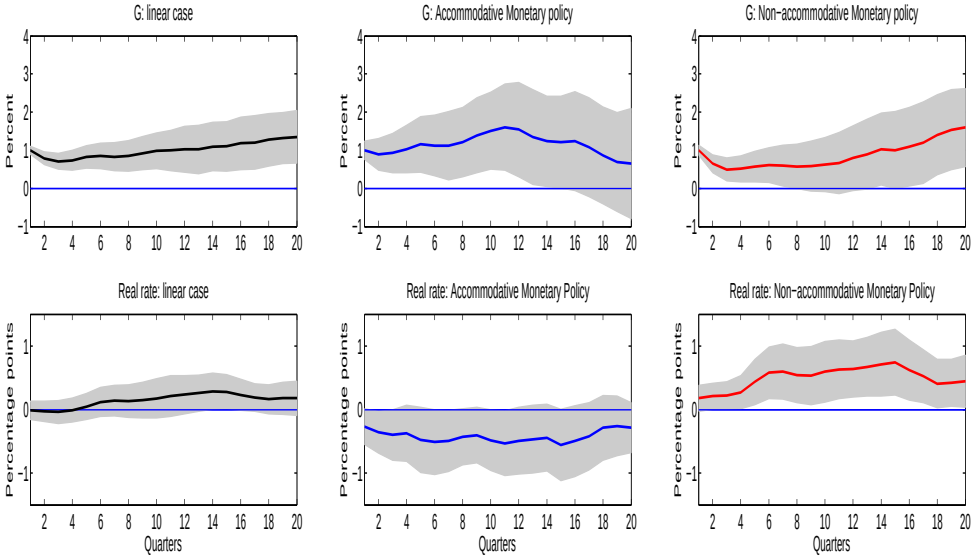
25. The low financing cost may therefore mitigate any ricardian-effect that would prevail.

Figure 2.5 – IRFs of the (Nominal) Fed Funds Rate



Notes: Shaded areas represent the 95 percent confidence bands around the estimates.

Figure 2.6 – IRFs of the Real Fed Funds Rate



Notes: Shaded areas represent the 95 percent confidence bands around the estimates.

2.4 Estimation Results (sample covering the recent ZLB episode)

2.4.1 Identification of the State of Monetary Policy at the ZLB and Estimated Multipliers

In a recent paper, Christiano et al. [2014] emphasize the critical role of the zero lower bound (interacting with financial frictions) in accounting for movements in aggregate real economic activity during the Great Recession. Because of the uncertainty surrounding the state of monetary policy at the ZLB, our above estimations covered a sample ending in 2008Q4. We examine in this section how our results change when the sample is extended through 2012Q4, using alternative approaches. One challenge is indeed that our index of monetary policy accommodation (defined as the difference between the actual Fed funds rate and the target rate) is biased upward when the Fed funds rate is stuck at 0. In fact, at 16 basis points in December 2008, the Fed funds rate *de facto* reached the zero lower bound on the nominal interest rate and was no longer an appropriate indicator to assessing the Fed's monetary policy stance. [26] In an attempt to relax financing conditions in the U.S. economy further, as the short-term rate was stuck at zero, the Federal Reserve has deployed a number of unconventional monetary policy tools. These included large-scale asset purchase programs (QE), and forward guidance, a new communication toolkit aims at signaling the future course of monetary policy to the public. [27] These policy measures have essentially affected the long end of the yield curve—long term interest rates have (temporarily) become the Fed's intermediate targets. Many researchers have since tried to assess the effectiveness of these unconventional monetary policy tools, an uncharted territory. One related question—of particular interest for the identification of the state of monetary policy adopted in this paper—is the level of the Fed funds rate that would generate the observed yield curve if the rate was not constrained (i.e could take negative values).

In that context, Wu and Xia [2014] develop a nonlinear term structure model

26. The nominal interest rate is bounded by 0 from below because holding cash is always a better (available) alternative option than borrowing at 0 or negative interest rate.

27. Forward guidance has recently consisted for the Fed in stating that the policy rate will be kept low as long as some amount of slack remains in the economy (unemployment rate below 6.5 percent) or the recovery remains fragile.

to summarize the macroeconomic effects of unconventional monetary policy at the ZLB. In particular the authors generate series of a "shadow" Fed funds rate from 2009Q1 to date. [28] Interestingly, the shadow rate coincides with the actual rate prior to 2008Q4. We first use these series to extend our sample of monetary policy state. More explicitly, we generate the target rate for the period from 2009Q1 to 2012Q4 during which the ZLB was binding in our sample, by fitting the actual values of the expected inflation and the output gap to our estimated Taylor rule. We then compute the index z of monetary policy accommodation as in Equation 2.9, and the function $F(z)$ capturing the likelihood of being in the accommodative state. Finally, we re-estimate the (monetary policy state-dependent) government spending multiplier on the extended sample.

Table 2.2 – GDP Cumulative and Peak Multipliers (extended sample through 2012Q4)

	1 year integral	2 years integral	4 years integral	Ratio of peak responses
ZLB: Wu and Xia [2014]				
Linear	-0.58	-0.29	1.61	2.79
Non accommodative	-2.89	-3.97	-1.16	1.63
Accommodative	1.72	2.52	2.97	3.68
ZLB: Own calculations				
Linear	-0.58	-0.29	1.61	2.79
Non accommodative	-2.00	-3.09	-0.86	1.54
Accommodative	1.47	2.45	3.01	3.77
ZLB: Lombardi and Zhu [2014]				
Linear	-0.58	-0.29	1.61	2.79
Non accommodative	-1.71	-2.13	-0.40	1.67
Accommodative	1.01	1.84	2.76	3.57

Notes: Cumulative multipliers are computed as the ratio of the sum of responses of GDP and government spending. The peak measure is the ratio of the IRFs at their respective peaks.

As robustness check of our identification of the state of monetary policy at the ZLB, we also use the shadow rate series generated by Lombardi and Zhu [2014]. [29] We also construct an alternative measure, assuming (naively) that

28. The series, including their description, are available on the web site of the Federal Reserve Bank of Atlanta: www.frbatlanta.org/cqer/researchcq/shadow_rate.cfm.

29. Our preferred series of the shadow rate are those from Wu and Xia [2014], partly

changes in the 10-year US rate reflect change that would have affected the Fed funds rate if the latter was unconstrained. Although the three methods deliver estimates of the shadow rate that are quite different quantitatively, they all suggest a shadow Fed funds rate that is broadly in the negative territory during the ZLB episode (see Figure A7 in appendix). Interestingly, our main qualitative result that the federal spending multiplier is higher under accommodative than under non-accommodative monetary policy is unaltered in all the three cases. Table 2.2 portrays our estimation results for the (surprise) federal government spending shock from SPF/Greenbook. The corresponding IRFs under accommodative and non-accommodative states, using Wu and Xia [2014]'s measure of the shadow rate, are displayed in Figure A11 in appendix. [30] To put these results in perspective, Figure A13 in appendix portrays our characterization of the state of monetary policy overtime, including under the recent UMP. It suggests that monetary policy became accommodative only progressively after the zero lower bound on the nominal interest rate had become binding. [31] Also, Figure A14 in appendix traces the cumulative fiscal multiplier overtime, along with the dating of our (extreme) monetary policy accommodation ($F(z) > 0.8$). As in Auerbach and Gorodnichenko [2012], there is quite some variability in state-dependent fiscal multipliers overtime with, in our case, usually higher multipliers when monetary policy accommodates.

Our estimations also indicate that the federal government spending multiplier is lower at all horizons (linear model) when the sample is extended through 2012Q4. Also, although it is still much higher compare to the case of non-accommodative monetary policy, the fiscal multiplier in the accommodative state of monetary policy is lower on the extended sample that covers the recent ZLB episode. These findings are consistent with recent contributions

because of the high volatility of the series in Lombardi and Zhu [2014], which seems at odd with interest rate smoothing. Christiano et al. [2014] also provide a specification for the shadow Fed funds rate in a DSGE set-up.

30. The IRFs corresponding to the two other measures of the shadow rate are available upon request.

31. Interestingly, the extent of monetary policy accommodation increases when we use a former vintage (Fall 2013) of the output gap from CBO to evaluating the Taylor-rule implied rate. The identification of the state of monetary policy for the remainder of the sample period, however, is robust across vintages of the output gap data. This heterogeneity stems from the fact that, while the output gap had been underestimated across the board, the underestimation was more pronounced for the post-crisis episode for which the output potential was recently marked-down significantly.

in the theoretical literature on the size of the fiscal multiplier at the ZLB. In fact, while Christiano et al. [2011] find an output multiplier of 3.7 in the benchmark specification of their DSGE model, Mertens and Ravn [2014] show that the size of the fiscal multiplier when the zero lower bound binds is reduced in a liquidity trap caused by a self-fulfilling state of low confidence.

2.4.2 What Happens at Times of Slack?

As a bridge between our analysis and former studies that examine how the fiscal multiplier varies with the state of the economy, we re-estimate Equation 2.1, distinguishing between periods of "slack" and periods of "non-slack". The amount of slack in the economy is captured by the unemployment rate. Following Owyang et al. [2013], we use 6.5 percent as the threshold, which is also in line with the recent Fed's forward guidance. This value of the threshold implies that the U.S. economy spends about one-third of the time in slack. This is higher than the 20 percent time proportion that the U.S. economy spends in recession, as implied by the information from the NBER Business Cycle Dating Committee (see Auerbach and Gorodnichenko [2012]). The relatively high frequency of slack is consistent with the fact that some economic recoveries are "jobless". [32]

Table 2.3 – GDP Cumulative and Peak Multipliers at Time of Slack and Non-slack (extended sample through 2012Q4)

	1 year integral	2 years integral	4 years integral	Ratio of peak responses
Linear	-0.58	-0.29	1.61	2.79
Non-slack	-1.04	-0.46	1.51	3.63
Slack	-0.15	-0.26	1.83	2.55

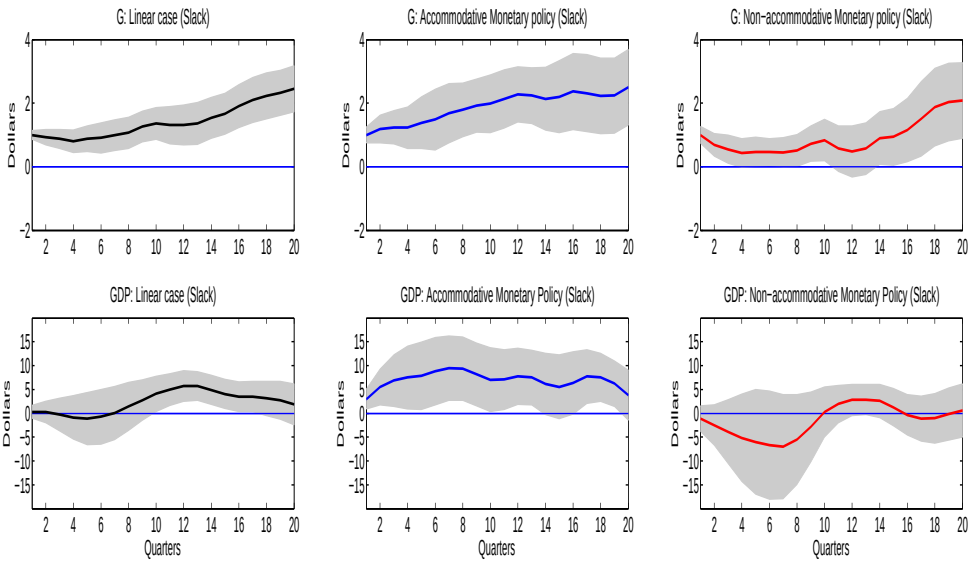
Notes: Cumulative multipliers are computed as the ratio of the sum of responses of GDP and government spending. The peak measure is the ratio of the IRFs at their respective peaks.

We generally do not find broad support to higher government spending multiplier at times of slack in the U.S. economy when the state of monetary policy is not accounted for (see Table 2.3). This is consistent with recent findings by Owyang et al. [2013], using newly constructed historical U.S.

32. Assuming the same 20 percent share for slack as for recessions would imply a cut-off unemployment rate of 7.3 percent. Some sensitivity analyses on the value of the threshold for characterizing the slack leave our qualitative results unaltered.

quarterly data from 1890 to 2010. Our estimations suggest, however, that federal government spending are highly effective at times of slack if monetary policy is accommodative, but are contractionary otherwise. Figure 2.7 clearly highlights the sharp contraction of output when monetary policy does not accommodate during slack. We also compute the response of employment and unemployment to a federal spending shock at times of slack and the non-linear effects with respect to the state of monetary policy are similar to those of output (see Figure A12 in appendix for the response of the employment).

Figure 2.7 – IRFs of Output at Times of Slack (extended sample, including the ZLB episode)



Notes: Shaded areas represent the 95 percent confidence regions around the estimates.

2.5 Sensitivity Analysis

We investigate the robustness of our results along two dimensions: first, the function characterizing the transition from the accommodative to the non-accommodative state of monetary policy, then the measure of inflation used in

estimating the Taylor rule. The first sensitivity analysis is important because it captures how far apart the two states are, while the second is relevant for determining the real interest rate, one of our transmission channels.

2.5.1 Model Parametrization: Smoothing Parameter

The smoothing parameter γ (see Equation 2.3) dictates the speed at which monetary policy moves from the accommodative to the non-accommodative state as z increases (e.g., moving from the negative to the positive territory) is relevant for our empirical analysis. That speed is decreasing in γ, given that F is an increasing function of γ. Table A2 in appendix displays output multipliers across different values of γ, with government spending shocks identified by forecast errors of federal spending. Our results are robust to the frequency of monetary accommodation. Regardless of the value of γ, GDP multipliers remain positive and larger under accommodative monetary policy while fiscal stimulus are at times recessionary when monetary policy is not accommodative. Note that, when γ increases, the difference in the size of the multipliers between the accommodative and the non accommodative state diminishes. Indeed, higher values of γ are associated with small deviations of the interest rate from the target, inducing less expansionary fiscal stimuli.

2.5.2 Measure of Inflation Used in the Estimation of the Taylor Rule

The measure of the inflation target used in the empirical analysis is potentially relevant. We estimate different specifications of the Taylor rule using respectively our benchmark measure of inflation (the one-quarter ahead forecast of inflation from the SPF), the quarterly CPI inflation, the quarterly Personal Consumption Expenditures (PCE) inflation, the year-on-year CPI inflation, and the year-on-year lead CPI inflation. The latter is used as inflation forecast. Our results (displayed in Table A1 in appendix) remain robust across different measures of inflation. Whatever the specification, output multipliers are larger under accommodative than non-accommodative monetary policy.

2.6 Conclusion, Policy Implications, and Possible Extensions

This paper examines how the stance of monetary policy affects the aggregate and sectoral response of output to government spending shocks. We apply the local projections method to quarterly U.S. data and provide estimates of the government spending multiplier over the monetary policy cycle. Government spending shocks are identified as forecast errors of the growth rate of federal government spending from the Survey of Professional Forecasters and the Greenbook, further stripped from their predictable components. The state of monetary policy is inferred from deviations of the Fed funds rate from the target rate, using a smooth transition distribution, calibrated to reflect the average frequency of monetary policy accommodation in Fed's history.

We find that the federal government spending multiplier is substantially higher under accommodative than under non-accommodative monetary policy. Moreover, by examining the response of various components of output, including disaggregated consumption expenditure, we are able to reconcile, within a unified framework, apparently contradictory findings in the existing literature: federal government spending may crowd-in or crowd-out private consumption, depending on the extent of monetary policy accommodation. Controlling for predictable components of government spending increases the estimated effectiveness of fiscal policy under accommodative monetary policy. The paper documents two channels through which monetary policy accommodation increases the effectiveness of fiscal policy: the real interest rate channel and the funding channel for federal government spending.

Our findings have important policy implications. They broadly suggest that fiscal policy is more effective when needed the most (e.g., at times of slack), if supported by monetary policy. Our results also have implications for the normalization of monetary conditions in advanced economies: the exit from UMP would lead to much lower federal government spending multipliers than otherwise, even if some amount of slack was to remain in the economy. This further highlights the need for a careful calibration of the timing of exit from unconventional monetary policy.

Our analysis can be extended along several dimensions. First, a more ambitious avenue to identifying the response of the monetary authority to macroeconomic developments, including fiscal policy, could be the narrative ap-

proach based on historical record. This would consist in exploiting information contained in the minutes of the meetings of the FOMC at the U.S. Federal Reserve, available electronically on a quarterly basis since 1936. Monetary policy could be deemed non-accommodative if the need to counter-act the effects of government actions was explicitly mentioned in the minutes of the FOMC meeting that took place around the time when the fiscal measure was legislated or in anticipation to its adoption. Another natural extension would be to apply the framework developed in this paper to examine the effects of tax policy changes. The (traditional) associated challenge would be the identification of exogenous variations in tax policy, given their distorsionary impact (e.g., on labor supply). Last, but not least, extending our empirical framework to other OECD countries, and to Euro area countries in particular (given their common central bank) would provide supplementary evidence on how fiscal and monetary policy interact.

