UNIVERSITÉ DE STRASBOURG

ÉCOLE DOCTORALE Augustin Cournot

Bureau d'Economie Théorique et Appliquée

THÈSE présentée par :

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soutenue le : **10 décembre 2015**

pour obtenir le grade de : **Docteur de l'université de Strasbourg**

Discipline/ Spécialité : Sciences Economiques

Fiscal Policy and the Labor Market in the Euro Area : Multiplier, Spillover Effects and Fiscal Federalism

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Remerciements

La réalisation d'une thèse est un exercice délicat, parfois fastidieux, toujours enrichissant. Pendant ces quatre années de thèse, j'ai reçu le soutien de nombreuses personnes à qui je dois adresser mes plus sincères remerciements.

En premier lieu, je me dois de remercier chaleureusement mes deux directeurs de thèse, Amélie Barbier-Gauchard et Giuseppe Diana, qui m'auront soutenu de manière infaillible. Leur présence aura été précieuse, leur professionnalisme un exemple, leurs coups de pression nécessaires. Au delà d'avoir co-écrit deux chapitres de cette thèse, c'est pendant tout le processus de réflexion et d'écriture qu'ils auront toujours été de précieux conseil.

Egalement, je tiens à remercier les membres du jury pour avoir accepté d'être présents à ma soutenance, à savoir Jean-Christophe Poutineau, Florence Huart, Moïse Sidiropoulos et Raf Wouters. C'est un honneur pour moi de pouvoir être évalué par des chercheurs de cette qualité.

Je ne peux que remercier Thomas Coudert, co-auteur du second chapitre de cette thèse. Il aura eu le talent d'être à la fois un co-auteur consciencieux, un collègue plein d'humour, et un ami à l'écoute et patient.

Un merci tout spécial également aux personnes ayant relu les différents chapitres de cette thèse, à savoir Thomas Coudert, Audrey-Rose Ménard, Frédéric Olland et Cyrielle Poiraud. Il est important et réconfortant de se savoir soutenu par des collègues et amis fidèles.

J'ai eu la chance d'évoluer durant ces quatre années dans un cadre agréable et propice au travail, que ce soit au sein de la Faculté des Sciences Economiques et de Gestion de Strasbourg, du Bureau d'Economie Théorique et Appliquée ou de l'Ecole

Doctorale Augustin Cournot. Tout d'abord, je tiens à féliciter et remercier l'ensemble des doctorants qui auront été présents au quotidien. Une pensée particulière à mes collègues hors-pair du bureau 154 et à mes deux camarades précieux et accueillants du bureau 105. Je garderai en tête pour toujours ces souvenirs de moments conviviaux et sympathiques. Nous avons la chance, doctorants, d'évoluer dans un groupe où prime sympathie et entraide. Ce serait faux cependant de ne parler que de chance, c'est à nous tous que nous le devons mais c'est également à nous, à vous, de faire perdurer cet état d'esprit.

Je tiens également à remercier l'équipe d'enseignants-chercheurs de la faculté ainsi que l'ensemble du personnel administratif et tout spécialement Danielle Genevé pour sa disponibilité et pour aider, toujours avec le sourire, à régler nos petits tracas de doctorants.

Enfin, cette thèse n'aurait pas été la même sans mes proches. Un grand merci à ma famille, mes parents et ma soeur, pour leur affection, leur présence inconditionnelle et leur patience. Même si nous n'habitons pas la même ville, votre présence est quotidienne par la pensée. Merci infiniment à Karina qui, au quotidien, aura su me réconforter et me faire rire. Il y a certains moments plus difficiles au cours d'une thèse, moments qui auront été bien plus simples à traverser grâce à elle.

Contents

Résumé de la thèse

L'objectif de cette thèse est d'analyser les effets macroéconomiques de la politique budgétaire à court terme. Plus précisément, la première partie de la thèse (**Chapitres 1 et 2**) étudie l'impact de chocs budgétaires sur le marché du travail dans des modèles d'économie fermée. La seconde partie (**Chapitres 3 et 4**) développe un modèle d'union monétaire qui permet d'analyser différents aspects des effets de débordement de la politique budgétaire en union monétaire. Nous traitons également des propriétés stabilisatrices de mécanismes de transferts budgétaires en union monétaire.

Dans le **Chapitre 1**, nous considérons que l'impact d'une politique budgétaire, qu'elle soit de relance ou de consolidation, est étroitement lié au type d'instrument fiscal utilisé par le gouvernement. Sur cette hypothèse, nous analysons les conséquences sur le marché du travail, notamment sur l'emploi, l'offre de travail, les salaires réels et le taux de chômage, de deux types de dépenses publiques : la consommation publique, c'est à dire l'achat de biens et services par le gouvernement et l'investissement public, c'est à dire la création de capital et d'infrastructures publiques. D'un point

de vue méthodologique, nous construisons un modèle d'équilibre général dynamique et stochastique (DSGE) très proche de celui développé dans Gali, Smets et Wouters (2012), en particulier pour ce qui est de la modélisation du marché du travail. Dans un cadre simple, cette modélisation nous permet d'introduire la décision de participation au marché du travail pour les ménages ainsi que le chômage comme variable observable. Cette première étude nous permet de conclure qu'un choc de consommation produira des effets sensiblement différents sur le niveau de production et le marché du travail qu'un choc d'investissement public. Ainsi, une politique d'investissement public stimulera davantage la production qu'une politique de consommation publique mais entraînera un effet plus faible sur le chômage. Ce chapitre contribue à la littérature théorique en montrant que, malgré des effets positifs de l'investissement public sur l'emploi à long-terme, cette hausse des dépenses productives produit également une hausse à long terme des salaires réels et de l'offre de travail, si bien que l'effet total sur le chômage demeure relativement faible.