Chapter 3

Fiscal Policy and Income Inequality: Evidence from Latin American Countries

3.1 Introduction

Over the past decade, the Latin America and Caribbean (LAC) region has experienced a significant decline in poverty and income inequality. Extreme poverty, defined in the region as the proportion of the population living with less than $2.50 Purchase Power Parity (PPP) a day, has declined by half in 15 years (from 26 percent in 1995 to less than 13 percent in 2010). The region has also added 50 million people in the middle income class [1]. However, despite these impressive achievements in poverty reduction and increasing income of the bottom segment, the region remains the most unequal in the world. According to World Bank Group [2013], the largest segment of the region's population still remains vulnerable to falling back into poverty. In 2011, 40 percent of the population, while living with incomes above the poverty line of $4 PPP a day, still remain below the middle class threshold of $10 PPP a day. When comparing income inequality to other regions in the world, with an average Gini coefficient of 0.52, the LAC region is 10.6 percent more unequal than Sub Saharan Africa (SSA), 36.8 percent more unequal than East Asia and the Pacific (EAP) and about 53 percent more unequal than Europe and Central Asia (ECA)(see López and Perry [2008]).

Because high inequality can constitute a barrier to poverty reduction (see López and Perry [2008]) or hinder economic growth by increasing political instability, policy actions need to be taken to tackle these inequalities and to foster the income growth of the population at the bottom of the social pyramid. Since 2012, the international community led by the World Bank Group (WBG) has set a new goal, achieving "shared prosperity". This goal consists of promoting the income growth of the bottom 40 percent of the population in every country, to reduce rising inequality. The focus on improving the income growth of the poorest 40 percent is a departure from traditional approaches of reducing poverty that focus on GDP growth per capita. In fact, while macroeconomic indicators such as GDP growth per capita are useful indicators of nations' economic progress, they miss the distributional aspects of the ensuing income. In this context, does fiscal policy contribute (or not) to spur the income growth of the bottom 40 percent based on past experience?

1. The proportion of people living with a daily per capita income between $10 and $50 PPP. This proportion of the population grew from 20 percent in 1995 to 30 percent in 2010.

The question of how fiscal policy affect inequality in general and income of the less well-off is relevant for a number of purposes. Temporary fiscal expansion can for instance stimulate low-skill employment, therefore increasing the wage share of the low income groups, then reducing income inequality. The composition of fiscal changes might also be relevant. For instance, a fiscal adjustment relying more on progressive taxes (income taxes) will be more likely to reduce income inequality [2] while regressive tax-based adjustment like VAT may lower the disposal income of the low income classes and increase inequality. Also, income inequality will tend to decrease with fiscal expansion based on more progressive spending like public transfers.

The aim of this paper is therefore twofold: (i) examine how fiscal expansion and fiscal contraction [3], including their composition, affect the income growth of the bottom 40 percent in the LAC region; (ii) investigate how those fiscal measures affect the two components associated to the income growth of the bottom 40 percent, their income share growth (a measure of income distribution) and the mean income growth captured in this study by the real GDP growth.

I find that on average, expenditures-based fiscal expansion are more likely to increase the income of the bottom 40 percent than revenues-based fiscal expansion. This result is mainly driven by government current consumption, transfers and subsidies. In addition, these fiscal expansion measures help to reduce income inequality by improving the income share of the bottom segments of the population while reducing the top income share. However, fiscal expansion could either have no effect on economic growth or prevent the latter through capital expenditures increases. Both expenditures and revenues-based fiscal contraction are harmful for the income growth of the bottom 40 percent and for income distribution. None of the fiscal contraction measures affects significantly GDP growth.

The remainder of the paper proceeds as follow. Section 3.2 exposes the review of the literature. Section 3.3 describes data and the identification strategy of episodes of fiscal expansion and fiscal consolidation. Section 3.4 specifies the econometric model and analyzes the estimation results. Section 3.5 presents some robustness checks and discusses the results in relation with previous

2. One could however acknowledge that vertical equity can be addressed with targeted tax credit.

3. I use alternatively fiscal adjustment or fiscal consolidation.

findings in the literature. Section 3.6 concludes, draws policy implications and explores extensions.

3.2 Review of literature

Recent empirical studies on the distributional impact of fiscal policy has mainly focused on advanced economies. Some of these papers examine the effects of fiscal consolidation on income inequality. Mulas-Granados [2005] find in a panel of 15 European member countries, that expenditures-based fiscal adjustment is associated with an increase in income inequality, the opposite holding true for revenue-based consolidation. In a panel of 18 industrialized, Agnello and Sousa [2012] find similar results. In addition, their results suggest that the size of the fiscal adjustment as share of GDP is relevant for income distribution. Indeed, a small size of fiscal adjustment was associated with an income gap widening. Looking at the effects of fiscal consolidation on income inequality, wages and unemployment in a panel of 17 OECD countries, Ball et al. [2013] find that fiscal adjustment is associated with raising inequality with larger distributional effects for spending-based adjustment than tax-based adjustments. They also find that fiscal consolidation decreases wage income shares and increases long-term unemployment.

Afonso et al. [2010] examine the relationship between public redistributive spending (social spending, transfers and subsidies) and income distribution in OECD countries with an emphasis on the role of educational achievement and the quality of countries institutions. They find that public spending when coupled with good educational achievement are associated with more equal income distribution.

Other studies have undertaken a comparison of the distributional impact of fiscal policy in developing countries versus advanced economies. Comparing market and disposal income Gini indexes, Bastagli et al. [2012] find that in advanced economies, fiscal policy has played a significant role in reducing inequalities mainly through expenditures-especially non-means-tested transfers-. The authors explain the declined redistributive impact of fiscal policy from the tax side by tax reforms introduced since mid-1990s that have reduced the overall progressivity of the tax-benefit system. For developing countries, they find that the redistributive impact of fiscal policy tends to be

restricted due to lower levels of taxes and transfers. In addition, in-kind public expenditures [4] have been found to be regressive, reflecting lack of access of low-income classes to key public services.

Comparing the redistributive performance of Latin American and Western European fiscal systems, Goni et al. [2011] find that the redistributive impact of the fiscal system is very large in Europe and very small in Latin America. In addition, in countries where fiscal redistribution is significant, it is achieved mostly through transfers rather than taxes. Lustig et al. [2011] also find that the redistributive impact of the fiscal system in LAC still remain little compared to the Western Europe. However the size of the redistribution has increased over time. In explaining the factors underlying the decline in income inequality observed in many of Latin America countries during the 2000-10, Lustig et al. [2013] show that apart from the fall in the skilled labor premium, more progressive government transfers primarily the introduction of large-scale cash transfers targeted to the poor over the last fifteen years has played a significant role.

This paper contributes to the existing literature along several dimensions. First, most of the existing studies have primarily examined the distributional impact of fiscal policy on OECD countries. Meanwhile, this paper focused on the LAC region, one of the most unequal region in the world. Second, the existing literature mainly focused on fiscal incidence on an aggregate measure of income distribution, the Gini coefficient. However, the decline of the Gini index does not provide information on how the income distribution changes in favor of specific income classes like the bottom 40 percent. Last but not the least, as robustness checks, not only this paper examine how fiscal expansion and fiscal consolidation affect consumption growth of the bottom 40 percent, it also investigates how those measures affect the Gini index and the top income share growth. Given that changes in fiscal policy can potentially be endogenous to income inequality, the sensitivity analysis also accounts for that eventuality and results remain broadly unchanged compared to the benchmark ones.

4. These expenditures refer to key public services such as education, health and housing.

3.3 Data description and identification strategy

I use the cyclically adjusted primary deficit ($CAPD$) to identify episodes of fiscal expansion and fiscal consolidation. To adjust fiscal variables from variations induced by the business cycle, I follow the methodology used by Alesina and Perotti [1995], Alesina and Ardagna [2009] and Alesina and Ardagna [2012]. This approach, very simple and transparent consists of correcting components of the government budget from changes in unemployment rate [5]. Because I use fiscal variables expressed as variation from the previous period, the cyclically adjusted value in the change of a fiscal variable in year t is obtained as the difference between the measure of the fiscal variable in period t computed as if the unemployment rate were equal to that of $t-1$ and the actual measure of the fiscal variable in $t-1$ when surveys are available for two consecutive years. When the frequency of two consecutive surveys is more than a year [6], the cyclically adjusted change in the budget component is the average change between the cyclically adjusted budget component and its value during the year where the previous survey took place [7].

3.3.1 Data description and sources

I use a panel of 18 Latin America countries during the period 1990-2010. The study starts in 1990 because data on fiscal variables are not available for most of the sample countries before 1990. Government spending and tax revenues variables are expressed in percent of GDP. Spending components include capital expenditures, government consumption (sum of : wages and

5. Note that there are other approaches of calculating cyclically-adjusted fiscal variables. For instance the IMF and the OECD use potential GDP and elasticities of fiscal variables to output-gap to correct fiscal variables from cyclical variations. However, long series of potential GDP and elasticities of budget variables to output-gap are not available for most of the study countries.

6. Income of the bottom 40 percent is collected from households surveys. Because the frequency of surveys is not regular, all the variables will be expressed in terms of average change between two consecutive surveys.

7. The cyclically adjusted fiscal variable $F_t(U_{t-1})$ that is the fiscal variable in period t as if the unemployment rate was equal to the one of t-1 is obtained by (i) estimating for each country $F_t = \alpha_0 + \alpha_1 Trend + \alpha_2 U_t + \epsilon_t$ (ii) and then recovered as $F_t(U_{t-1}) = \hat{\alpha}_0 + \hat{\alpha}_1 Trend + \hat{\alpha}_2 U_{t-1} + \hat{\epsilon}_t$. The cyclically-adjusted change in the fiscal variable is then $F_t(U_{t-1}) - F_{t-1}$ when surveys are available for two consecutive years.

salaries, purchase of goods and services and other current expenditures) and transfers and subsidies. Tax revenues components include direct tax revenues, indirect tax revenues and social security contributions. The sample of countries covers Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, El Salvador, Uruguay and the Bolivarian Republic of Venezuela (Venezuela, RB). Fiscal variables are from the ECLAC-CEPALSTAT [8] database. Data on mean and income quintiles are from the World BANK database PovcalNet. Table A7 in appendix provides information on years where households surveys took place and from which data on income are obtained.

Note that most household surveys included in the sample are nationally representative with few exception with Argentina, where surveys cover only urban population, which nonetheless represents more than 85 percent of the total population in that country. Some surveys also cover only urban areas in Bolivia, Colombia and Paraguay for the early 90s, and Uruguay until 2005. Individual income is before taxes and is constructed as the sum of labor income (self-employed or salaried work) and non-labour income (includes: pensions, capital income, public and private transfers and for some countries imputed rents). The household income is constructed by adding incomes of household members which are finally adjusted for several equivalence scales to obtain household income per capita. The consumer price index is then used to adjust nominal incomes in real incomes [9].

Other control variables and unemployment rate are taken from the World Development Indicators (WDI) database.

3.3.2 Episodes of fiscal expansion and fiscal consolidation

Episodes of fiscal expansion are identified as periods during which the change in the $CAPD$ is at least equal to 0.5 percent of GDP. Meanwhile, *episodes*

8. CEPALSTAT is the gateway to all the statistical information of Latin America and the Caribbean countries collected, systematized and published by the Economic Commission for Latin America and the Carribbean(ECLAC)

9. For more information on household surveys and definitions of income variables, visit the Socio-Economic Database for Latin America and the Caribbean(SEDLAC) website: http://sedlac.econo.unlp.edu.ar/eng/.

of fiscal consolidation correspond to periods during which the change in the $CAPD$ is less than or equal to -0.5 percent of GDP [10]. These thresholds are reasonable given that most of the countries in the LAC region have low tax performance and are constrained to borrow on international financial markets. Also, choosing larger thresholds would have reduced the number of identified episodes and make the analysis less robust. However, I proceed to some sensitivity analysis around these thresholds and the results remain broadly unchanged.

Using the above definitions, 73 cases of fiscal expansions and 67 cases of fiscal consolidations are selected. These episodes account respectively for 34.76 percent and 32 percent of total observations. Table A4 in appendix provides detailed information for cases of fiscal expansions and fiscal consolidations during years where household survey data were available. From this table, one can mainly observe that: (i) most of the countries have typically implemented loose fiscal policy during the 2008-2009 crisis except Guatemala, Nicaragua, Panama and Venezuala, RB; (ii) of the 67 periods of fiscal consolidations, 8 cases last for two consecutive years; (iii) Paraguay and El Salvador have introduced adjustment plans lasting for 3 years (2002-2004) for the former and 5 years (2002-2005) for the latter.

3.3.3 Composition of fiscal expansion and fiscal consolidation

3.3.3.1 Aggregate expenditures and tax revenues

Table 3.1 provides summary information for changes in the $CAPD$ and its main components, the primary expenditures and tax revenue-both cyclically adjusted-during the whole sample period, episodes of fiscal expansion, episodes of fiscal consolidation and during episodes of neutral fiscal policy [11].

10. Alesina and Perotti [1995], Alesina and Ardagna [2009] and Alesina and Ardagna [2012] use 1.5 percent of GDP and -1.5 percent of GDP as thresholds to identity episodes of large fiscal expansions and fiscal consolidations in the case of OECD countries. These thresholds are reasonable for advanced economies as they have higher tax performance and not constrained to borrow on financial markets.

11. Episodes of neutral fiscal policy are periods during which the change in the $CAPD$ relies between -0.5 and +0.5 percent of GDP. However, in the analysis, I don't give emphasis to those episodes because the induced changes although cyclically adjusted could be attributed to business cycle fluctuations.

The table shows that, on average the $CAPD$ during episodes of fiscal expansions increases by 1.46 percent of GDP while the corresponding decline during episodes of fiscal consolidations is equal to 1.20 percent of GDP.

Does fiscal expansion typically occur on the spending side or on the tax side? Is fiscal consolidation driven by spending cuts or tax increases? Figure 3.1 displays by how much each aggregate budget item contributes to the change in the $CAPD$. It appears that fiscal expansion is typically a result of expenditures increases than cuts in taxes. Indeed, the primary expenditures contribute to roughly 91 percent to the increase in the $CAPD$ during episodes of fiscal expansions. Fiscal consolidation is typically a result of a policy mix between spending cuts and tax increases. Of the -1.20 percent of GDP reduction of the $CAPD$ during episodes of fiscal consolidations, roughly 55 percent represents cuts in expenditures and the rest represents the increase in tax revenues.

Table 3.1 – Average changes in percent of GDP of the $CAPD$ and its main components

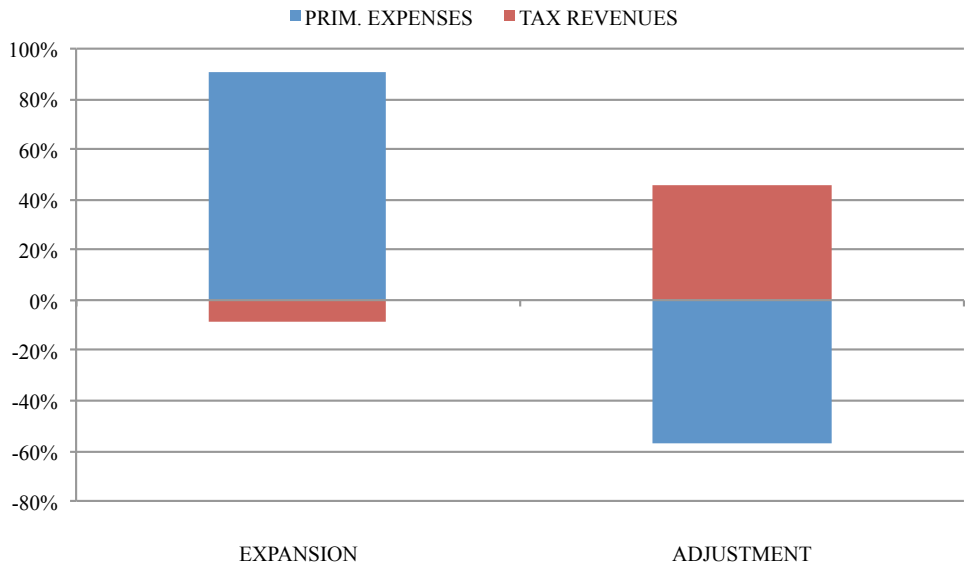
FISCAL IMPULSES	Nobs	PRIM. DEFICIT	PRIM. EXPENSES	TAX REVENUES
ALL	210	0.12	0.35	0.22
		(0.09)	(0.09)	(0.05)
EXPANSIONS	73	1.46	1.33	-0.13
		(0.11)	(0.14)	(0.09)
CONSOLIDATIONS	67	-1.20	-0.66	0.52
		(0.08)	(0.12)	(0.09)
NEUTRAL	70	-0.02	0.29	0.31
		(0.03)	(0.07)	(0.07)

Notes: This table displays the average changes in the $CAPD$ and its two main components for the sample-period and during episodes of fiscal expansions, fiscal consolidations and neutral fiscal policy.