La suite de ce chapitre, cette fois-ci empirique, s'attache à déterminer les effets d'une hausse de la consommation publique et d'une hausse de l'investissement public sur un ensemble de variables macroéconomiques dans la Zone Euro. En nous appuyant sur un modèle SVAR, nous utilisons deux approches pour l'identification des chocs structurels budgétaires : une décomposition de Choleski et l'approche développée dans Blanchard et Perotti (2002). Suivant la première approche, les fonctions de réponses impulsion-

nelles indiquent qu'une politique d'expansion de l'investissement public entraine une augmentation du chômage tandis qu'une politique de consommation publique soutient la réduction du chômage, ce qui corrobore plutôt les résultats issus du modèle théorique. En revanche, les résultats produits par la simulation du modèle suivant la seconde approche, proposée par Blanchard et Perotti (2002), sont significativement différents. Nous rappelons ici un résultat récurrent dans la littérature : les résultats obtenus par l'estimation de ces modèles de séries temporelles sont fortement dépendants de la méthode d'identification des chocs budgétaires retenue.

Le **Chapitre 2** prend en compte un des éléments influençant la taille du multiplicateur budgétaire : la position de l'économie sur le cycle lors de la mise en place de politiques de relance ou de consolidation. Des études empiriques récentes, notamment Creel, Heyer et Plane (2011) et Auerbach et Gorodnichenko (2012), ont montré que le multiplicateur budgétaire était plus élevé en période de ralentissement économique qu'en période d'expansion, période au cours de laquelle le multiplicateur pourrait même tendre vers 0. Cependant, à l'exception des travaux de Sims et Wolff (2013) et Michaillat (2014), peu d'explications théoriques ont été apportées pour traduire ces résultats empiriques. Dans ce chapitre, nous proposons d'expliquer en partie ce différentiel de multiplicateur observé le long du cycle économique en introduisant l'idée d'un canal de transmission basé sur la dynamique du marché du travail et plus particulièrement du salaire réel. D'un point de vue méthodologique, nous utilisons un modèle DSGE avec

une modélisation à la Mortensen et Pissarides pour le marché du travail. Pour introduire deux positions différentes sur le cycle, nous considérons deux valeurs différentes pour le taux de chômage à l'état stationnaire du modèle. Il en résulte que les conséquences sur le marché du travail des chocs budgétaires diffèrent suivant le niveau initial du chômage. Plus précisément, une politique budgétaire expansionniste a un effet sur l'emploi plus important lorsque le chômage est élevé, un mécanisme déjà présent dans Michaillat (2014). Cet effet sur l'emploi engendre une dégradation plus forte du salaire réel (ou une hausse plus faible selon l'outil budgétaire) suite à une baisse plus notable de la productivité marginale du travail. Ce plus faible salaire réel, occasionné dans le cadre d'un chômage plus élevé à l'état stationnaire, affecte en retour la consommation privée. Notre modèle inclut des ménages Ricardiens, optimisateurs et ayant accès à des marchés financiers parfaits, mais également des ménages non-Ricardiens qui consomment simplement leur revenu disponible à chaque période. Une plus forte dégradation du salaire réel engendre une consommation plus faible pour les ménages non-Ricardiens. Cependant, cette même dégradation du salaire réel provoque également des coûts marginaux plus faibles pour les entreprises, conférant ainsi au choc budgétaire un impact inflationniste moindre qu'en haut du cycle. En conséquence, les taux d'intérêt réels augmentent moins en bas du cycle et l'effet d'éviction par le taux d'intérêt des dépenses publiques sur la consommation des ménages en est donc amoindri. En calibrant notre modèle avec un fort taux de chômage, nous observons que l'effet positif sur la consommation des ménages Ricardiens l'emporte sur le niveau de consommation plus faible des ménages non-Ricardiens,

ce qui produit un multiplicateur sur l'activité plus fort en bas du cycle. Pour finir, nous discutons le fait que ce canal de transmission n'est pas contradictoire avec celui proposé par Sims et Wolff (2013) mais, au contraire, qu'il est complémentaire. Comme le leur, notre canal de transmission nécessite la présence de ménages Ricardiens dans le modèle.

Les **Chapitres 3 et 4** s'intéressent plus spécifiquement à la politique budgétaire dans une union monétaire. Dans le **Chapitre 3**, nous analysons les effets de débordement de la politique budgétaire dans un modèle DSGE représentant une union monétaire à deux pays. Que ce soit dans un cadre théorique ou à l'aide d'outils empiriques, ces effets de débordement ont été étudiés avec comme objectif principal d'évaluer les effets d'une politique budgétaire expansionniste sur le reste de l'union. Deux mécanismes de transmission principaux ont ainsi déjà été mis en évidence. Premièrement, si l'Etat membre dans lequel est mise en place la politique budgétaire est suffisamment grand par rapport au reste de l'union, une hausse des dépenses publiques génère de l'inflation, au niveau national mais également au niveau de l'union dans son ensemble. La banque centrale aura ainsi tendance à augmenter son taux d'intérêt, ce qui provoquera un effet d'éviction de la politique budgétaire sur la demande privée dans l'union. Deuxièmement, lorsqu'un Etat membre augmente ses achats de biens et services ou ses transferts versés aux ménages, une partie de ces dépenses supplémentaires sera adressée au secteur privé dans le reste de l'union, augmentant ainsi les exportations des autres Etats membres. Ce mécanisme de transmission est mieux connu sous le nom d'effet de fuite de la poli-

tique budgétaire. Le signe de l'effet de débordement dépend donc de la force relative de ces deux mécanismes de transmission. Nous contribuons à cette littérature en étudiant les effets de débordement de différents outils budgétaires, en particulier de six outils budgétaires spécifiques : la consommation publique, l'investissement public, les transferts versés aux ménages, la TVA, les impôts sur le revenu ainsi que les charges patronales sur les salaires. En effet, seulement la consommation publique et les dépenses publiques en totalité ont eu tendance à être considérées. Dans ce chapitre, nous montrons que le signe des effets de débordement ainsi que les mécanismes de transmission de la politique budgétaire en économie ouverte dépendent fortement de l'instrument budgétaire considéré. Egalement, nous étudions l'impact d'une politique monétaire passive sur le signe et la taille des effets de débordement. Nos résultats indiquent que ce type de politique génère des effets de débordement de la politique budgétaire différents bien que l'impact d'une politique monétaire passive dépende aussi de l'outil budgétaire utilisé.

Dans le **Chapitre 4**, nous nous intéressons à un nouvel aspect de la politique budgétaire en union monétaire ayant trait aux mécanismes de transferts budgétaires entre Etats membres pour amortir les chocs conjoncturels. Présent dans de nombreuses unions monétaires, comme aux USA, le Canada, l'Allemagne et la Suisse, ce type de mécanisme vise à diminuer le différentiel de taux de croissance qui peut exister entre membres d'une même union monétaire. Bien que plus complexe dans la réalité, le fonctionnement de ce mécanisme de transferts budgétaires peut être résumé simplement. En

cas de différentiel de taux de croissance entre deux économies d'une union monétaire, un cadre fiscal permet le transfert de fonds publics de l'économie avec le taux de croissance le plus élevé vers l'Etat membre plus en difficulté. Dans ce chapitre, nous traitons des propriétés stabilisatrices de ce type de mécanisme de transferts entre Etats membres. Plus précisément, nous analysons l'efficacité du transfert en fonction de son utilisation par le pays receveur. De même qu'au **Chapitre 3**, nous faisons l'hypothèse que le transfert peut-être utilisé par le gouvernement au travers de différents outils budgétaires. Nous montrons que les propriétés stabilisatrices du transfert sont intimement liées à l'outil budgétaire considéré et au type de choc occasionné, ici de demande ou d'offre. Nous concluons que différents types d'outils budgétaires sont nécessaires pour stabiliser conjointement la production et le chômage en situation de chocs de différentes natures.

Cette thèse contribue à la littérature actuelle attenante à l'étude de la politique budgétaire en appréhendant ses effets sur le marché du travail. Nous concluons qu'il est difficile de déduire les effets de chocs fiscaux sur le chômage à partir du multiplicateur budgétaire sur l'activité. Dans les modèles DSGE que nous utilisons, si la production et l'emploi sont fortement corrélés, la réponse de l'offre de travail aux chocs budgétaires peut entraîner des réponses du chômage peu corrélés avec celles de la production. Certaines contributions récentes montrent même qu'un choc positif de dépenses publiques peut entraîner une hausse conjointe de l'activité et du taux de chômage. Cette thèse s'inscrit particulièrement dans la littérature actuelle en montrant la pertinence de

l'analyse spécifique des effets de la politique budgétaire sur le marché du travail. Plus précisément, nos travaux se focalisent sur deux éléments principaux. Premièrement, une analyse de la politique budgétaire sur le marché du travail nous montre que ses effets varient en fonction de l'outil budgétaire considéré. Deuxièmement, le marché du travail est mis en exergue pour expliciter le canal de transmission permettant de produire des multiplicateurs différents sur l'activité en fonction de la position sur le cycle économique. Au-delà des effets de la politique budgétaire sur le marché du travail, un résultat sous-jacent de la thèse est que l'impact de la politique budgétaire de court terme, aussi bien en économie fermée qu'en économie ouverte, dépend très fortement du type de dépenses ou de taxes concernés.

Depuis le modèle Keynésien canonique, tous les cadres d'analyse théoriques ont été utilisés afin d'étudier les cannaux de tranmissions de la politique budgétaire, tels que le modèle IS/LM ou le modèle OG/DG. Cependant, malgré que cette problématique a été centrale dans le développement de la macroéconomie et qu'une très large littérature s ?est développée, beaucoup d ?aspects de la politique budgétaire prêtent encore à discussion. En conséquence, les effets macroéconomiques de la politique budgétaire sont encore à l ?agenda des économistes et une nouvelle littérature s'est développée depuis les années 90.

Un nouveau regard sur la politique budgétaire

L ?émergence d ?un intérêt renouvelé pour les problématiques liées à la politique

budgétaire peut être expliquée par au moins 5 raisons. Premièrement, de nouveaux outils d ?analyse se sont développés : la théorie des cycles réels et ensuite le modèle nouveau-Keynésien (les modèles d'équilibre général dynamique et stochastique) du côté théorique mais également le développement de l'économétrie des séries temporelles. Le modèle nouveau-Keynésien a été fortement utilisé afin d'étudier les canaux de transmission de la politique budgétaire depuis les années 90 alors que l'attention était plutôt donnée à l'analyse de la politique pendant les années 80. La structure dynamique de ces modèles combinée à l'hypothèse d'anticipations rationnelles permet d'analyser les effets inter temporels de la politique budgétaire, contrairement aux cadres d'analyses statiques précédents comme le modèle IS/LM. Surtout, les modèles DSGE permettent de prendre en compte les effets d'équivalence Ricardienne de la politique budgétaire puisque ces modèles peuvent inclure une modélisation détaillée de la politique budgétaire, avec l'introduction par exemple de nombreuses taxes. De plus, le développement des méthodes macro économétriques a ouvert de nouvelles perspectives. Estimer les effets de la politique budgétaire sur les variables macroéconomiques clefs ainsi que la taille du multiplicateur budgétaire permettrait d'atteindre un certain consensus quant à ces questions. Cependant, trouver un consensus va s'avérer être une tâche difficile. Surtout, les différentes approches pour identifier les chocs budgétaires fournissent des résultats divergents.

Cela constitue la seconde raison principale : aucun réel consensus a été trouvé quant

aux effets de court terme de la politique budgétaire, si bien qu'une large littérature continue de se développer jusqu'à aujourd'hui. Pour résumer, le point de vue Keynésien défend l'idée de forts effets de la politique budgétaire sur l ?activité alors que les économistes classiques argumentent en faveur de l'inefficacité de la politique budgétaire pour relancer la production. De nombreuses études portent sur les effets de court terme de la politique budgétaire, avec des méthodologies de plus en plus rigoureuses et sophistiquées. Cependant, une lecture exhaustive et méticuleuse de cette littérature révèle le manque de consensus quant à la taille du multiplicateur budgétaire. Ramey (2012) résume : "Overall, most output multiplier estimates from the aggregate literature tend to lie between 0.5 and 1.5". Egalement, au delà de la détermination des effets généraux de la politique budgétaire et de la taille du multiplicateur, la littérature récente s'est intéressée à des aspects plus spécifiques de la politique budgétaire à court terme, si bien est est que cette littérature s'est fortement diversifiée. Les interactions entre politique budgétaire et monétaire, entre la politique budgétaire et les marchés financiers, the effets des différentes sortes de dépenses publiques et de taxes sur l'activité, les effets en économie ouverte et les canaux de transmissions spécifiques, sont parmi d'autres les nombreux aspects de la politique budgétaire qui ont été étudiées par les économistes ces dernières années.