3.3.3.2 Disaggregate expenditures and tax revenues

Detailed information about changes in more disaggregate expenditures and tax revenues items during episodes of fiscal expansion and fiscal consolidation is provided in Table A5 and Table A6 in the appendix. Meanwhile, Figure 3.2 displays the contribution of the budget components to the change in the

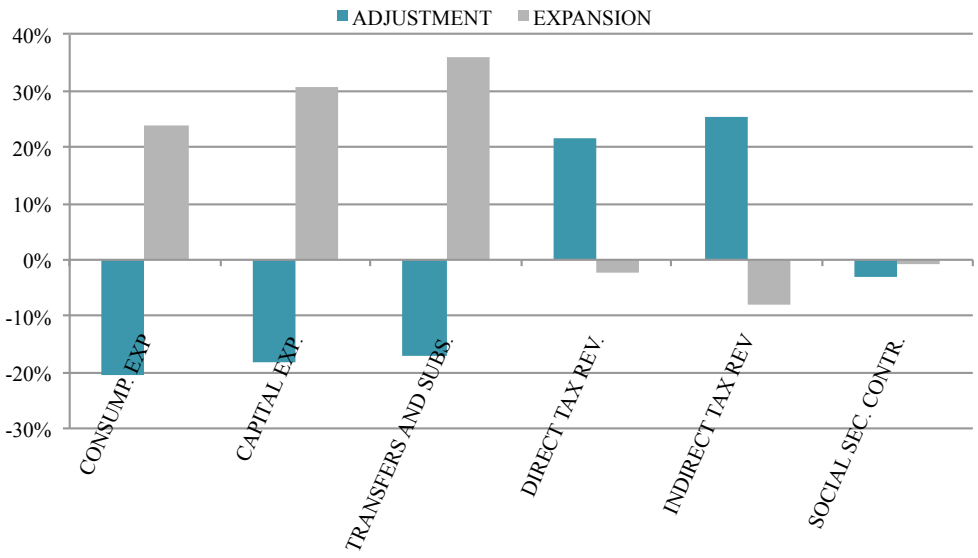
Figure 3.1 – Contributions of primary expenses and tax revenues to changes in the $CAPD$



Notes: The chart portrays contributions of cyclically adjusted primary expenditures and tax revenues to the change in the $CAPD$.

$CAPD$. Accordingly, during episodes of fiscal expansion, the 91 percent contribution of the average increase in the primary expenditures are distributed as following: 24 percent from government current consumption, 31 percent from capital expenditures and 36 percent from transfers and subsidies. During episodes of fiscal consolidation, spending cuts as share of GDP is almost the same amount among the three expenditures with a slightly larger drop in current consumption. In the tax side, fiscal consolation is typically driven by an equivalent rise in direct and in indirect taxes as share of GDP.

Figure 3.2 – Contributions of expenditures and tax revenues components to the change in the $CAPD$



Notes: The chart portrays contributions of cyclically adjusted expenditures and tax revenues components to the change in the $CAPD$.

3.4 Econometric specification and results analysis

3.4.1 Econometric model

The following panel econometric model is estimated to explore the empirical relationship between my variables of interest and fiscal variables during episodes of fiscal expansion or during episodes of fiscal consolidation:

$$\Delta y_{i,t} = \alpha_i + \beta_1(\Delta CAPD \times D)_{i,t-1} + \beta(\Delta CAPD \times D)_{i,t} + \Delta X'_{i,t}\Phi + \epsilon_{i,t} \quad (3.1)$$

where Δy_t is the growth rate of each variable of interest. $D_{i,t}$ is a dummy variable taking value of 1 during episodes of fiscal expansion or during episodes of fiscal consolidation; α_i is the country fixed effect, $X_{i,t}$ is a vector of control variables that have been found likely to affect variables of interest. β_1 captures the lagged effect of adopted fiscal measures while β captures the contemporaneous effect.

To account for the composition of fiscal expansion and fiscal consolidation, I extend the benchmark Equation 3.1 replacing the $CAPD$ by its components: the primary expenditures and tax revenues. I also decompose each of the previous component to its main items, that is government consumption, capital expenditures, transfers and subsidies for primary expenditures; direct taxes, indirect taxes and SSC for tax revenues.

3.4.2 Results for fiscal expansion

3.4.2.1 Effects of fiscal expansion on the income of the bottom 40 percent

Table 3.2 reports the effects on the income growth of the bottom 40 percent of alternative measures of fiscal policy during episodes of fiscal expansion. These episodes are identified as periods during which the change in the cyclically-adjusted primary deficit is a least equal to 0.5 percent of GDP.

The first row shows the contemporaneous effect of an increase in the $CAPD$ of 1 percentage point of GDP. Specifications (3) to (8) include control variables likely to affect the income growth of the poor. These controls are respectively a measure of: financial development(real growth of M2), agricultural development(real growth of agricultural value added), trade liberalization(real export growth) and the U.S. GDP growth. The latter variable may capture the effect of remittances inflows from Latin American immigrants leaving in the U.S. as remittances outflows in the U.S. tend to be synchronized with the U.S. business cycle. Estimates suggest that, on average, fiscal expansion induces a rise of the income growth of the bottom 40 percent of about 2.5 percentage points [12]. This result remain unchanged with or without the inclusion of control variables. Among control variables, agricultural development affect significantly the income of the poor. The impact of financial development and the state of the U.S. economy is positive but non-significant. In column (2) fiscal expansion seems not to have a significant lagged effect on the income growth of the poor.

Columns (9) to (11) account for the composition of fiscal expansion. In these specifications, lagged fiscal variables are not included in the RHS of

12. I obtain the same results on the income growth of the bottom 20 percent with a more pronounced impact of about 4 percentage point increase.

the estimated equation [13]. Results in column (9) suggest that expenditures-based fiscal expansion are more likely to stimulate the income of the bottom 40 percent while tax revenues-based stimulus tend to not have a significant impact. In specification (10) primary expenditures are decomposed in terms of its main items. The findings show that government current consumption and transfers and subsidies are the expenditures items stimulating the income of the bottom 40 percent, a result that does not hold for capital expenditures. The decomposition of aggregate tax revenue show that reducing direct taxes affect positively the income of the poor.

3.4.2.2 Effects of fiscal expansion on GDP growth and on income inequality

The mean income growth of the less well-off can mechanically be expressed as the sum of the growth rate of the share income accruing to the less well-off and the growth rate of the average income as following:

$$\frac{dlnY_t^P}{dt} \approx \frac{dlnS_t^P}{dt} + \frac{dlnY_t}{dt}$$

Where Y_t^P is the average income of the bottom 40 percent, S_t^P their income share and Y_t, the average income. In the following, I examine how fiscal expansion affect these two components.

Table 3.3 reports the effects on real GDP growth per capita considered as a measure of the mean income growth [14]. The main control variables are those usually used in the empirical growth and development literature, that is financial development (growth rate of M2), homicides growth rate, a measure of human capital (gross primary school enrollment growth). I also control for the state of the U.S. business cycle. Estimates suggest that fiscal expansion does not have a significant effect on GDP growth. This results holds for both spending increases and tax-cuts at the aggregate level. Surprisingly, increasing capital expenditures tends to hinder economic growth. This result is consistent with Alesina and Ardagna [2009] finding and could be due to the fact that high public investment is sometime associated with high corruption. As consequences some public investment can end up reducing growth because the productivity of that investment has declined.

13. Their impacts are not significant

14. I also use the mean income growth from households surveys data. Results, not reported here remain consistent with those where GDP growth per capita is used.

Table 3.2 – Effects of fiscal fiscal expansion on the income growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPD$	0.026**	0.022*	0.026**	0.030**	0.026**	0.027**	0.026**	0.029**			
	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)			
Lag $\Delta CAPD$		-0.013									
		(0.008)									
$\Delta ln(Real\ M_2)$			0.117					0.178	0.172	0.169	0.193
			(0.085)					(0.106)	(0.108)	(0.120)	(0.114)
$\Delta ln(Real\ Agri)$				0.349*				0.355**	0.366*	0.332*	0.456**
				(0.170)				(0.160)	(0.175)	(0.160)	(0.189)
$\Delta ln(GDP\ deflator)$					0.044			-0.258	-0.249	-0.253	-0.360*
					(0.222)			(0.191)	(0.190)	(0.201)	(0.182)
$\Delta ln(Real\ Export)$						0.027		-0.025	-0.021	-0.069	-0.053
						(0.105)		(0.112)	(0.113)	(0.145)	(0.126)
$\Delta ln(U.S.\ RGDP)$							0.598	0.497	0.541	0.561	0.714
							(1.287)	(1.284)	(1.288)	(1.412)	(1.387)
$\Delta Prim.\ expend.$									0.030**		0.034***
									(0.012)		(0.011)
$\Delta Tax\ revenues$									-0.017	-0.021	
									(0.027)	(0.027)	
$\Delta Gov.\ Consump.$										0.090***	
										(0.027)	
$\Delta Capital\ expend.$										-0.004	
										(0.024)	
$\Delta Transfert\ \&\ subs.$										0.023**	
										(0.009)	
$\Delta Direct\ taxes$											-0.064*
											(0.031)
$\Delta Indirect\ taxes$											0.034
											(0.026)
ΔSSC											0.027
											(0.028)
Constant	0.136	0.104***	0.086	0.115	0.126	0.136	0.136	0.096	0.096	-0.197***	0.115
	(0.219)	(0.028)	(0.211)	(0.218)	(0.214)	(0.221)	(0.220)	(0.215)	(0.215)	(0.051)	(0.225)
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal expansion on the income growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Among control variables, results suggest that inflation and homicides are detrimental to economic growth. It is worth nothing that while an improvement of the U.S. economy does not necessarily increase significantly the income of the poor in LAC, but it significantly affects the aggregate economic growth.

Table 3.4 shows the impact of fiscal expansion on the income share growth of the bottom 40 percent. I use almost the same control variables as in the case of the income growth of the bottom 40 percent except for inflation rate and U.S. GDP growth. However, I control for countries real GDP growth to look at how much inclusive is economic growth in LAC. In general, results look very similar to those in Table 3.2. A percentage point GDP increase in the primary deficit increases the income share growth of the bottom 40 percent by 2 percentage points. Also, the composition of fiscal expansion affect the income share growth primarily through consumption expenditures and transfers and subsidies. Tax reductions including their composition do not have a significant impact on the income share growth of the bottom 40 percent. Results in column (7) suggest that economic growth also tends to improve the income share of the poor.

The improvement of the income share of the bottom 40 percent by government current consumption could be driven by the fact that new job creation, including in the private sector, might mostly be low-skill. In fact, firms may not expand high-skill employment to meet extra short-term demand brought about by a temporary fiscal stimulus. In fact, high-skill business processes are already in places and firms may just need more people to produce more in the short-term. For transfers, since the latter are progressive, their increase should induce a rise of the income share of the less well-off.

3.4.3 Results for fiscal consolidation

3.4.3.1 Effects of fiscal consolidation on the income of the bottom 40 percent

To investigate how fiscal contraction affect variables of interest, the baseline Equation 3.1 is estimated during episodes of fiscal consolidation. The latter episodes are identified as periods during which the cyclically-adjusted primary deficit declines at least by 0.5 percent of GDP (or the cyclically adjusted primary balance ($CAPB$) improves by at least 0.5 percent of GDP).

Table 3.3 – Effects of fiscal expansion on GDP growth per capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPD$	-0.000	-0.000	-0.001	-0.000	-0.002	-0.000	-0.000	-0.005			
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)			
Lag $\Delta CAPD$		0.000									
		(0.003)									
$\Delta ln(homicides)$			-0.070**					-0.071**	-0.069**	-0.071**	-0.069**
			(0.027)					(0.025)	(0.026)	(0.030)	(0.026)
$\Delta ln(GDP\ deflator)$				-0.039				-0.134**	-0.142**	-0.136*	-0.138**
				(0.051)				(0.061)	(0.067)	(0.065)	(0.063)
$\Delta ln(School\ enrol.)$					0.132			0.106	0.079	0.085	0.088
					(0.104)			(0.108)	(0.120)	(0.119)	(0.116)
$\Delta ln(Real\ M_2)$						0.013		0.032	0.035	0.034	0.034
						(0.015)		(0.021)	(0.023)	(0.023)	(0.022)
$\Delta ln(U.S.\ RGDP)$							1.385**	1.800**	1.806**	1.808**	1.807**
							(0.552)	(0.756)	(0.754)	(0.755)	(0.780)
$\Delta Prim.\ expend.$									-0.006		-0.006
									(0.004)		(0.004)
$\Delta Tax\ revenues$									-0.001	-0.002	
									(0.007)	(0.006)	
$\Delta Gov.\ Consump.$										0.001	
										(0.010)	
$\Delta Capital\ expend.$										-0.015**	
										(0.006)	
$\Delta Transfert\ \&\ subs$										-0.004	
										(0.003)	
$\Delta Direct\ taxes$											-0.007
											(0.020)
$\Delta Indirect\ taxes$											0.005
											(0.012)
ΔSSC											-0.001
											(0.011)
Constant	0.004	0.046***	0.009	0.013	0.007	-0.001	0.006	-0.075**	-0.076**	-0.078**	-0.076**
	(0.006)	(0.010)	(0.019)	(0.013)	(0.010)	(0.009)	(0.007)	(0.033)	(0.033)	(0.032)	(0.034)
No.Obs	210	190	149	210	172	210	210	128	128	128	128
No.countries	18	18	18	18	17	18	18	17	17	17	17

Notes: This table displays the effects of fiscal expansion on GDP growth per capita. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include growth rate of: homicides, M2, gross primary school enrollment, export, inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.4 – Effects of fiscal expansion on the income share growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta CAPD$	0.021**	0.022**	0.021**	0.021**	0.023***	0.021**	0.022**			
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)			
Lag $\Delta CAPD$		0.002								
		(0.006)								
$\Delta ln(RGDP)$			0.248				0.333*	0.314	0.276	0.288
			(0.171)				(0.188)	(0.182)	(0.199)	(0.204)
$\Delta ln(Real\ M_2)$				0.102			0.091	0.085	0.087	0.083
				(0.079)			(0.075)	(0.075)	(0.085)	(0.078)
$\Delta ln(Real\ Agri)$					0.053		0.068	0.085	0.080	0.133
					(0.089)		(0.091)	(0.100)	(0.099)	(0.115)
$\Delta ln(Real\ Export)$						-0.106	-0.165	-0.154	-0.131	-0.164
						(0.098)	(0.103)	(0.101)	(0.108)	(0.104)
$\Delta Prim.\ expend.$								0.023**		0.026***
								(0.008)		(0.008)
$\Delta Tax\ revenues$								-0.004	-0.002	
								(0.019)	(0.021)	
$\Delta Gov.\ Consump.$									0.065**	
									(0.024)	
$\Delta Capital\ expend.$									0.004	
									(0.018)	
$\Delta Transfert\ \&\ subs.$									0.019*	
									(0.010)	
$\Delta Direct\ taxes$										-0.031
										(0.022)
$\Delta Indirect\ taxes$										0.023
										(0.022)
ΔSSC										0.007
										(0.029)
Constant	0.105	0.025	0.104	0.062	0.103	0.108	0.065	0.066	-0.082*	0.068
	(0.113)	(0.015)	(0.112)	(0.104)	(0.114)	(0.114)	(0.100)	(0.101)	(0.039)	(0.103)
No.Obs	210	190	210	210	208	209	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18

Notes: This table reports the effects of fiscal expansion on the income share growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: GDP, M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.5 reports the effects of different measures of fiscal consolidation on the income growth of the bottom 40 percent. The first row points out the

impact of an improvement of the $CAPB$ of 1 percentage point GDP. Results in column (8) suggest that fiscal consolidation may to some extent impede the income growth of the less well-off. The effects of the composition of fiscal contraction are displayed in columns (9)-(11). Accordingly, expenditures-based fiscal contraction are more likely to hinder the income growth of the bottom segment of the income distribution than tax-based consolidation. Disaggregating primary expenditures and total revenues doesn't conduct to significant impact.

3.4.3.2 Effects of fiscal consolidation on GDP growth and on income inequality

What is the impact of fiscal contraction on the average income and on the income share of the bottom 40 percent? Table 3.6 portrays the effect of fiscal consolidation on GDP growth per capita. It emerges from the table that reducing the primary deficit does not necessarily impede economic growth as the impact in all the specification is not significant. In the same vein, the composition of fiscal consolidation from the spending side or from the revenue side does not prevent economic growth.

Table 3.7 shows the effects of fiscal consolidation on the growth rate of the income share accruing to the bottom 40 percent. Results indicate that reducing the primary deficit does not impact the income share of the less well-off. However, the composition of fiscal consolidation indicates a decline of the income share of the bottom 40 percent due to an increase in taxes, primarily indirect taxes.