Troisièmement, la littérature académique s'est plus intéressées durant les années 80 et le début des années 90 à des problématiques liées à la politique monétaire. Comme énoncé par Ramey (2012), les décideurs politiques ainsi que les économistes avaient une

préférence pour l'emploi de la politique monétaire pour réduire les fluctuations macroéconomiqes : "Before the crisis, there was broad agreement among macroeconomists and policymakers that short-run stabilization was almost exclusively the province of monetary policy. Monetary policy is more flexible ; it is more easily insulated from political pressures ; and it can more easily be put in the hands of independent experts. We thought that the zero lower bound would bind infrequently and not sharply ; and that in the unlikely event that it did bind sharply, monetary policymakers had other tools they would use in place of reductions in the policy interest rate". Cependant, avec la crise récente et l'incapacité de la politique monétaire conventionnelle de contrer la forte baisse de l'activité économique, les economistes ont renouvellé leur intérêt pour la politique budgétaire en tant qu'outil de stabilisation macroéconomique. Dans ce sens, la plupart des économies développées ont mis en place des plans de relance, comme l'American Recovery and Reinvestment Act de 2009 et le plan de relance Européen.

Finalement, depuis la crise récente, les aspects reliés à la politique budgétaire ont été centraux dans les débats économiques et politiques, tout spécialement dans la Zone-Euro. La crise des dettes souveraines souleva des questions quant à la soutenabilité de la dette dans certaines économies de la Zone Euro et quant à la stratégie à adopter en termes de finances publiques. De plus, de nombreaux économistes argumentent en faveur d'une plus forte intégration budgétaire dans la Zone Euroavec la création par exemple d'une vraie union fiscale et budgétaire. Du côté financier, avec certaines

économies de l'Eurozone éprouvant des difficultés à emprunter sur les marchés financiers, certains économistes et décideurs politiques ont suggéré de mutualiser les dettes européennes, avec la création par exemple des Eurobonds. Egalement, la mise en place de plans d'austérité fut fortement débattue. Est-ce que la réduction des déficits et des niveaux de dette peut augmenter la confiance du secteur privé dans le future de telle sorte que ces politiques restrictives n'ont pas d'impact négatif sur la croissance ? Ou alors ces plans d'austérité sont inappropriés en période de récession sachant que les multiplicateurs sont particulièrement larges ? Le contexte politique et économique actuel est favorable au développement d'une large littérature afin d'étudier les nombreuses facettes de la politique budgétaire

Objectifs de la thèse et questions méthodologiques

Trois principales dimensions de la politique budgétaire

Afin d'étudier les effets de la politique budgétaire dans ce contexte, plusieurs dimensions de la politique budgétaire doivent être prises en compte. Cette thèse de doctorat s'intéresse à trois d'entre elles : le signe et la taille du multiplicateur budgétaire, les effets de débordement en union monétaire et les capacités stabilisatrices de mécanismes de transferts budgétaires entre états membres.

Le multiplicateur budgétaire. Le concept de multiplicateur budgétaire est crucial

dans cette thèse. Premièrement, le chapitre 1 traite des effets de la politique budgétaire sur le PIB, rendant l'analyse du multiplicateur budgétaire centrale. De plus, d'autres multiplicateurs que le multiplicateur sur l'activité sont étudiés dans la thèse. Tout spécialement, cette thèse vise à étudier les effets de la politique budgétaire sur l'emploi et le chômage. En conséquence, les termes de « multiplicateur budgétaire sur le chômage » et de « multiplicateur budgétaire sur l'emploi » sont souvent présents au travers des chapitres.

Les effets de débordements de la politique budgétaire. Les chapitres 3 et 4 étudient les effets de la politique budgétaire en union monétaire. Un élément important est les effets de débordement qui peuvent exister quand un état membre met en plus une politique budgétaire expansionniste. Ces effets de débordement vont influencer les effets stabilisants de la politique budgétaire au niveau de l'union mais également au niveau de l'état concerné. Egalement, si les effets de débordement sont larges, les états membres se doivent de prendre en compte les effets de leur politique budgétaire sur les autres états membre dans la cadre de la coordination des politiques économiques dans la Zone Euro. Les effets en économie ouverte de la politique budgétaire ont été analysés en profondeur depuis au moins le modèle IS/LM. Cependant, dans le cas de l'union monétaire, le signe et la taille des effets de débordements prêtent encore à débats. Le chapitre 3 contribue à la littérature récente analysant cette problématique.

Fédéralisme fiscal and transferts budgétaire en unions monétaires. La ques-

tion de la politique budgétaire en union monétaire est fortement liée aux premiers travaux sur les zones monétaires optimales de Mundell (1961) ou Mc Kinnon (1963) parmi d'autres. En présence de chocs asymétriques, de rigidité des prix et d'une faible mobilité du travail, la politique budgétaire pourrait être un outil efficace pour stabiliser l'activité macroéconomique au niveau de l'union et entre états membres. En réalité, la politique budgétaire a été intensément utilisée afin de stabiliser l'activité économique et l'emploi mais la manière dont est menée la politique budgétaire comme instrument de stabilisation conjoncturelle diffère fortement parmi les unions monétaires. Par exemple, la politique budgétaire est très centralisée aux Etats-Unis, avec un budget central important et un système de transferts sophistiqué entre le gouvernement central et les états membres. Au contraire, la politique budgétaire est plutôt décentralisée malgré la présence de règles communes, au travers du Pacte de Stabilité et de Croissance et de ses extensions récentes (le semestre Européen, le "two-packs etc"). De nombreux économistes argumentent en faveur d'une intégration fiscal renforcée pour la Zone Euro et tout spécialement pour la mise en place de mécanismes de transferts budgétaires entre états membres. Le chapitre 4 analyse les capacités stabilisatrices de tels mécanismes de transferts.

Les effets de la politique budgétaire sur le marché du travail. Si on considère qu'une augmentation des dépenses publiques a un effet positif sur l'activité économique, en d'autres mots que le multiplicateur budgétaire est supérieur à 0, il est vraisemblable qu'une hausse des dépenses publiques a également un impact positif sur l'emploi. Par

exemple, Monacelli, Perotti et Trigari (2010), en utilisant une approche SVAR , trouvent que un choc de dépenses publiques augmente l'emploi et la probabilité de trouver un travail. Cependant, le lien entre les effets d'expansions fiscales sur l'activité et l'emploi ne semblent pas être si certains.Comme l'a souligné Ramey (2012) : "[...] most economists and policymakers would agree that job creation is at least as important a goal as stimulating output. In theory, one can use Okun's law to translate GDP multipliers to unemployment multipliers. However, because of variations in the parameters of this "law" over time, the advent of jobless recoveries, and the frictions involved in creating and filling jobs, the translation of output multipliers to employment or unemployment multipliers is not straightforward". Ramey (2012) fournit des évidences empiriques quant aux effets de la politique budgétaire sur l'emploi et le chômage pour différents schémas d ?identification et différents échantillons. Le message principal est qu ?une augmentation des dépenses publiques tend à diminuer le chômage mais que l ?effet positif suer l ?emploi est plus du à de nouveaux salariés engagés dans le sectur public que dans le secteur privé. Dans ce papier mais également dans certains travaux précédents, Ramey (2012) conclue pour un effet négatif de la politique budgétaire sur l'activité privée.

General introduction

Since the canonical Keynesian model, all theoretical frameworks have been extensively used for investigating the transmission channels of fiscal policy, such as the IS/LM or the AS/AD models. However, despite this issue has been central in the development of macroeconomics and that a very large literature has grown up, a lot of aspects of fiscal policy still rise to discussions. As a consequence, the macroeconomic effects of fiscal policy are still in the research agenda and especially an extensive new literature has grown up since the nineties.

A renewed focus on fiscal policy

The emergence of this renewed interest for issues related to fiscal policy can be explained by at least four main reasons. First, some new analysis tools emerged: the Real Business Cycle theory and then the new-Keynesian framework (Dynamic and Stochastic General Equilibrium models) on the theoretical side and the development of empirical time series methods on the other side.[1] The new-Keynesian framework has been used extensively to explore the transmission channels of fiscal policy since the late nineties while the attention was more given to the effects of monetary policy in the eighties and the early nineties. The dynamic structure of these models combined with the rational expectations assumption enable to investigate the intertemporal effects of fiscal policy, in contrary to previous static frameworks like the AS/AD model. Especially, the DSGE models are suitable for taking into account the Ricardian effects of fiscal policy since

[1] The methodological distinction between theory and empirics could be criticized since the DSGE models can be now easily estimated with Bayesian methods and that identification schemes in time series (for instance in S-VAR models) are based on theoretical considerations.

such models can feature a rich fiscal side, with the introduction of a large range of taxes, in which different fiscal scenarios can be tested (for instance the duration of the fiscal adjustment and its composition). Moreover, the development of macroeconometric methods and especially the vector autoregression models have opened new perspectives in the field. Estimating the effects of fiscal policy on key macroeconomic variables and the size of the fiscal multiplier seemed to be very promising for reaching a consensus about these issues. However, to find a consensus will turn out to be a complicated task. Especially, the different approaches[2] to identify fiscal shocks seem to provide very divergent results.

This constitutes the second main reason: no real consensus arises concerning the short-run effects of fiscal policy so that a large literature still continues to grow up until now. Briefly speaking, the Keynesian point of view argues for strong effects of fiscal policy on real activity while the neo-classical view concludes that fiscal policy has no effect (or even negative effects) on output. Of course, the numerous studies dealing with the short-run effects of fiscal policy have highlighted interesting findings and the methods used have been more and more rigorous and sophisticated. However, an exhaustive and meticulous reading reveals a lack of consensus for the size of the fiscal multiplier as well as the transmission channels of fiscal policy. As summarized in Ramey (2012): *"Overall, most output multiplier estimates from the aggregate literature tend to lie between* 0.5 *and* 1.5*"*. Also, beyond the determination of the general effects of fiscal policy and of the size of the multipliers, the recent literature has focus on the different and more specific aspects of fiscal policy in the short run so that this literature has become interestingly diversified. The interactions between fiscal and monetary policy, between fiscal policy and the financial markets, the effects of the different sorts of public spending and taxes, the open-economy effects and transmission channels, are among others numerous aspects of fiscal policy that have been studied by economists in recent years.

[2]Three main approaches have been used: the so-called S-VAR approach introduced by Blanchard and Perotti (2002), the identification by sign restrictions like in Mountford and Uhlig (2009) and the narrative approach suggested first in Ramey and Shapiro (1998). An important survey can be found in Perotti (2008).

Third, as already said, the academic literature focused more during the eighties and the nineties on issues related to monetary policy. As pointed out by Romer (2012), policy makers and economists favor monetary policy for reducing macroeconomic fluctuations in the short run: *"Before the crisis, there was broad agreement among macroeconomists and policymakers that short-run stabilization was almost exclusively the province of monetary policy. Monetary policy is more flexible; it is more easily insulated from political pressures; and it can more easily be put in the hands of independent experts. We thought that the zero lower bound would bind infrequently and not sharply; and that in the unlikely event that it did bind sharply, monetary policymakers had other tools they would use in place of reductions in the policy interest rate".* However, with the recent crisis and the inability of the conventional monetary policy to overcome the strong decline in economic activity, economists renew interest for fiscal policy as a stabilization policy. In this sense, most developed economies have implemented large recovery plans, like the American Recovery and Reinvestment Act of 2009 (preceded by the Bush tax cuts) or the European Economic Recovery Plan.

Finally, since the recent crisis, some aspects related to fiscal policy have been central in the policy and economic debates, especially in the Eurozone. The sovereign debt crisis with the Greek situation as a climax raises questions about the sustainability of the debt for some Eurozone members and the public finance strategy to be adopted. Moreover, many economists argue in response to this situation for a deeper fiscal integration within the Eurozone with the creation of an effective fiscal union. On the financial side, with some European countries facing difficulties to borrow in financial markets, some economists and policy makers have suggested to pool the European debt, for instance through the creation of Eurobonds. These are some examples of aspects of fiscal policy in a monetary union that have been extensively discussed in the recent years. Also, the implementation of austerity (or at least consolidation) plans has received considerable attention. Finally, the neo-classical and the Keynesian views were underlying to the debates about the validity of these austerity plans. Does the reduction of deficit and debt levels can increase private sector's confidence on the future so that these restrictive policies are not harmful for growth? Or do these austerity plans are inappropriate and

disrupting growth in these times of economic downturn during which the fiscal multiplier is likely to be very large? The current economic and political context is favorable to the development of a large literature which investigates the different facets of fiscal policy.