Table 3.5 – Effects of fiscal contraction on the income growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPB$	-0.017	-0.022	-0.019	-0.022	-0.017	-0.020	-0.017	-0.025*			
	(0.014)	(0.016)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)			
Lag $\Delta CAPB$		0.007									
		(0.010)									
$\Delta ln(Real\ M_2)$			0.119					0.185	0.180	0.171	0.208
			(0.092)					(0.111)	(0.112)	(0.122)	(0.124)
$\Delta ln(Real\ Agri)$				0.301*				0.343**	0.362**	0.316**	0.394**
				(0.152)				(0.143)	(0.150)	(0.138)	(0.148)
$\Delta ln(GDP\ deflator)$					0.029			-0.285	-0.263	-0.295	-0.320
					(0.243)			(0.198)	(0.209)	(0.242)	(0.209)
$\Delta ln(Real\ Export)$						-0.038		-0.097	-0.095	-0.135	-0.131
						(0.107)		(0.117)	(0.121)	(0.152)	(0.150)
$\Delta ln(U.S.\ RGDP)$							0.671	0.751	0.794	0.816	1.250
							(1.212)	(1.166)	(1.189)	(1.210)	(1.362)
$\Delta Prim.\ expend.$									0.032*		0.037*
									(0.016)		(0.018)
$\Delta Tax\ revenues$									-0.014	-0.010	
									(0.014)	(0.014)	
$\Delta Gov.\ Consump.$										0.029	
										(0.043)	
$\Delta Capital\ expend.$										0.023	
										(0.016)	
$\Delta Transfert\ \&\ subs.$										0.020	
										(0.027)	
$\Delta Direct\ taxes$											0.009
											(0.024)
$\Delta Indirect\ taxes$											-0.040
											(0.028)
ΔSSC											0.007
											(0.049)
Constant	0.184	0.112**	0.138	0.179	0.178	0.194	0.184	0.172	0.172	-0.136**	0.195
	(0.231)	(0.044)	(0.222)	(0.231)	(0.223)	(0.235)	(0.232)	(0.229)	(0.233)	(0.052)	(0.242)
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal consolidation on the income growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.6 – Effects of fiscal contraction on GDP growth per capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPB$	-0.003	-0.003	-0.001	-0.003	-0.001	-0.003	-0.002	0.006			
	(0.003)	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)	(0.002)	(0.008)			
$Lag\ \Delta CAPB$		0.002									
		(0.004)									
$\Delta ln(homicides)$			-0.069**					-0.072**	-0.072**	-0.068**	-0.076***
			(0.028)					(0.027)	(0.027)	(0.028)	(0.026)
$\Delta ln(GDP\ deflator)$				-0.038				-0.122*	-0.120*	-0.177**	-0.125*
				(0.051)				(0.059)	(0.060)	(0.082)	(0.066)
$\Delta ln(School\ enrol.)$					0.139			0.128	0.132	0.217*	0.180
					(0.105)			(0.101)	(0.102)	(0.123)	(0.117)
$\Delta ln(Real\ M_2)$						0.014		0.030	0.030	0.030	0.034
						(0.015)		(0.020)	(0.020)	(0.020)	(0.021)
$\Delta ln(U.S.\ RGDP)$							1.371**	1.827**	1.845**	1.950**	1.721*
							(0.551)	(0.790)	(0.776)	(0.772)	(0.815)
$\Delta Prim.\ expend.$									-0.005		-0.009
									(0.010)		(0.010)
$\Delta Tax\ revenues$									0.007	0.006	
									(0.007)	(0.005)	
$\Delta Gov.\ Consump.$										-0.028	
										(0.028)	
$\Delta Capital\ expend.$										-0.002	
										(0.007)	
$\Delta Transfert\ \&\ subs$										0.006	
										(0.010)	
$\Delta Direct\ taxes$											-0.006
											(0.009)
$\Delta Indirect\ taxes$											0.015
											(0.016)
ΔSSC											0.033
											(0.020)
$Constant$	0.012	0.040**	0.008	0.020	0.009	0.007	0.012	-0.088**	-0.090**	-0.091**	-0.095**
	(0.012)	(0.017)	(0.019)	(0.015)	(0.017)	(0.013)	(0.012)	(0.035)	(0.035)	(0.036)	(0.040)
No.Obs	210	190	149	210	172	210	210	128	128	128	128
No.countries	18	18	18	18	17	18	18	17	17	17	17

Notes: This table displays the effects of fiscal consolidation on GDP growth per capita. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include growth rate of: homicides, M2, gross primary school enrollment, export, inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 3.7 – Effects of fiscal contraction on the income share growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta CAPB$	-0.002	-0.005	-0.001	-0.003	-0.004	-0.006	-0.007			
	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)			
$Lag\ \Delta CAPB$		-0.003								
		(0.005)								
$\Delta ln(RGDP)$			0.243				0.372*	0.443**	0.388**	0.468**
			(0.169)				(0.179)	(0.169)	(0.175)	(0.188)
$\Delta ln(Real\ M_2)$				0.102			0.090	0.088	0.082	0.089
				(0.085)			(0.081)	(0.079)	(0.083)	(0.078)
$\Delta ln(Real\ Agri)$					0.001		0.030	-0.003	0.001	0.004
					(0.091)		(0.096)	(0.093)	(0.107)	(0.094)
$\Delta ln(Real\ Export)$						-0.143	-0.202*	-0.221**	-0.212*	-0.233*
						(0.106)	(0.111)	(0.100)	(0.106)	(0.116)
$\Delta Prim.\ expend.$								-0.002		0.003
								(0.009)		(0.009)
$\Delta Tax\ revenues$								-0.023*	-0.012	
								(0.013)	(0.010)	
$\Delta Gov.\ Consump.$									-0.000	
									(0.016)	
$\Delta Capital\ expend.$									-0.013	
									(0.022)	
$\Delta Transfert\ \&\ subs.$									-0.004	
									(0.011)	
$\Delta Direct\ taxes$										-0.010
										(0.015)
$\Delta Indirect\ taxes$										-0.036*
										(0.017)
ΔSSC										-0.046
										(0.029)
$Constant$	0.110	0.061***	0.107	0.070	0.115	0.125	0.088	0.085	-0.070	0.099
	(0.122)	(0.014)	(0.121)	(0.113)	(0.122)	(0.128)	(0.114)	(0.111)	(0.042)	(0.116)
No.Obs	210	190	210	210	208	209	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18

Notes: This table reports the effects of fiscal consolidation on the income share growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: GDP, M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

3.5 Sensitivity analysis and discussion

The sensivity analysis is articulated around the following points: (i) changing the threshold to identify episode of fiscal expansion and fiscal contraction; (ii) using consumption growth of the bottom 40 percent as measure of welfare instead of their income growth; (iii) examining the effects of fiscal expansion/consolidation on an aggregate measure of income inequality, the Gini index, and on the top income share; (iv) examining the effects of fiscal expansion/consolidation on variables of interest when fiscal variables are corrected for potential endogeneity.

3.5.1 Changing the threshold for identification of fiscal measures

Increasing the threshold for identification of episodes of fiscal expansion and fiscal consolidation is important to assess if the size of the stimulus or adjustment is relevant for the income growth of the poor. In this vein, episodes of fiscal expansion (consolidation) are identified as periods during the change in the $CAPD$ is at least equal to 1 percent (-1 percent) of GDP. With these thresholds, 45 periods, roughly 21 percent of the sample are identified as episodes of fiscal expansion while 30 periods (14 percent of the sample) are identified as episodes of fiscal consolidation. During episodes of fiscal expansion, on average the $CAPD$ increases by 1.90 percent of GDP with primary expenditure contributing up to 1.64 percent of GDP and tax-cut of 0.26 percent of GDP. During episodes of fiscal contraction, the $CAPD$ declines on average by 1.70 percent of GDP. On average, cuts in primary expenditure are equal to 1.27 percent of GDP while tax revenues increase on average by 0.42 percent of GDP. When comparing to the baseline case, it should be noted that with the new thresholds, fiscal consolidation is mainly driven by cuts in primary expenditures; while in the baseline, fiscal consolidation was a mix of expenditures increases and tax-cuts of almost the same importance.

How the income growth of the bottom 40 percent responds to these changes? Table A8 and Table A9 in appendix report respectively the impact of fiscal expansion and fiscal consolidation on the income growth of the bottom 40 percent. For fiscal expansion, results remain broadly similar to the baseline scenario where the income growth of the bottom 40 percent increases by 2 percentage points when the primary deficit increases by 1 percent of

GDP. Results for the composition of fiscal expansion also remain broadly unchanged. These findings suggest that the size of fiscal expansion seems to not be relevant to increase the income of the poor. None of the fiscal consolidation measure affect significantly the income growth of the bottom 40 percent. This result is somewhat different from the baseline scenario where expenditures-based consolidation were associated with the decline of the income of the less well-off [15].

3.5.2 Consumption of the bottom 40 percent and fiscal expansion/adjustment

Are the bottom 40 percent ricardians or rule-of-thumb consumers? One might expect this segment of the population consuming their current income as they are financially constraints. In the baseline scenario, the findings show that during episode of fiscal expansion, an increase of the $CAPD$ of 1 percent of GDP improves the income growth of the bottom 40 percent by 2 percentage points while the effect of an improvement of the primary deficit could to some extent reduce their income. How these changes in the primary deficit affect consumption growth of the bottom 40 percent?

Results in Table A10 in appendix suggest that fiscal expansion leads to more consumption for the bottom 40 percent. Consumption growth increases by 2 percentage points as the $CAPD$ increases by 1 percent of GDP. This results tend to confirm the non-ricardian prediction of the bottom 40 percent as fiscal expansion also increase their income growth by 2 percentage points. Expenditures-based fiscal expansion are also more likely to increase consumption of the poor than those based in tax-cuts. When looking at the composition of primary expenditures, government current consumption is the main expenditures item stimulating consumption of the poor. Although the effect of tax-cuts is non significant at the aggregate level, reducing direct taxes tends to stimulate consumption of the poor. Fiscal consolidation seems to not have a significant impact on consumption growth of the bottom 40 percent (see Table A11 in appendix). This result is almost consistent with the effects of fiscal consolidation on the income growth of the bottom 40 percent with few exceptions.

15. Compared to the baseline scenario, results not shown here for the effects of fiscal expansions/adjustment on GDP growth and income distribution remain unchanged.

3.5.3 Gini index and fiscal expansion/adjustment

The Gini index and the income share of the bottom segment might evolve in opposite direction. Indeed, if the income share of the lower segment increases, this reduces income disparities and lower the Gini index. Below, I investigate how fiscal expansion and fiscal consolidation affect the Gini coefficient.

Table A12 in appendix reports the effects of fiscal expansion on the growth rate of the market income Gini coefficient. Consistent with the effects of fiscal expansion on the income share of the bottom 40 percent, fiscal expansion reduces the overall income inequality. On average, an increase of the cyclically-adjusted primary deficit of 1 percentage point of GDP induces a decline of the Gini index growth rate of 1 percentage point. When looking at the composition of fiscal expansion, expenditures-based fiscal expansion are more likely to reduce income inequality primarily through current consumption, transfers and subsidies. There is also an evidence that cutting direct taxes is likely to reduce income inequality. The effects of fiscal consolidation (see Table A13 in appendix) remain broadly non significant with a small exception for indirect taxes that tend to increase income inequality. The latter finding is in line with the effects of indirect taxes-based fiscal adjustment on the income share of the bottom 40 percent.

3.5.4 What happens for the top income?

The above results showed that expenditures-based fiscal expansion increase the income share of the bottom 40 percent and induce a decline of the Gini index. We might therefore expect the top income share declining with expenditures-based fiscal expansion. Table 3.8 provides estimates of the impact of fiscal expansion on the income share growth of the top 40 percent.

Consistent with the above findings, expenditures-based fiscal expansion, primarily government current consumption, transfers and subsidies are more likely to reduce the income share of the top 40 percent. I also perform the same exercise on the income share growth of the top 20 percent and top 10 percent. Results, not reported here remain consistent with those associated to the top 40 percent [16].

16. The effects of fiscal consolidation of the top income share are non significants. Results remain available upon request.

Table 3.8 – Effects of fiscal expansion on the income share growth of the top 40 percent

	(1)	(2)	(3)	(4)	(5)
$\Delta CAPD$	-0.004***	-0.005***			
	(0.001)	(0.001)			
Lag $\Delta CAPD$		-0.002**			
		(0.001)			
$\Delta Prim.\ expend.$			-0.004***		-0.004***
			(0.001)		(0.001)
$\Delta Tax\ revenues$			0.001	0.001	
			(0.003)	(0.003)	
$\Delta Gov.\ Consump.$				-0.010**	
				(0.004)	
$\Delta Capital\ expend.$				0.000	
				(0.002)	
$\Delta Transfert\ \&\ subs.$				-0.006*	
				(0.003)	
$\Delta Direct\ taxes$					0.004
					(0.004)
$\Delta Indirect\ taxes$					-0.001
					(0.003)
ΔSSC					0.000
					(0.005)
Constant	-0.021	-0.002	-0.021	0.008***	-0.021
	(0.022)	(0.005)	(0.022)	(0.000)	(0.022)
No.Obs	205	187	205	194	203
No.countries	18	18	18	18	18

Notes: This table reports the effects of fiscal expansion on the income share growth of the top 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Regressions include countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

3.5.5 Correcting fiscal variables from potential endogeneity

It is likely that fiscal policy responds endogenously to the level of income inequality. Not considering this eventuality could bias our results. To account for that possibility, I correct cyclically-adjusted budget variables from changes in the level of income inequality using the Gini index. This consists of estimating what cyclically-adjusted government outlays and revenues

would be in any given year if the Gini index had remain the same as in the previous survey. The cyclically adjusted value in the change of a fiscal variable in year t correcting for possible endogeneity is obtained as the difference between the cyclically-adjusted fiscal variable in period t computed as if the Gini index were equal to that of the previous survey and the actual measure of the fiscal variable at the year of the previous survey [17].

Table A14 in the Appendix portrays the impact of fiscal expansion (columns 1-4) and the impact of fiscal contraction (columns 5-8) on the income growth of the bottom 40 percent. Results remain broadly unchanged (see Tables Table 3.2 and 3.5). Expenditures-based fiscal expansion (through government current consumption and transfers and subsidies) are more likely to stimulate the income of the bottom 40 percent. The positive impact of direct taxes reduction on the income growth of the bottom 40 percent is now slightly higher. For fiscal contraction, the negative impact of primary expenditures reduction and tax revenues increase is now more pronounced.

For the income share growth of the bottom 40 percent, results in Table A15 remain broadly unaltered for the impact of fiscal expansion(columns 1-4) compared to the benchmark ones (see Table 3.4). Results for fiscal consolidation(columns 5-8) are slightly different. Expenditures and revenues based-consolidation are both harmful for the income share growth of the bottom 40 percent, increasing therefore income inequality [18].

3.5.6 Discussion

This paragraph discusses the results in relation with previous in the literature. In this study, expenditures-based fiscal expansion tend to reduce income inequality meanwhile expenditures-based fiscal consolidation exacerbate income inequality. These findings are consistent with previous findings in the literature (see Mulas-Granados [2005] Agnello and Sousa [2012] Bastagli et al.

17. In fact, I follow the same approach of correcting fiscal variables from variations induced by the business cycle (see Section 3.3). Instead of regressing each cyclically-adjusted fiscal variable on the Gini index country by country, I use a panel regression because some countries have limited data on the Gini index

18. I also performed the same exercise using the Gini index growth rate and results not reported show that both expenditures and revenues (including all the 3 revenues items) based-consolidation increase overall income inequality

[2012] Lustig et al. [2013]). However, results for tax-based fiscal consolidation in this study are somewhat in contrast with previous findings. In the literature, previous studies on OECD countries generally find that tax-based fiscal consolidation tend to reduce income inequality meanwhile I find rising inequality sometime associated with tax-based fiscal consolidation. A possible explanation could be related to the fact that in advanced economies, the tax system is quite progressive which is not often the case in developing countries. But this explanation should be taken with caution, given that the income distribution variables in this study are not net of taxes.

3.6 Conclusion

In this paper, I have examined the effects of fiscal expansion, fiscal consolidation and their compositions on the income growth of the bottom 40 percent, on income inequality and on economic growth using a panel of 18 countries in the Latin America region. Fiscal expansion and fiscal consolidation are identified by periods for which there is a significant change in the cyclically-adjusted primary deficit as share of GDP.

The findings of the paper can be summarized as following: on average in Latin American countries, expenditures-based fiscal expansion are more likely to increase the income of the bottom 40 percent than revenues-based fiscal expansion. This result is mainly driven by government current consumption, transfers and subsidies. In addition, these fiscal expansion measures help to reduce income inequality by improving the income share of the bottom segments of the population while reducing the top income share. However, fiscal expansion could either have no effect on economic growth or prevent the latter through capital expenditures increases. Results for fiscal consolidation are somewhat mixed. Sometime, fiscal consolidation is associated with a decline of the income growth of the less well-off and rising inequality, sometime the impact is non-significant. Further investigation is needed to draw general conclusions. None of the fiscal contraction measures affects significantly GDP growth.