Aim of this PhD thesis and methodological issues

Three main dimension considered.

To be able to study the effects of fiscal policy in this renewed context, several dimensions of fiscal policy should be taken into account. This PhD thesis focuses on three of them: the sign and the size of the fiscal multiplier, the spillover effects in an integrated economic union in which members are linked commercially and financially, and the stabilizing properties of fiscal transfers schemes between member states in a monetary union.

The fiscal multiplier. The concept of fiscal multiplier is crucial in this thesis. First, chapter 1 discusses the effects of fiscal policy on output so that the size of the output fiscal multiplier is central in this analysis. Moreover, throughout the thesis other kinds of multipliers are studied. Especially, this thesis aims at investigating the effects of fiscal policy on employment and unemployment. As a consequence, the terms "unemployment fiscal multiplier" and "employment fiscal multiplier" are often present in all chapters.

Spillover effects of fiscal policy. Chapters 3 and 4 investigate the effects of fiscal policy in a monetary union. One important element are the possible spillover effects that can arise when one member state implement a fiscal expansion or a fiscal contraction. Possible spillovers will influence the stabilizing effects of fiscal policy at both the union and the member level but also influence the output fiscal multiplier produced in the member who implemented fiscal policy. Also, if spillovers are large, member states have to take into account these cross-border effects for macroeconomic policy coordination. The open economy effects of fiscal policy have been studied extensively since at least the IS/LM model. However, in the case of a monetary union, the sign and the size

of the spillover effects are still unclear. Chapter 3 aims at contributing to the recent literature which investigates this issue.

Fiscal federalism and fiscal transfers in monetary unions. The question of fiscal policy in monetary unions is closely related to the seminal works on optimal currency areas by Mundell (1961) or Mc Kinnon (1963) for instance. In presence of asymmetric shocks, price rigidities and a weak labor mobility, fiscal policy could be the effective tool for stabilizing the macroeconomic activity at the union level and between member states. In reality, fiscal policy has been used extensively to stabilize output and employment but the way fiscal policy is implemented differs greatly among the existing monetary unions. As an example, fiscal policy as a stabilization tool is quite centralized in the United States, with a large central budget and a sophisticated system of transfers between the central government and the member states. On the contrary, fiscal policy is rather decentralized in the Euro Area despite the presence of common rules, namely the Stability and Growth Pact and more recent extensions (the European semester, the "two-packs"). Many economists argue for a deeper fiscal integration for the Eurozone and especially for the implementation of fiscal transfers between member states. Chapter 4 aims at investigating the stabilizing properties of such a fiscal transfers mechanism.

The effects of fiscal policy on the labor market

If one considers that rises in government spending boost economic activity, namely that the output fiscal multiplier is superior to 0, it is likely that government expenditure shocks increase also employment. For instance, Monacelli, Perotti and Trigari (2010), using a SVAR approach with a Choleski decomposition, find that public expenditure shocks boost employment, vacancies and the job finding probability. However, the link between the effects of fiscal expansions on output and on employment seems not be so certain. As pointed out by Ramey (2012): *"[...] most economists and policymakers would agree that job creation is at least as important a goal as stimulating output. In theory, one can use Okun's law to translate GDP multipliers to unemployment multipliers. However, because of variations in the parameters of this "law" over time, the*

advent of jobless recoveries, and the frictions involved in creating and filling jobs, the translation of output multipliers to employment or unemployment multipliers is not straightforward". Ramey (2012) provides empirical evidence of the effects of fiscal policy on employment and unemployment for different identification schemes and different samples. The message is that rises in public expenditure tend to lower unemployment but that the positive effect on employment is more due to more hired workers in the public sector than to more jobs in the private sector. In this paper but also in previous studies, Ramey (2012) argues for a negative effect of fiscal policy on private activity.

If the effects of fiscal policy shocks on employment are unsure, most of studies conclude nevertheless in a positive effect on employment. However, the response of unemployment to fiscal expansions is even less clear. In addition to uncertain effects on employment, a rise in government expenditure tends to cause variations on the labor force participation. Monacelli, Perotti and Trigari (2010) estimate the effects of a government consumption shock with a standard S-VAR approach (a Choleski decomposition) on a large set of labor market variables, especially on hours worked, civilian employment, unemployment, vacancies, the labor force, the real wage or the labor market tightness. The point estimates indicate that the labor force participation does not move significantly. In addition, hours worked, employment and the real wage increase so that the unemployment rate falls by 0.6 percentage points at the peak. Turning to a theoretical exercise, the authors show that a standard neo-classical framework with search and matching frictions on the labor market hardly reproduces these empirical findings, with a lower effect on unemployment. More importantly, the introduction of a complementary in preferences between consumption and labor helps to reproduce the observed dynamic of the labor market following a government expenditure shock.

As said previously, in a standard DSGE model the negative wealth effect induced by fiscal policy rises labor supply. Moreover, if the model produces a rise in real wages, for instance in the presence of nominal rigidities on prices, rule-of-thumb consumers will also increase their labor force participation. Some studies conclude that the unemployment rate could increase since the rise in the labor force participation could prevail over

the rise in employment. For instance, Brückner and Pappa (2012) estimate the effects of government expenditure shocks on output and the labor market for a large set of OECD countries. In most cases, the unemployment rate tends to increase. In a new-Keynesian model with a Mortensen and Pissarides framework, Mayer, Moyen and Stähler (2010) argue that the unemployment can increase following a positive government expenditure shock although hours worked increase.[3] The authors focus also on the parameters which drive the unemployment fiscal multiplier. Coherently, the level of price stickiness increases the job creation, and the debt-based public expenditure expansions trigger the larger unemployment fiscal multiplier. Since the evolution of the marginal rate of substitution between consumption and leisure is central, the degree of risk aversion and of convexity in labor disutility are parameters which drive the response of vacancies and of unemployment.