The findings of this paper have some policy implications: expenditures-based fiscal expansion affect the income growth of the less-well primarily through reduced inequality by improving their income share. Countries with some fiscal space could initiate or continue to implement safety nets program –like con-

ditional cash transfer programs–necessary to prevent the vulnerable segment of the population to adverse shocks and to improve their living standards. With a potential of stimulating low-skill employment, a wise fiscal stimulus through government current consumption increases could also play a significant role to reduce inequality. Finally, to avoid capital expenditures that hinder economic growth, efficient public investment projects should be prioritized in the policy making process. This consists of implementing investment projects with higher productivity that can enhance economic growth necessary to reduce inequality.

This analysis can be extended along several dimensions. A more ambitious avenue to identifying episodes of fiscal expansion and fiscal consolidation is the narrative approach that consists of exploiting the information contained in budget acts. This might help comparing the results of this study from those obtained using the narrative approach. Another natural extension would be to apply the framework developed in this paper to other regions and to try to understand the potential differences that may emerge across regions.

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Appendix

Appendix Chapter 1

Identification of the $\tilde{A}$ matrix

In order to easily recover the block exogeneity, $\tilde{A}$ is chosen as follows:

$$\tilde{A} = \begin{bmatrix} \tilde{A}_{11} & \tilde{A}_{12} \\ 0 & \tilde{A}_{22} \end{bmatrix}$$

The relation (1.6) in the paper can then be written as:

$$\Omega = \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{12}{}' & \Omega_{22} \end{bmatrix} = \begin{bmatrix} \tilde{A}_{11}\tilde{A}_{11}' + \tilde{A}_{12}\tilde{A}_{12}' & \tilde{A}_{12}\tilde{A}_{22}' \\ \tilde{A}_{22}\tilde{A}_{12}' & \tilde{A}_{22}\tilde{A}_{22}' \end{bmatrix} = \tilde{A}\tilde{A}' \tag{A1}$$

— Because of the block exogeneity, $\tilde{A}_{22}$ is identified solely from the lower-right block of (A1) as the lower triangular Cholesky factor of Ω_{22}, which is estimated directly from the y_2 sub-system and independently of y_1; see (1.4)

— Once $\tilde{A}_{22}$ is identified, $\tilde{A}_{12}$ is derived from the upper-right matrix in (A1):

$$\Omega_{12} = \tilde{A}_{12}\tilde{A}_{22}' \tag{A2}$$

$$\tilde{A}_{12} = \Omega_{12}\left(\tilde{A}_{22}'\right)^{-1} \tag{A3}$$

— Finally, from the upper-left matrix in relation (A1), $\tilde{A}_{11}\tilde{A}_{11}'$ is derived:

$$\tilde{A}_{11}\tilde{A}_{11}' = \Omega_{11} - \tilde{A}_{12}\tilde{A}_{12}' \tag{A4}$$

Since the right-hand side of (A4) is symmetric and positive definite, $\tilde{A}_{11}$ is identified as the lower triangular Cholesky factor of the right-hand side of (A4).

Identification of the impulse vectors

Using the penalty function defined in Mountford and Uhlig [2009], an impulse vector a is identified through the following minimization:

$$a = argmin_{a=\tilde{A}q}\Psi(a)$$

where

$$\Psi(a) = \sum_{j \in \mathcal{J}_+} \sum_{k=\underline{k}}^{\overline{k}} f\left(-\frac{r_{ja}(k)}{s_j}\right) + \sum_{j \in \mathcal{J}_-} \sum_{k=\underline{k}}^{\overline{k}} f\left(\frac{r_{ja}(k)}{s_j}\right)$$

s_j is the standard error of variable j, $\mathcal{J}_+$ and $\mathcal{J}_-$ are the subsets of variables j such that $r_{ja}(k) \geq 0, j \in \mathcal{J}_+$ and $r_{ja}(k) \leq 0, j \in \mathcal{J}_-$, respectively, for some horizon $k = \underline{k}, .., \overline{k}$. The f function, which rewards large impulse responses with the right sign and penalizes impulse responses with the wrong sign, is given by

$$f(x) = \begin{cases} 100x & \text{if} \quad x \geq 0 \\ x & \text{if else} \end{cases}$$

Now consider $[a^1, a^2]$, the two impulse vectors that help to identify the business cycle shock and the fiscal policy shock, respectively (i.e. the government spending shock and the net tax revenue shock).
a^1 is identified as follows:

$$a^1 = argmin_{a=\tilde{A}q \; q_i=0, \; i=m_1+1,...,m} \Psi(a)$$

with $\mathcal{J}_- = \emptyset$, $\mathcal{J}_+$={Canadian GDP, Private consumption, Private investment, Tax revenue}, $\underline{k} = 0$ and $\overline{k} = 3$.
Once a^1 is identified through the choice of q^1, a^2 is identified such that:

$$a^2 = argmin_{a=\tilde{A}q, \; q'q^1=0, \; q_i=0, \; i=m_1+1,...,m} \; \Psi(a)$$

with $\mathcal{J}_- = \emptyset$, $\mathcal{J}_+$={Government spending} or $\mathcal{J}_+$={Net tax revenue}, $\underline{k} = 0$ and $\overline{k} = 3$.

The constraints $q_i = 0, \; i = m_1 + 1, ..., m$ allow the variables in the second block y_2 to not respond to the shock from the first block.

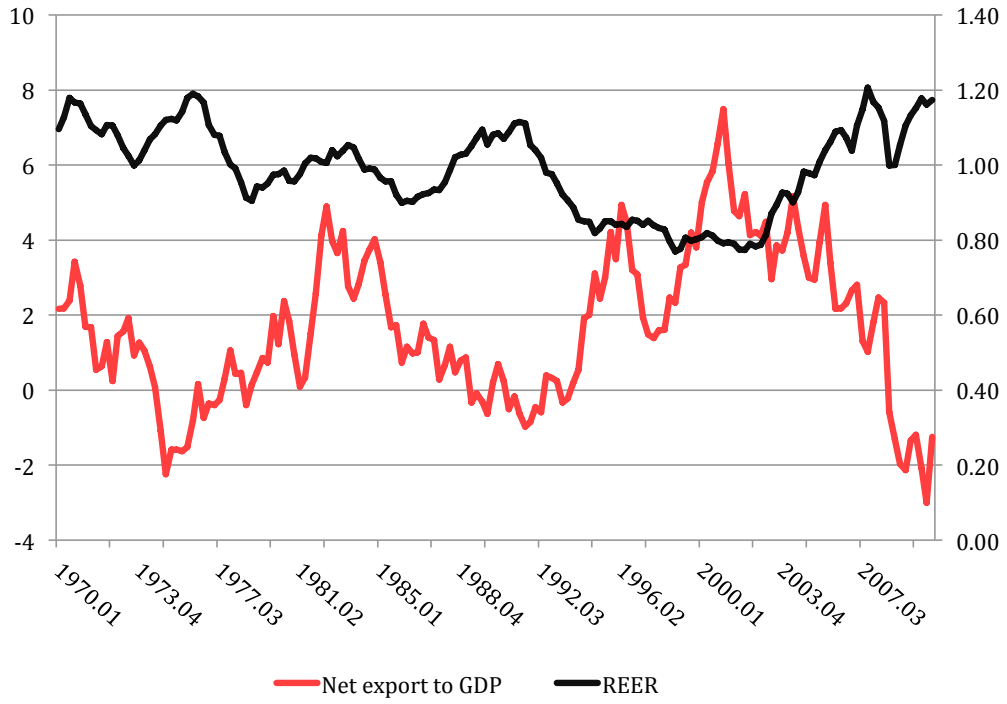
Sources and definitions of data

Canadian data the from the CANSIM data base:
Real GDP: Table 380-0002: row 1
Real private consumption: Table 380-0002: Sum of personal expenditures on non-durables (row 5) and services (row 6)
Real private non-residential investment: Table 380-0002: Sum of total

business GFCF (row 10) and business investment in inventories (row 15) minus residential structures (row 11)
Real government purchases: Table 380-0002: Sum of government current expenditure on goods and services (row 7), government GFCF (row 8) and government inventories (row 9)
Net exports to GDP ratio: Table 380-0002: is obtained as the ratio of net exports (row 19 minus row 22) over GDP (row 1)
GDP deflator (2002=100): Table 380-0003: row 1
The labor force: Table 282-0087: row 2. Quarterly data are obtained by taking the monthly average of each quarter. In the database, data are available from 1976. Data from 1970 to 1975 are obtained through documents available at the Université de Montréal library.
Nominal tax revenue: Table 380-0007: Sum of taxes on income (row 2), Social security contributions (row 6) and taxes on productions and imports (row 7)
Transfers: Table 380-0007: Sum of transfers to persons (row 15) and transfers to business (row 16)
Net tax revenue is the difference between nominal tax revenue and transfers, and real net tax revenue is obtained by dividing the nominal net tax revenue by the GDP deflator.
The three-month T-bill rate: Table 176-0043: row 34. Quarterly data are obtained taking the average of the monthly data for each quarter.
Real per-capita variables (GDP, consumption, investment, net taxes and government spending) are obtained by dividing data in level y by the labor force.
The REER is from the FRED database at http://research.stlouisfed.org/fred2/series/CCRETT02CAQ661N
U.S. real GDP: NIPA Serie ID: GDPC96
U.S. labor force participation: NIPA Series CNP16OV. Quarterly data are obtained by taking the average of monthly data of each quarter.
U.S. GDP deflator (2005=100): NIPA Series GDPDEF. Real per-capita GDP is obtained by dividing real GDP by the labor force.
Oil prices (Crude Oil (petroleum), West Texas Intermediate 40 API, Midland Texas, U.S$ per barrel) are from the IMF World Economic Outlook database.

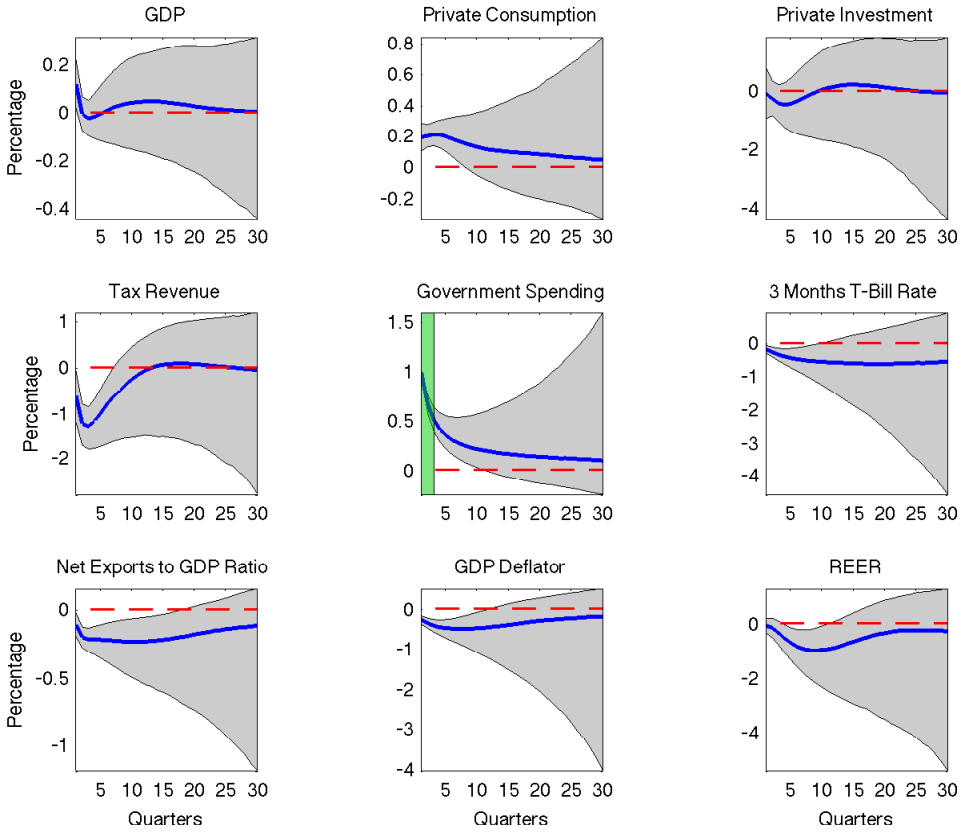
Figures

Figure A1 – Net-exports-to-GDP ratio in percentage and the REER index



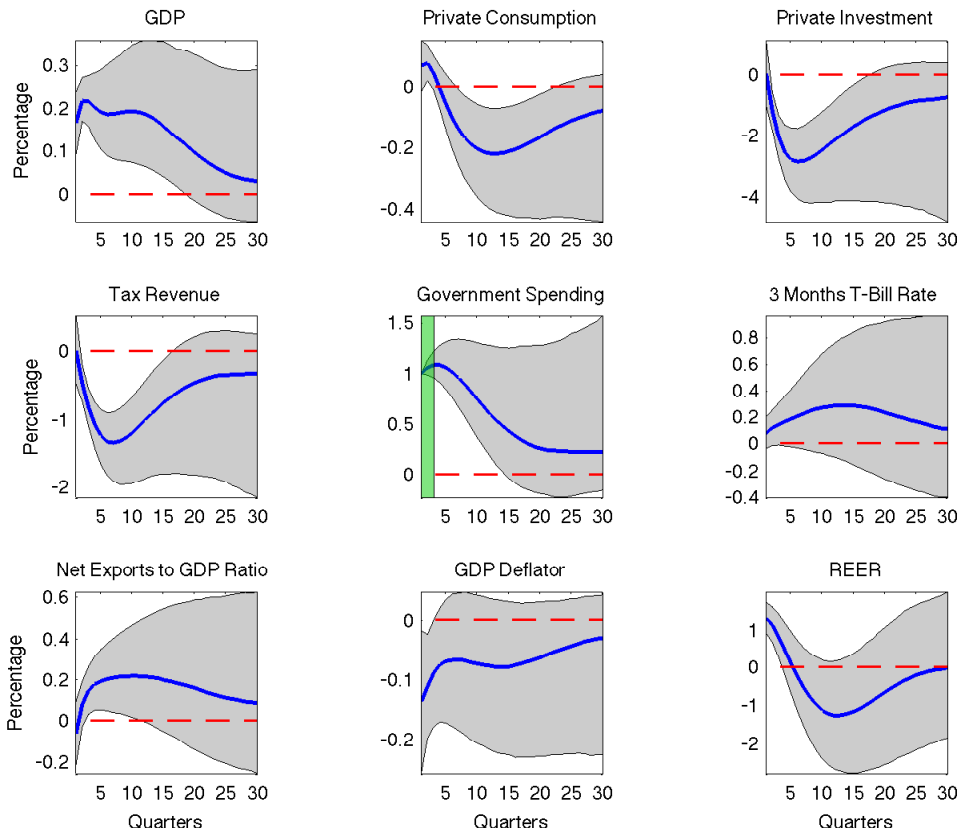
Notes: The left vertical axis measures net exports to GDP in percentages; the right vertical axis measures the REER index

Figure A2 – IRFs to a government spending shock (1970:Q1-1990:Q4)



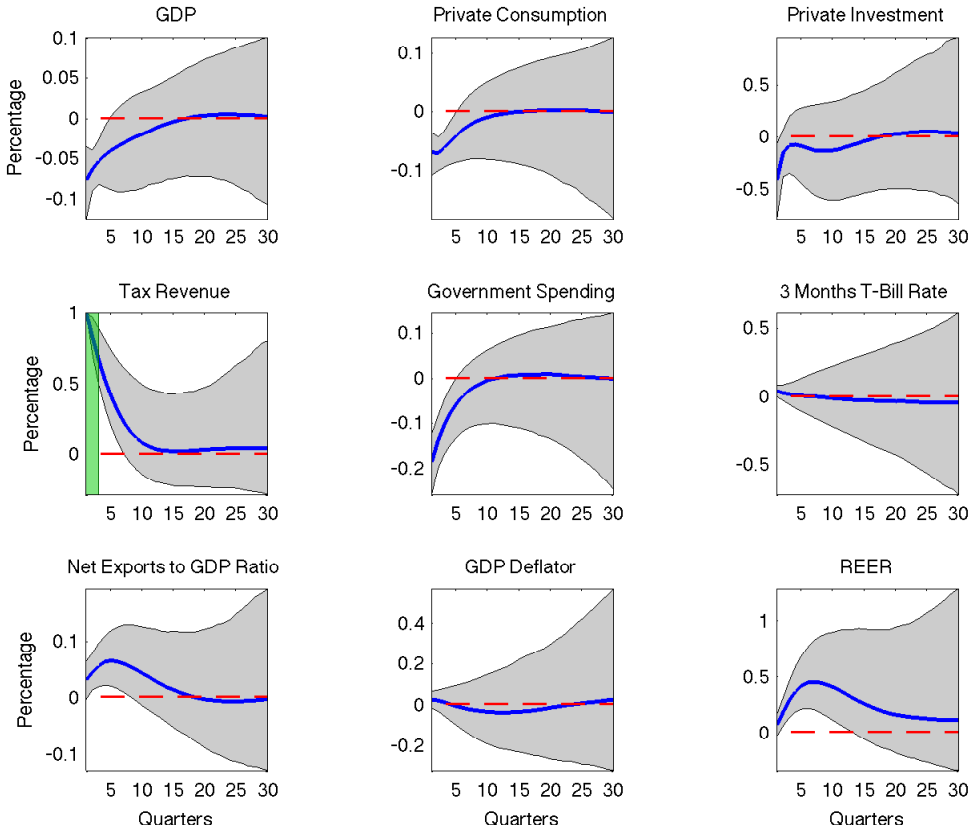
Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

Figure A3 – IRFs to a government spending shock (1991:Q1-2010:Q4)



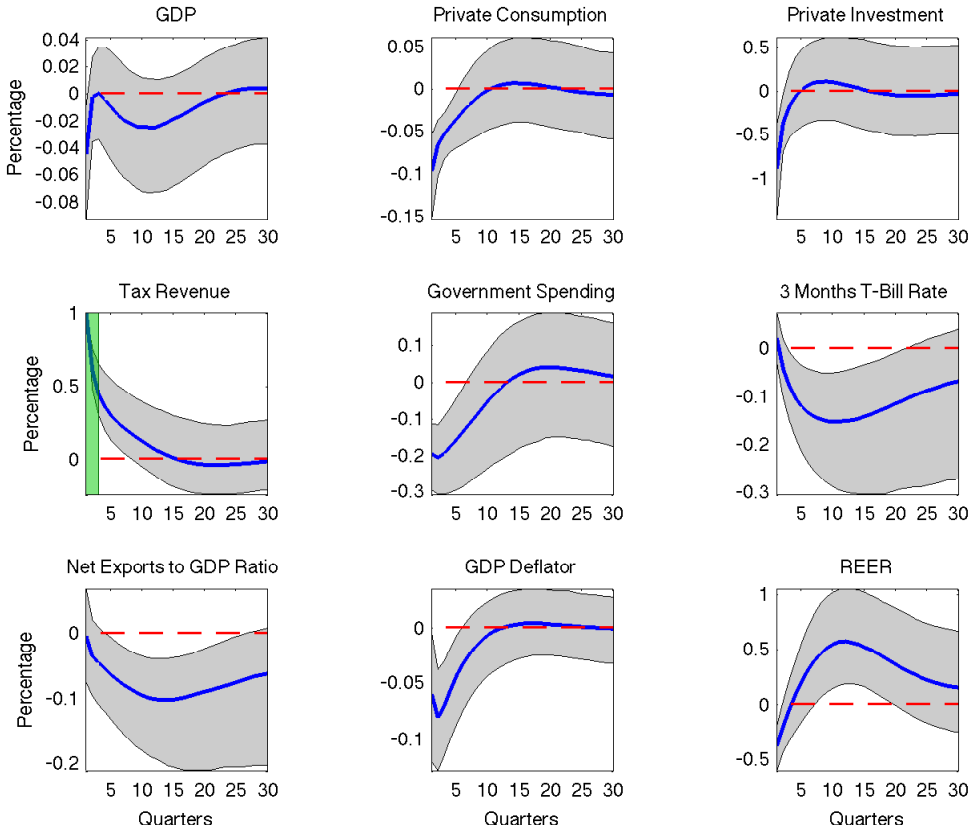
Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

Figure A4 – IRFs to a net tax revenue shock (1970:Q1-1990:Q4)



Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

Figure A5 – IRFs to a net tax revenue shock (1991:Q1-2010:Q4)



Notes: The green areas denote the identified sign restriction assumptions, the blue lines denote the median impulse responses, and the shaded areas denote the 68% confidence region.

Appendix Chapter 2

Tables

Table A1 – GDP Cumulative and Peak Multipliers with Alternative Measures of Inflation in the Taylor Rule

	Measure of inflation	1 year integral	2 years integral	4 years integral	Ratio of peak responses
Non accommodative	SPF forecast Infl.	-1.55	-1.97	-0.22	2.76
Accommodative		2.50	3.96	4.48	5.51
Non accommodative	Quarterly CPI Infl.	-1.28	-1.73	0.72	2.88
Accommodative		2.47	3.90	4.15	5.25
Non accommodative	Quarterly PCE Infl.	-2.19	-2.93	-0.39	2.20
Accommodative		2.78	4.09	4.22	5.21
Non accommodative	Year/year CPI infl.	-1.21	-1.62	0.54	3.47
Accommodative		2.49	4.02	4.53	5.33
Non accommodative	Year/year lead CPI Infl.	-1.35	-2.10	-0.54	2.33
Accommodative		2.73	4.36	4.60	5.87

Notes: This table provides GDP multipliers from a surprise federal spending shock across alternative measures of inflation in the Taylor-rule. The benchmark corresponds to one-quarter ahead inflation forecast from SPF.

Table A2 – GDP Cumulative and Peak Multipliers with Different Values of the Smoothing Parameter, γ

	γ	1 year integral	2 years integral	4 years integral	Ratio of peak responses
Non accommodative	2.5	-2.78	-4.95	-4.39	2.07
Accommodative		3.00	4.60	4.75	5.55
Non accommodative	3.5	-2.12	-3.24	-1.77	2.42
Accommodative		2.77	4.29	4.62	5.52
Non accommodative	5	-1.55	-1.97	-0.22	2.76
Accommodative		2.50	3.96	4.48	5.51
Non accommodative	6.5	-1.21	-1.28	0.52	2.97
Accommodative		2.32	3.74	4.39	5.51
Non accommodative	7.5	-1.06	-0.99	0.82	3.07
Accommodative		2.24	3.64	4.35	5.52
Non accommodative	10	-0.82	-0.53	1.27	3.22
Accommodative		2.10	3.47	4.28	5.53

Notes: This table provides GDP multipliers from a surprise federal spending shock across different values of the smoothing parameter γ. Note that the lower γ is the more far apart are the two states of monetary policy. $\gamma = 5$ corresponds to the benchmark case where monetary policy remains accommodative for about 30 of the time in our sample period.

Table A3 – Cumulative and Peak Sectoral Multipliers (surprise federal government spending)

	1-year integral	2-year integral	4-year integral	Ratio of peak responses
Total Consumption				
Linear	0.09	0.93	2.53	2.98
Non accommodative	-0.64	-0.82	-0.01	1.63
Accommodative	1.09	2.27	3.29	3.87
Cons. of durables				
Linear	0.10	0.32	0.71	0.85
Non accommodative	-0.16	-0.21	-0.04	0.49
Accommodative	0.43	0.76	0.85	0.99
Cons. of non durables & serv.				
Linear	-0.11	0.22	1.27	1.71
Non accommodative	-0.57	-0.60	-0.00	0.79
Accommodative	0.47	0.91	1.69	2.43
Private fixed investment				
Linear	-0.26	-0.42	0.96	0.65
Non accommodative	0.11	-0.86	-1.11	2.30
Accommodative	-0.17	0.02	0.22	0.91

Cumulative multipliers are computed as the ratio of the sum of responses of GDP and government spending. The peak measure is the ratio of the IRFs at their respective peaks.

Figures

Figure A6 – Federal Spending-to-GDP Ratio (in percent) Over the Sample Period

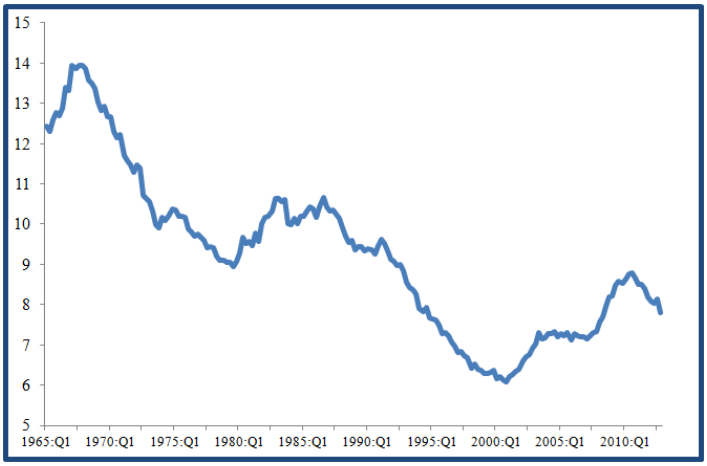


Figure A7 – Shadow Fed Funds Rate Near the ZLB (2008Q1-2012Q4)

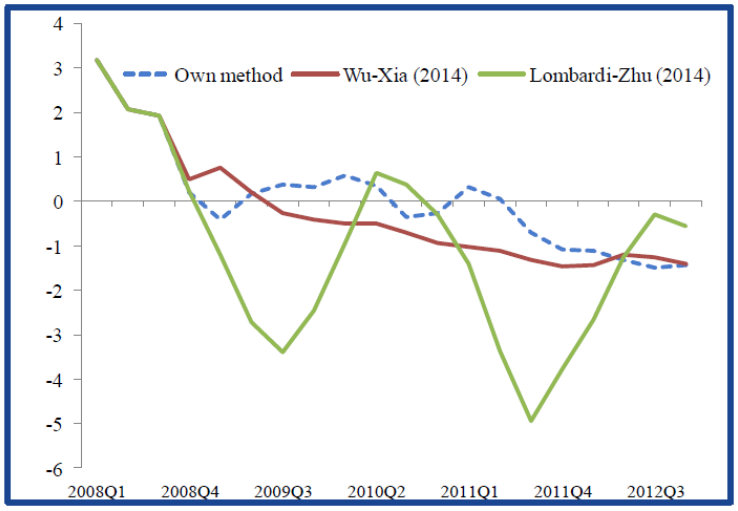
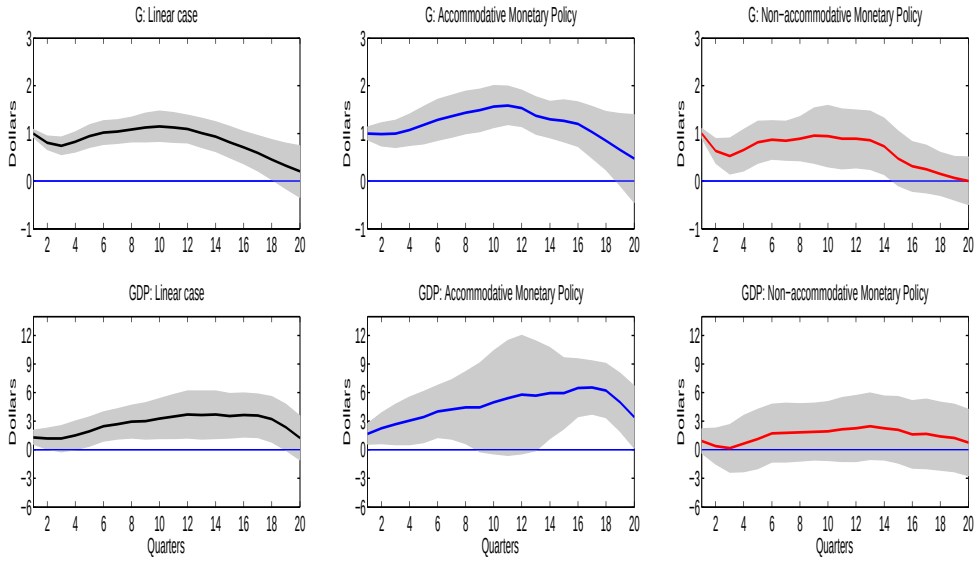
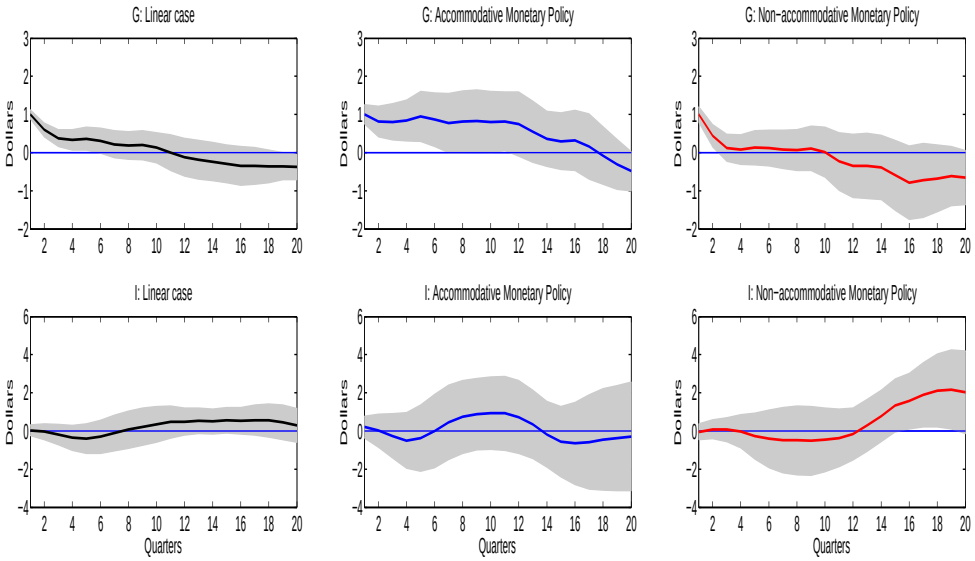


Figure A8 – IRFs of Federal Government Spending and Output to Federal Government Spending Shocks Using the Cholesky Decomposition



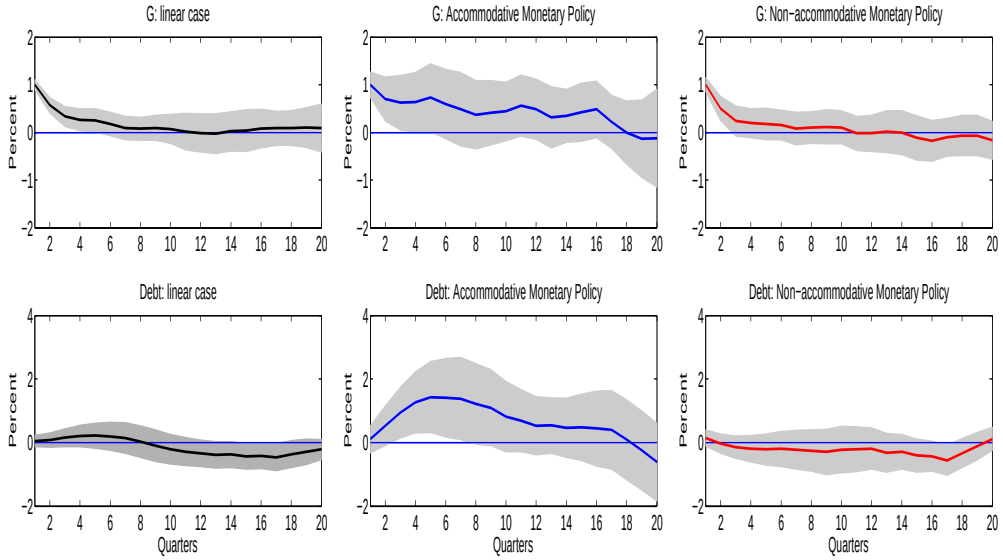
Notes: Shaded areas represent the 95 percent confidence bands around the estimates.

Figure A9 – IRFs of Private Investment (SPF/Greenbook)



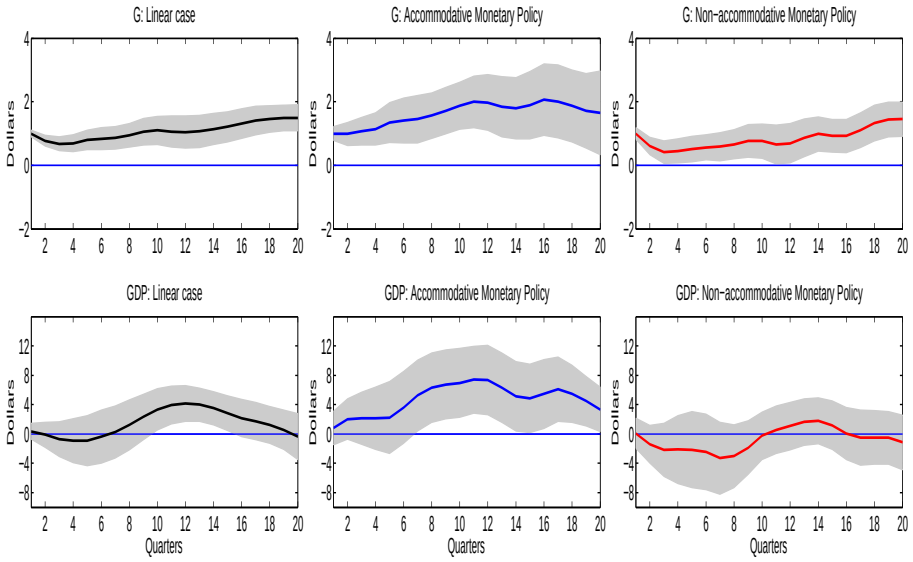
Notes: Shaded areas represent the 95 percent confidence bands around estimates.