This thesis aims at contributing to this growing literature by focusing on the effects of fiscal policy on the labor market. As it will be presented later on in more detail, in this thesis I attempt to show that the effects of fiscal policy on the labor market depend on the fiscal instrument used in the case of fiscal expansions. Also, most of papers dealing with spillover effects of fiscal policy or fiscal transfers schemes in monetary union focus on variables such as output, consumption or inflation and thus neglect the labor market. In this thesis I also take into consideration the spillover effects of fiscal policy on the foreign labor market and discuss the ability of fiscal transfers to smooth unemployment differential between member states of a monetary union.

The suitability of the new-Keynesian framework for the study of the fiscal policy.

In this thesis I use essentially DSGE models for investigating the short-run effects of fiscal policy. During the two last decades, the new-Keynesian framework has been used

[3]The explanation is based on the evolution of the marginal utility of consumption of the Ricardian households. The combination of a negative wealth effect (in the case of a tax-financed rise in public expenditure) and of rise in the real interest rate decrease private consumption for the Ricardian households and increase accordingly the their marginal utility of consumption. The households will thus accept easily to work more so that firms can increase production by adjusting upwards at the intensive margin and not by posting more vacancies.

extensively to document different issues related to fiscal policy, such as the response of the private sector to increases in government spending, the size of the fiscal multiplier or yet the effects of fiscal policy during Zero Lower Bound episodes. Adopted by most of central banks and a large strand of the literature on fiscal policy, the DSGE model seems to be very accurate for analyzing such issues.

In this paragraph, I discuss the ability of DSGE models to analyze such issues. Beyond fiscal policy, the new-Keynesian model has been adopted by a large part of the profession. Beside the empirical time series models, the DSGE framework has become the main analysis tool in modern macroeconomics. However, the DGSE models face various criticisms, which have been, for some of them, essentially present since the recent crisis. I briefly list here some of the main criticisms addressed to the DSGE modeling.

In the aftermath of the crisis, many economists pointed out the inability of such models to predict the crisis. More importantly, a DSGE model describes the economy in normal times so that it is irrelevant to describe the episodes of bubbles or large recessions. In the same sense, Stiglitz (2011) argues that the representative agent assumption is irrelevant and engender too simplistic models. Especially, Stiglitz highlights the inability of DSGE models with a representative agent to include satisfactory representations of the financial markets:*"Many used "representative agent models" - all individuals were assumed to be identical, and this meant there could be no meaningful financial markets (who would be lending money to whom?). Information asymmetries, the cornerstone of modern economics, also had no place: they could arise only if individuals suffered from acute schizophrenia, an assumption incompatible with another of the favored assumptions, full rationality"*. It is a fact that pre-crisis DSGE models neglect the modeling and the role of the financial markets. However, and in response to this clear failure, the introduction of more sophisticated financial markets, especially through the presence of information asymmetries and credit constraints, is an active issue in the broad DSGE literature nowadays. Since the great recession is closely related to financial matters, the inability of DSGE models to forecast the recent crisis and the absence of a relevant description of the financial markets in these models are also

related. Recently, one important attempt to respond to this lack can be found in Del Negro, Giannoni and Schorfheide (2015). They show that, combining the Smets-Wouters model with a financial accelerator like in Bernanke, Gertler and Gilchrist (1999), the model (estimated on pre-crisis data) is able to forecast the large decline of output and the mitigated decrease in inflation after 2008. In any case, the DSGE modelers have visibly taken into account that the DSGE models have to be improved in this way.

Stiglitz (2011), among others, states that DSGE models also fail to produce a clear description of the dynamic of the labor market. Especially, most of DSGE models (at least pre-crisis models) assume the absence of unemployment at the general equilibrium. Since the labor market is central in the present thesis, the ability of DSGE models to investigate issues related to the labor market is a crucial element. It is true that benchmark DSGE models propose a poor description of the labor market. However, an important step in the DSGE literature was to introduce the job search and matching framework into a standard RBC or DSGE structure. First attempts to introduce a labor market *à la* Mortensen and Pissarides are not new and can be found for instance in Merz (1995) and Andolfatto (1996)[4]. Nowadays, numerous articles dealing with the short-run fluctuations of the labor market have adopted a Mortensen and Pissarides framework into a DSGE model.[5] Such models have been used for investigating different issues in macroeconomics: the unemployment puzzle[6], the labor wedge and the business cycle, the inflation persistence and so on.

A job search and matching structure can be easily introduced in a DSGE framework, so that it enables to look at the interactions between the labor market and the rest of the economy. Such models have been used recently to investigate the effects of

[4]In Merz (1995), the author discusses the inability of a Walrasian labor market to reproduce most of US labor market stylized facts, like the low volatility of wages, the persistence of employment and unemployment or the fact that the marginal productivity of labor drives the real wage over the business cycle. In the same sense, Andalfatto (1996) shows that introducing a search and matching model in a RBC structure allows to fit better the empirical evidence, for instance the correlation between hours and productivity.

[5]See Trigari (2006) or Gertler, Sala and Trigari (2008) for benchmark DSGE models with a search and matching labor market.

[6]See Shimer (2005) and Pissarides (2009) for important contributions.

fiscal policy shocks on the labor market (for instance the papers quoted previously and other articles mentioned throughout the thesis). Also, some papers focus on the effects of structural reforms on the labor market. For instance Cacciatore, Duval and Fiori (2012) investigate the short-run effects of three different labor market reforms: a relaxation of job protection, reduction in the unemployment benefit replacement rate and a strengthening in activation policy.

Summarize and added value of the thesis

The first part of the thesis aims at investigating the effects of fiscal shocks on the labor market in the case of a closed economy (Chapter 1 and Chapter 2). A second part extends the closed economy framework by considering a monetary union structure (third and fourth chapter). In the case of a decentralized fiscal policy, I investigate the spillover effects of fiscal policy from one member state to the rest of the union. Also, this part studies the stabilizing properties of fiscal transfers schemes implemented between member states.

Chapter 1 is dedicated to disentangle the effects of government consumption and government investment on the labor market and especially on the unemployment rate. I develop a new-Keynesian DSGE model closely following Gali, Smets and Wouters (2012), especially for the introduction of the labor market. This modeling for the labor market introduces a labor force participation decision and enriches the analyses of the dynamic of unemployment. A first main result is that government consumption and investment have very different effects on output and on the labor market. Government investment triggers a higher output fiscal multiplier than government consumption. However, and despite the long-run effects of government investment on output and employment, a rise in public investment triggers lower effects on unemployment. The main contribution is to demonstrate that, if government investment produces positive long-run effects on employment, it also generates a strong rise in the real wage and in the labor force participation in the long-run. Effects on unemployment are therefore only temporary and the unemployment fiscal multiplier is significantly lower than in the case

of an increase in government consumption.