Figure A10 – IRFs of Federal Debt (SPF/Greenbook)



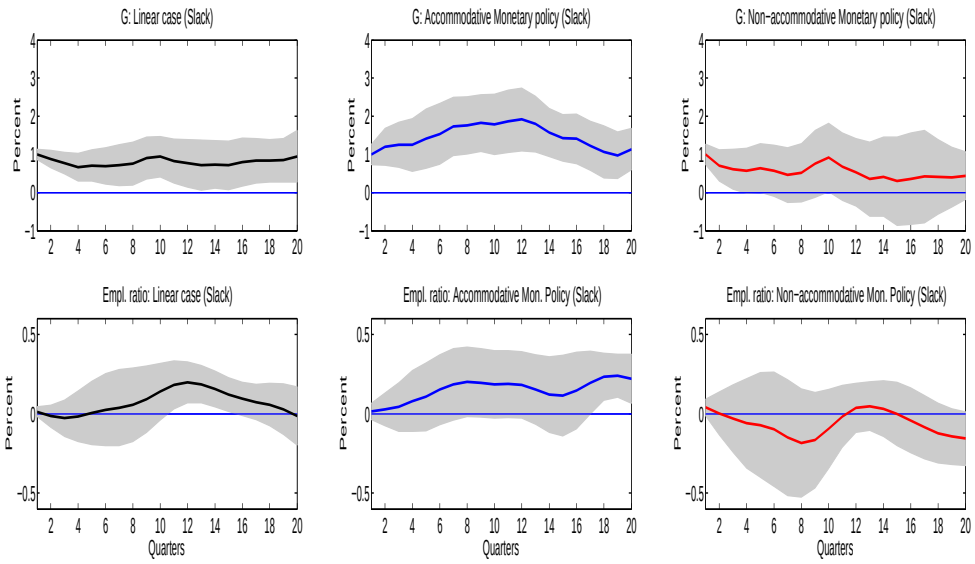
Notes: Shaded areas represent the 95 percent confidence regions around estimates.

Figure A11 – IRFs of Output (SPF/Greenbook): Extended Sample Through 2012Q4



Notes: Shaded areas represent the 95 percent confidence regions around estimates.

Figure A12 – IRFs of Employment at Times of Slack (SPF/Greenbook): Extended Sample, Including the ZLB Episode



Notes: Shaded areas represent the 95 percent confidence bands around the estimates.

Figure A13 – The Fed Funds Rate, the Shadow Fed Funds Rate, and the Likelihood of Being in the Accommodative State (extended sample, including the recent ZLB episode)

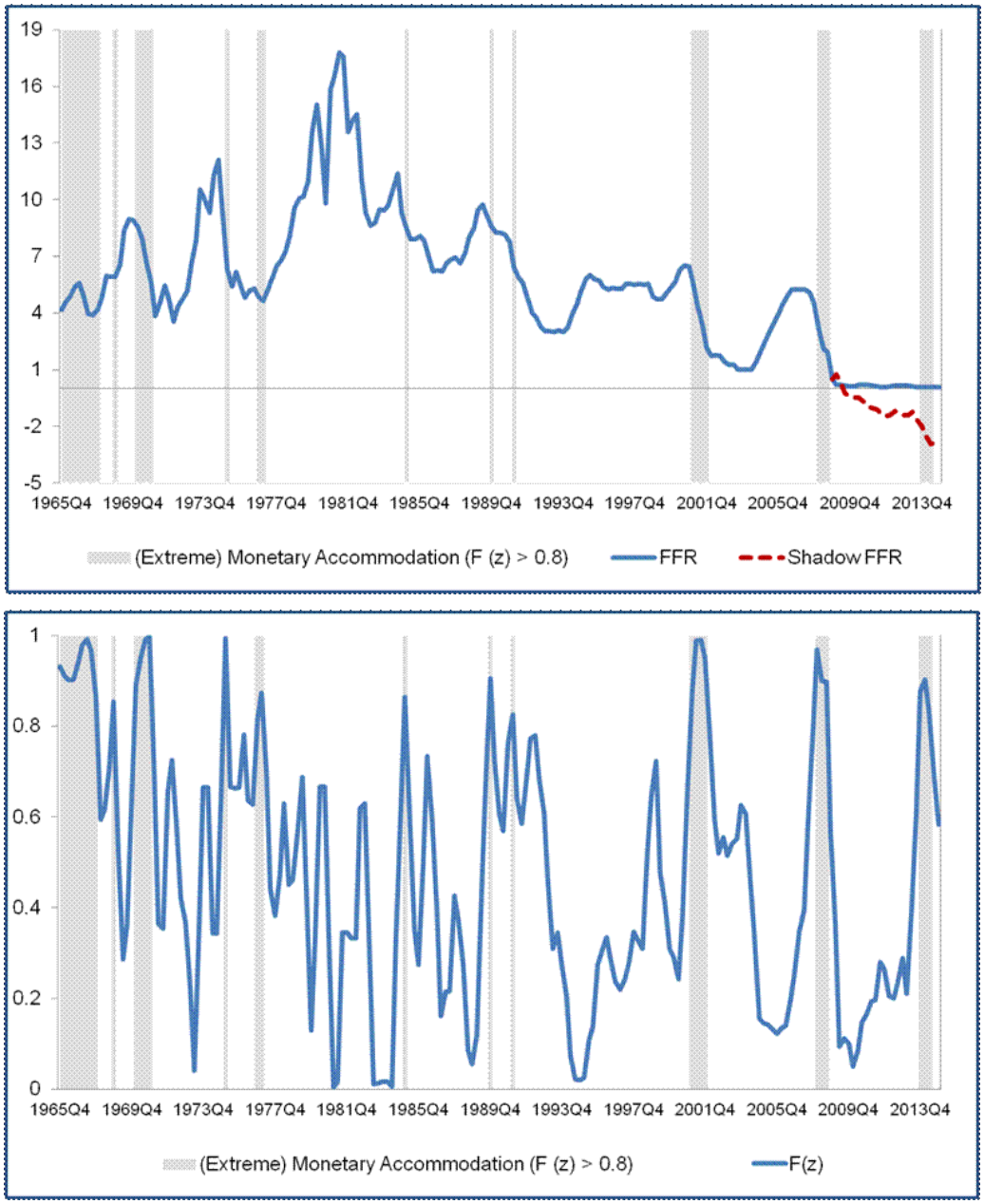
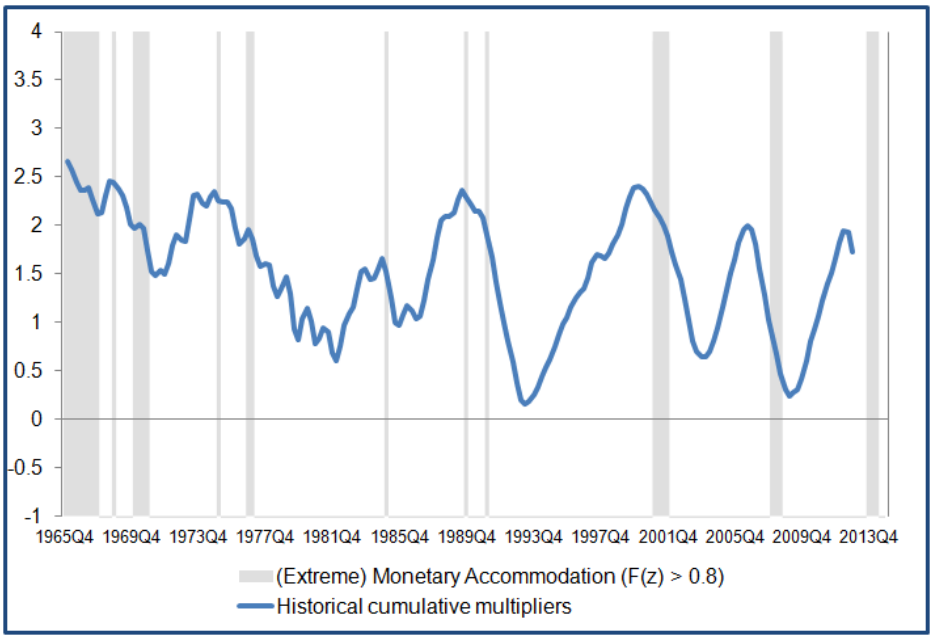


Figure A14 – Historical Cumulative Fiscal Multipliers Over the Sample Period



Notes: The multiplier in each quarter is cumulative over 16 quarters ahead (4-year integral).

Appendix Chapter 3

Tables

Table A4 – Years of fiscal expansions and fiscal consolidations

	Fiscal expansions	Fiscal consolidations
Argentina	1993, 96, 05, 09	1992, 97, 00, 02, 04
Bolivia	1999, 01, 02, 07, 08	1997, 05, 06
Brazil	1998, 02, 06, 09	1999
Chile	1998, 00, 09	1994, 96, 06
Colombia	2002, 09	2000, 03, 10
Costa Rica	1992, 93, 94, 00, 08, 09	1991, 95, 96, 99, 01, 03, 05
Dominican Rep.	2001, 08	2004, 05, 09
Ecuador	1995, 07, 08	1999, 00, 06, 09, 10
Guatemala	2003	2002, 04
Honduras	1992, 93, 96, 97, 99, 01, 05, 07,08, 09	1991, 94, 95, 98, 04
Mexico	1994, 96, 00, 04, 05, 06, 08	2010
Nicaragua	2001	2005
Panama	2003, 04, 10	1995, 06
Paraguay	1995, 99, 05, 09	2001, 02, 03, 04, 08, 10
Peru	1999, 04, 09	2001, 02, 03, 06, 10
El Salvador	1996, 01, 08, 09	1995, 02, 03, 04, 05, 06
Uruguay	1995, 98, 00, 04, 07, 10	1996, 02, 03, 05, 06
Venezuela, RB	1998, 01, 03, 06	1999, 02, 04, 05

Table A5 – Average changes in percent of GDP of the cyclically adjusted primary deficit and its main components

	PRIM. EXPENSES	CONSUMP. EXP.	CAPITAL EXP.	TRANSFERS AND SUBS.
ALL	0.35	0.06	0.09	0.21
	(0.09)	(0.04)	(0.05)	(0.05)
EXPANSION	1.33	0.35	0.45	0.53
	(0.14)	(0.07)	(0.09)	(0.09)
ADJUSTMENT	-0.66	-0.24	-0.21	-0.20
	(0.12)	(0.06)	(0.08)	(0.09)

Notes: This table displays the average changes in the cyclically adjusted primary expenses and its main components for the sample-period and during episodes of fiscal expansions and fiscal consolidations.

Table A6 – Average changes in percent of GDP of the cyclically tax revenue and its main components

	TOTAL TAX REV.	DIRECT TAX REV.	INDIRECT TAX REV.	SOCIAL SEC. CONTR.
ALL	0.22	0.13	0.09	0.01
	(0.05)	(0.04)	(0.04)	(0.02)
EXPANSION	-0.13	-0.03	-0.11	0.01
	(0.09)	(0.05)	(0.06)	(0.04)
ADJUSTMENT	0.52	0.25	0.29	-0.03
	(0.09)	(0.08)	(0.08)	(0.04)

Notes: This table displays the average changes in the cyclically adjusted primary expenses and its main components for the sample-period and during episodes of fiscal expansions and fiscal consolidations.

Table A7 – Household surveys data availability

	First year	Last year	Total obervations
Argentina	1991	2010	20
Bolivia	1991	2008	11
Brazil	1990	2009	17
Chile	1990	2009	9
Colombia	1992	2010	12
Costa Rica	1990	2010	20
Dominican Rep.	1992	2010	13
Ecuador	1994	2010	12
Guatemala	1998	2006	5
Honduras	1991	2009	19
Mexico	1992	2010	11
Nicaragua	1993	2005	4
Panama	1991	2010	12
Paraguay	1990	2010	14
Peru	1994	2010	15
El Salvador	1991	2009	14
Uruguay	1992	2010	16
Venezuela, RB	1992	2006	10

Table A8 – Effects of fiscal expansion on the income growth of the bottom 40 percent(robustness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPD$	0.022**	0.020*	0.022*	0.025**	0.022**	0.023**	0.022**	0.024**			
	(0.010)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)			
Lag $\Delta CAPD$		-0.008									
		(0.008)									
$\Delta ln(Real\ M_2)$			0.117					0.178	0.174	0.167	0.192
			(0.086)					(0.108)	(0.113)	(0.122)	(0.120)
$\Delta ln(Real\ Agri)$				0.324*				0.334**	0.341*	0.358**	0.394**
				(0.165)				(0.157)	(0.170)	(0.157)	(0.163)
$\Delta ln(GDP\ deflator)$					0.040			-0.265	-0.256	-0.263	-0.328
					(0.226)			(0.193)	(0.197)	(0.202)	(0.190)
$\Delta ln(Real\ Export)$						0.013		-0.038	-0.035	-0.093	-0.051
						(0.105)		(0.113)	(0.114)	(0.142)	(0.127)
$\Delta ln(U.S.\ RGDP)$							0.757	0.737	0.734	0.621	1.014
							(1.274)	(1.257)	(1.238)	(1.318)	(1.327)
$\Delta Prim.\ expend.$									0.025**		0.030***
									(0.011)		(0.009)
$\Delta Tax\ revenues$									-0.016	-0.020	
									(0.030)	(0.028)	
$\Delta Gov.\ Consump.$										0.103***	
										(0.024)	
$\Delta Capital\ expend.$										-0.011	
										(0.023)	
$\Delta Transfert\ \&\ subs.$										0.020**	
										(0.008)	
$\Delta Direct\ taxes$											-0.068**
											(0.031)
$\Delta Indirect\ taxes$											0.049
											(0.032)
ΔSSC											0.042
											(0.031)
Constant	0.135	0.114***	0.085	0.116	0.126	0.136	0.135	0.098	0.097	-0.193***	0.106
	(0.218)	(0.024)	(0.209)	(0.217)	(0.212)	(0.220)	(0.219)	(0.214)	(0.213)	(0.051)	(0.214)
R-squared	0.249	0.262	0.269	0.266	0.249	0.253	0.250	0.296	0.297	0.348	0.325
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal expansion on the income growth of the bottom 40 percent. Episodes of fiscal expansion are identified as periods during which the $CAPD$ increases by at least 1 percent of GDP. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A9 – Effects of fiscal contraction on the income growth of the bottom 40 percent(robustness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPB$	-0.009	-0.014	-0.010	-0.015	-0.009	-0.011	-0.009	-0.016			
	(0.013)	(0.018)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)			
$Lag\ \Delta CAPB$		-0.000									
		(0.011)									
$\Delta ln(Real\ M_2)$			0.117					0.183	0.175	0.171	0.203
			(0.093)					(0.114)	(0.115)	(0.124)	(0.124)
$\Delta ln(Real\ Agri)$				0.301*				0.326**	0.387**	0.323**	0.406**
				(0.157)				(0.147)	(0.170)	(0.139)	(0.167)
$\Delta ln(GDP\ deflator)$					0.028			-0.284	-0.269	-0.318	-0.345
					(0.246)			(0.204)	(0.216)	(0.220)	(0.212)
$\Delta ln(Real\ Export)$						-0.014		-0.066	-0.101	-0.132	-0.115
						(0.096)		(0.108)	(0.127)	(0.149)	(0.145)
$\Delta ln(U.S.\ RGDP)$							0.751	0.815	0.890	0.838	1.161
							(1.218)	(1.212)	(1.235)	(1.220)	(1.349)
$\Delta Prim.\ expend.$									0.031		0.031
									(0.019)		(0.020)
$\Delta Tax\ revenues$									0.026	0.006	
									(0.025)	(0.023)	
$\Delta Gov.\ Consump.$										0.015	
										(0.038)	
$\Delta Capital\ expend.$										0.023	
										(0.026)	
$\Delta Transfert\ \&\ subs.$										0.014	
										(0.045)	
$\Delta Direct\ taxes$											0.031
											(0.033)
$\Delta Indirect\ taxes$											0.013
											(0.030)
ΔSSC											0.055
											(0.106)
$Constant$	0.159	0.134***	0.113	0.159	0.154	0.167	0.160	0.147	0.143	-0.155**	0.155
	(0.228)	(0.046)	(0.223)	(0.230)	(0.222)	(0.231)	(0.229)	(0.232)	(0.231)	(0.066)	(0.238)
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal consolidation on the income growth of the bottom 40 percent. Episodes of fiscal expansion are identified as periods during which the $CAPD$ increases by at least 1 percent of GDP. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A10 – Effects of fiscal expansion on consumption growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPD$	0.021**	0.022**	0.021**	0.023**	0.021**	0.021**	0.021**	0.023**			
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)			
Lag $\Delta CAPD$		0.002									
		(0.008)									
$\Delta ln(Real\ M_2)$			0.098					0.120	0.113	0.122	0.121
			(0.095)					(0.121)	(0.122)	(0.130)	(0.125)
$\Delta ln(Real\ Agri)$				0.203*				0.217*	0.230*	0.231*	0.316**
				(0.105)				(0.109)	(0.120)	(0.123)	(0.125)
$\Delta ln(GDP\ deflator)$					0.112			-0.098	-0.087	-0.107	-0.152
					(0.187)			(0.182)	(0.182)	(0.189)	(0.183)
$\Delta ln(Real\ Export)$						0.007		-0.028	-0.023	-0.016	-0.019
						(0.123)		(0.139)	(0.141)	(0.158)	(0.142)
$\Delta ln(U.S.\ RGDP)$							0.910	0.887	0.942	0.974	0.630
							(1.216)	(1.185)	(1.181)	(1.278)	(1.272)
$\Delta Prim.\ expend.$									0.024**		0.030***
									(0.009)		(0.008)
$\Delta Tax\ revenues$									-0.007	-0.010	
									(0.024)	(0.024)	
$\Delta Gov.\ Consump.$										0.073***	
										(0.025)	
$\Delta Capital\ expend.$										0.002	
										(0.016)	
$\Delta Transfert\ \&\ subs.$										0.017	
										(0.014)	
$\Delta Direct\ taxes$											-0.049**
											(0.022)
$\Delta Indirect\ taxes$											0.041
											(0.024)
ΔSSC											0.004
											(0.023)
Constant	0.123	0.057	0.081	0.111	0.099	0.124	0.123	0.082	0.081	-0.083	0.092
	(0.122)	(0.039)	(0.114)	(0.122)	(0.122)	(0.124)	(0.122)	(0.124)	(0.124)	(0.049)	(0.131)
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal expansion on consumption growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A11 – Effects of fiscal contraction on consumption growth of the bottom 40 percent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta CAPB$	-0.005	-0.010	-0.007	-0.008	-0.006	-0.008	-0.005	-0.010			
	(0.010)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.010)	(0.011)			
$Lag\ \Delta CAPB$		-0.001									
		(0.005)									
$\Delta ln(Real\ M_2)$			0.099					0.126	0.128	0.129	0.137
			(0.101)					(0.127)	(0.126)	(0.130)	(0.130)
$\Delta ln(Real\ Agri)$				0.155				0.187*	0.180*	0.179	0.204*
				(0.097)				(0.106)	(0.102)	(0.112)	(0.100)
$\Delta ln(GDP\ deflator)$					0.098			-0.122	-0.130	-0.178	-0.158
					(0.206)			(0.196)	(0.187)	(0.208)	(0.192)
$\Delta ln(Real\ Export)$						-0.032		-0.067	-0.068	-0.065	-0.064
						(0.129)		(0.148)	(0.148)	(0.166)	(0.156)
$\Delta ln(U.S.\ RGDP)$							1.008	1.109	1.093	1.247	0.925
							(1.222)	(1.172)	(1.181)	(1.106)	(1.182)
$\Delta Prim.\ expend.$									0.008		0.011
									(0.010)		(0.013)
$\Delta Tax\ revenues$									-0.015	-0.005	
									(0.016)	(0.014)	
$\Delta Gov.\ Consump.$										0.007	
										(0.023)	
$\Delta Capital\ expend.$										-0.007	
										(0.017)	
$\Delta Transfert\ \&\ subs.$										0.009	
										(0.016)	
$\Delta Direct\ taxes$											-0.013
											(0.016)
$\Delta Indirect\ taxes$											-0.028
											(0.024)
ΔSSC											-0.023
											(0.045)
$Constant$	0.138	0.087**	0.099	0.136	0.117	0.145	0.138	0.116	0.116	-0.055	0.131
	(0.135)	(0.031)	(0.127)	(0.135)	(0.133)	(0.141)	(0.136)	(0.138)	(0.138)	(0.046)	(0.141)
No.Obs	210	190	210	208	210	209	210	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18	18

Notes: This table displays the effects of fiscal consolidation on consumption growth of the bottom 40 percent. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: M2, agriculture value-added, export, U.S. GDP and inflation rate, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A12 – Effects of fiscal expansion on the Gini index growth rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta CAPD$	-0.010**	-0.010***	-0.010***	-0.010**	-0.010***	-0.010***	-0.010***			
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)			
$Lag\ \Delta CAPD$		-0.002								
		(0.003)								
$\Delta ln(RGDP)$			-0.136				-0.180*	-0.170*	-0.153	-0.154
			(0.087)				(0.092)	(0.090)	(0.100)	(0.101)
$\Delta ln(Real\ M_2)$				-0.035			-0.030	-0.027	-0.027	-0.026
				(0.035)			(0.033)	(0.033)	(0.037)	(0.034)
$\Delta ln(Real\ Agri)$					-0.027		-0.024	-0.033	-0.031	-0.046
					(0.050)		(0.055)	(0.054)	(0.056)	(0.063)
$\Delta ln(Real\ Export)$						0.036	0.071	0.065	0.048	0.067
						(0.047)	(0.052)	(0.049)	(0.046)	(0.049)
$\Delta Prim.\ expend.$								-0.011***		-0.012***
								(0.003)		(0.003)
$\Delta Tax\ revenues$								0.000	0.000	
								(0.005)	(0.006)	
$\Delta Gov.\ Consump.$									-0.032***	
									(0.008)	
$\Delta Capital\ expend.$									0.001	
									(0.005)	
$\Delta Transfert\ \&\ subs.$									-0.011**	
									(0.005)	
$\Delta Direct\ taxes$										0.015*
										(0.008)
$\Delta Indirect\ taxes$										-0.012
										(0.008)
ΔSSC										0.007
										(0.011)
$Constant$	-0.041	-0.004	-0.041	-0.027	-0.040	-0.043	-0.028	-0.029	0.037*	-0.029
	(0.051)	(0.011)	(0.050)	(0.045)	(0.051)	(0.051)	(0.044)	(0.044)	(0.018)	(0.045)
No.Obs	210	190	210	210	208	209	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18

Notes: This table reports the effects of fiscal expansion on the Gini index growth rate. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: GDP, M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by group are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A13 – Effects of fiscal contraction on the Gini index growth rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta CAPB$	0.001	0.002	0.000	0.001	0.001	0.002	0.003			
	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)			
$Lag\ \Delta CAPB$		-0.000								
		(0.002)								
$\Delta ln(RGDP)$			-0.134				-0.198**	-0.222**	-0.199*	-0.233**
			(0.089)				(0.088)	(0.092)	(0.095)	(0.093)
$\Delta ln(Real\ M_2)$				-0.035			-0.029	-0.029	-0.026	-0.028
				(0.038)			(0.036)	(0.035)	(0.037)	(0.035)
$\Delta ln(Real\ Agri)$					-0.003		-0.005	0.006	0.004	0.009
					(0.054)		(0.062)	(0.062)	(0.068)	(0.062)
$\Delta ln(Real\ Export)$						0.052	0.087	0.093*	0.083	0.096
						(0.050)	(0.054)	(0.053)	(0.053)	(0.058)
$\Delta Prim.\ expend.$								0.000		-0.002
								(0.005)		(0.005)
$\Delta Tax\ revenues$								0.008	0.004	
								(0.006)	(0.006)	
$\Delta Gov.\ Consump.$									-0.003	
									(0.009)	
$\Delta Capital\ expend.$									0.003	
									(0.010)	
$\Delta Transfert\ \&\ subs.$									0.003	
									(0.006)	
$\Delta Direct\ taxes$										0.003
										(0.007)
$\Delta Indirect\ taxes$										0.013*
										(0.007)
ΔSSC										0.020
										(0.015)
$Constant$	-0.043	-0.017	-0.041	-0.029	-0.045	-0.049	-0.037	-0.036	0.032*	-0.043
	(0.056)	(0.010)	(0.055)	(0.050)	(0.056)	(0.058)	(0.050)	(0.049)	(0.017)	(0.051)
No.Obs	210	190	210	210	208	209	208	208	197	206
No.countries	18	18	18	18	18	18	18	18	18	18

Notes: This table reports the effects of fiscal consolidation on the Gini index growth rate. All fiscal variables are expressed as share of GDP and are cyclically-adjusted. Controls include real growth of: GDP, M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table A14 – Effects of fiscal expansion(columns 1-4) and fiscal contraction(columns 5-8) on the income growth of the bottom 40 percent (correcting fiscal variables from potential endogeneity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(Real\ M_2)$	0.200	0.205	0.197	0.224	0.210*	0.206*	0.197	0.227*
	(0.121)	(0.127)	(0.145)	(0.129)	(0.109)	(0.110)	(0.129)	(0.116)
$\Delta ln(Real\ Agri)$	0.404*	0.396*	0.352*	0.491**	0.395**	0.413**	0.304*	0.424**
	(0.206)	(0.220)	(0.189)	(0.222)	(0.180)	(0.186)	(0.172)	(0.181)
$\Delta ln(GDP\ deflator)$	-0.347	-0.356	-0.375	-0.423**	-0.328	-0.313	-0.364	-0.416*
	(0.227)	(0.228)	(0.230)	(0.184)	(0.221)	(0.233)	(0.280)	(0.220)
$\Delta ln(Real\ Export)$	-0.041	-0.049	-0.074	-0.068	-0.153	-0.147	-0.111	-0.138
	(0.212)	(0.206)	(0.190)	(0.197)	(0.220)	(0.223)	(0.219)	(0.256)
$\Delta CAPD \times D^{exp}$	0.036**							
	(0.013)							
$\Delta Prim.\ expend. \times D^{exp.}$		0.035**		0.037**				
		(0.013)		(0.013)				
$\Delta Tax\ revenues \times D^{exp.}$		-0.045	-0.044					
		(0.030)	(0.031)					
$\Delta Gov.\ Consump. \times D^{exp.}$			0.109***					
			(0.021)					
$\Delta Capital\ expend. \times D^{exp.}$			-0.015					
			(0.019)					
$\Delta Transfert\ \&\ subs. \times D^{exp.}$			0.026*					
			(0.014)					
$\Delta Direct\ taxes \times D^{exp.}$				-0.094**				
				(0.040)				
$\Delta Indirect\ taxes \times D^{exp.}$				0.034				
				(0.022)				
$\Delta SSC \times D^{exp.}$				-0.042				
				(0.035)				
$\Delta CAPB \times D^{cont.}$					-0.045**			
					(0.017)			
$\Delta Prim.\ expend. \times D^{cont.}$						0.051**		0.064***
						(0.018)		(0.020)
$\Delta Tax\ revenues \times D^{cont.}$						-0.034*	-0.021	
						(0.017)	(0.016)	
$\Delta Gov.\ Consump. \times D^{cont.}$							0.060	
							(0.050)	
$\Delta Capital\ expend. \times D^{cont.}$							0.012	
							(0.015)	
$\Delta Transfert\ \&\ subs. \times D^{cont.}$							0.034	
							(0.029)	
$\Delta Direct\ taxes \times D^{cont.}$								-0.017
								(0.018)
$\Delta Indirect\ taxes \times D^{cont.}$								-0.046
								(0.027)
$\Delta SSC \times D^{cont.}$								-0.140*
								(0.078)
Constant	0.105	0.106	-0.191***	0.117	0.227	0.227	-0.097*	0.275
	(0.225)	(0.225)	(0.053)	(0.234)	(0.232)	(0.235)	(0.053)	(0.241)
No.Obs	159	159	150	157	159	159	150	157
No.countries	16	16	16	16	16	16	16	16

Notes: This table reports the effects of fiscal expansion and fiscal contraction on the income growth of the bottom 40 percent. All fiscal variables expressed as share of GDP are cyclically-adjusted and corrected from potential endogeneity. Controls include real growth of: M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

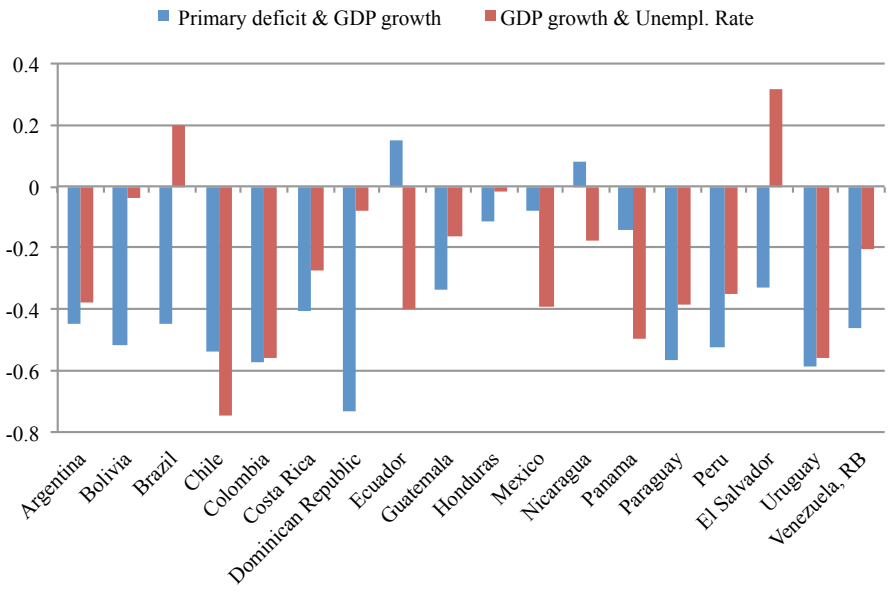
Table A15 – Effects of fiscal expansion(columns 1-4) and fiscal contraction(columns 5-8) on the income share growth of the bottom 40 percent (correcting fiscal variables from potential endogeneity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(Real\ GDP)$	0.364	0.360	0.328	0.295	0.417*	0.512**	0.466**	0.415
	(0.228)	(0.226)	(0.240)	(0.252)	(0.218)	(0.215)	(0.216)	(0.254)
$\Delta ln(Real\ M_2)$	0.103	0.101	0.105	0.104	0.111	0.109	0.109	0.100
	(0.089)	(0.091)	(0.106)	(0.094)	(0.092)	(0.091)	(0.096)	(0.092)
$\Delta ln(Real\ Agri)$	0.081	0.088	0.073	0.141	0.050	0.006	-0.042	0.013
	(0.127)	(0.135)	(0.111)	(0.145)	(0.119)	(0.112)	(0.124)	(0.114)
$\Delta ln(Real\ Export)$	-0.176	-0.168	-0.147	-0.161	-0.259*	-0.287*	-0.226	-0.224
	(0.137)	(0.131)	(0.122)	(0.121)	(0.145)	(0.142)	(0.138)	(0.164)
$\Delta CAPD \times D^{exp}$	0.028***							
	(0.009)							
$\Delta Prim.\ expend. \times D^{exp.}$		0.028***		0.028***				
		(0.009)		(0.009)				
$\Delta Tax\ revenues \times D^{exp.}$		-0.020	-0.016					
		(0.023)	(0.028)					
$\Delta Gov.\ Consump. \times D^{exp.}$			0.090***					
			(0.024)					
$\Delta Capital\ expend. \times D^{exp.}$			-0.012					
			(0.016)					
$\Delta Transfert\ \&\ subs. \times D^{exp.}$			0.023*					
			(0.011)					
$\Delta Direct\ taxes \times D^{exp.}$				-0.048				
				(0.029)				
$\Delta Indirect\ taxes \times D^{exp.}$				0.036				
				(0.021)				
$\Delta SSC \times D^{exp.}$				-0.058				
				(0.038)				
$\Delta CAPB \times D^{cont.}$					-0.028**			
					(0.012)			
$\Delta Prim.\ expend. \times D^{cont.}$						0.018		0.027***
						(0.011)		(0.008)
$\Delta Tax\ revenues \times D^{cont.}$						-0.048***	-0.032**	
						(0.015)	(0.012)	
$\Delta Gov.\ Consump. \times D^{cont.}$							0.039	
							(0.023)	
$\Delta Capital\ expend. \times D^{cont.}$							-0.015	
							(0.023)	
$\Delta Transfert\ \&\ subs. \times D^{cont.}$							0.009	
							(0.015)	
$\Delta Direct\ taxes \times D^{cont.}$								-0.032
								(0.020)
$\Delta Indirect\ taxes \times D^{cont.}$								-0.044**
								(0.016)
$\Delta SSC \times D^{cont.}$								-0.135**
								(0.046)
Constant	0.063	0.063	-0.086*	0.062	0.143	0.142	-0.020	0.154
	(0.104)	(0.104)	(0.046)	(0.106)	(0.114)	(0.110)	(0.047)	(0.110)
No.Obs	159	159	150	157	159	159	150	157
No.countries	16	16	16	16	16	16	16	16

Notes: This table reports the effects of fiscal expansion and fiscal contraction on the income growth of the bottom 40 percent. All fiscal variables expressed as share of GDP are cyclically-adjusted and corrected from potential endogeneity. Controls include real growth of: M2, agriculture value-added, export, as well as countries and years fixed effects. Robust standard errors clustered by country are reported in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Figures

Figure A15 – Cyclicality of the primary deficit and unemployment rate



Notes: This figures portrays correlations between GDP growth and the primary deficit and between GDP growth and unemployment rate.