In Chapter 1, I also estimate the respective effects of government consumption and investment on key macroeconomic variables for the Euro Area. To identify fiscal structural shocks, I use the well-known structural vector autoregression approach following the seminal paper by Blanchard and Perotti (2002). Also, for comparison purposes, I impose constraints in the S-VAR by applying a Choleski decomposition. The Choleski decomposition and the Blanchard and Perotti approach provide rather different results. The Choleski decomposition generate responses of unemployment which rather support the results from the theoretical exercise. In the case of a rise in public consumption, results support the neo-classical view: public consumption decreases the real wage and crowds out employment. However, the labor force participation also falls and the unemployment rate decreases. A rise in government investment triggers a comovement of employment, the labor force participation and of the real wage. More interestingly, a rise in public investment, despite a positive effect on total employment, increases slightly unemployment. These results confirm the findings produce by the new-Keynesian model and the estimates in Bermperoglu, Pappa and Vella (2013) since the authors find a higher effect of public investment on output but a lower effect on unemployment. Unfortunately, the impulse response functions with the Blanchard and Perotti approach provides rather different results. With this specification, both expenditure shocks trigger the (positive) comovement of employment, the labor force participation and the real wage and in both cases unemployment falls. However, the unemployment fiscal multiplier is slightly larger in the case of public investment. In contrary to the new-Keynesian model, in the case of government investment impulse response functions do not reveal long-run effects on the labor force participation and on the real wage.

Chapter 2 deals with the size of the fiscal multipliers over the business cycle. Some recent empirical studies[7] argue that the fiscal multipliers strongly depend on the position of the economy over the business cycle. The effects of fiscal policy shocks (expansions

[7]See among others Creel, Heyer and Plane (2011), Auerbach and Gorodnichenko (2012) and Baum, Poplawski-Ribeiro and Weber (2012). Also, Auerbach and Gorodnichenko (2013) demonstrate that spillover effects of fiscal policy are also larger during bad times.

or consolidations) seem to be larger during economic downturn. For now, only few papers investigate the underlying theoretical mechanisms as, for example, Sims and Wolff (2013) and Michaillat (2014). The contribution of Chapter 2 is to suggest a new transmission channel which could explain different values for the multiplier according to the position over the business cycle. More precisely, the output fiscal multiplier during economic downturn is produced thanks to the dynamic of the labor market. A stronger positive response of employment when the steady-state unemployment is high triggers a stronger decrease (or a lower increase) in the real wage so that inflation pressures are lower. The crowding-out effect on private consumption of a public spending shock through a rise in real interest rate is then lower during economic downturn so that the output fiscal multiplier is larger. From a methodological point of view, I use a new-Keynesian model with a search and matching model for the labor market. Especially, the labor market is composed by both a private and a public sector, with a modeling close to Afonso and Gomes (2014) for instance. We introduce the position over the business cycle thanks to two steady state values for the unemployment rate, in the spirit of Michaillat (2014). The main result is that the labor market, and especially the dynamic of the real wage, is crucial to generate higher output fiscal multipliers in a theoretical framework. Moreover, the findings highlighted in this chapter do not conflict with those obtained in the two papers mentioned above: our result is based on the same transmission channel that Michaillat (2014) and is complementary with the one expounded in Sims and Wolff (2013).

Chapter 3 and 4 investigate issues related to fiscal policy in a monetary union. Chapter 3 is dedicated to the analysis of the spillover effects of fiscal policy shocks in one member state on the rest of the union. While most of existing studies consider the spillover effects of a government consumption shock and/or a general government total expenditure shock, Chapter 3 aims at disentangling in a theoretical framework the respective effects of six fiscal instruments: three taxes (VAT, a labor income tax and a social protection tax) and three sorts of expenditure (government consumption, investment and social transfers). I show that the sign and the size of the spillovers depend on the fiscal instrument. The different fiscal tools trigger different effects on

home and foreign inflation so that all fiscal expansions do not generate a rise in the real exchange rate in the home economy. Also, the rise in the nominal interest rate depends on the inflation pressures produced by the fiscal expansion. I consider the case in which the monetary policy is passive. In this case, spillovers tend to increase.

In chapter 4, the case of fiscal transfers between member states is considered. In the case of the Euro Area in which fiscal policy is decentralized, the implementation of fiscal transfers could help to improve the macroeconomic stabilization within this heterogeneous monetary union. First, I introduce the topic with a presentation of issues which have been considered by the academic literature about the effectiveness of fiscal transfers schemes. Then, different transfers schemes are tested according to the use of different fiscal instruments by the recipient economy. I simulate the model with both a demand and a supply negative shock in the home economy. In the case of the demand shock, fiscal transfers used through a rise in public consumption, transfers and a VAT cut are more effective to stabilize output, unemployment and inflation differentials between the two economies than the labor income tax and the social protection tax. However, in the case of a supply shock, the two latter taxes are more effective. First, a negative supply shock triggers a decline in output but a rise in inflation. Funds used *via* transfers to households, VAT and public consumption trigger additional upward pressures on inflation while a labor income tax or a social protection tax cut produce weak pressures on inflation, so that these two taxes stabilize more inflation in the monetary union. Second, in the case of the negative supply shock, even if output falls, unemployment decreases. A VAT cut or a rise in public consumption or transfers to households trigger downward pressures on unemployment so that the volatility of unemployment is increased.

Main lessons

This thesis aims at contributing to the current literature by delivering three main messages. First, in the spirit of Ramey (2012), I attempt to show that one cannot translate output multipliers to unemployment multipliers. In the DSGE models used in this the-

sis, if output and employment are strongly correlated, the dynamic of the labor force participation can trigger responses of unemployment weakly correlated to output.

Second, and as said previously, a body of papers on fiscal policy has been written since the nineties, in parallel with the development of microfounded theoretical frameworks and time series methods. An important part of the literature has attempted to document the *general* short-run effects of fiscal policy. Especially, empirical and theoretical studies has been produced in order to investigate important issues, like the size of the multiplier, the response of key macroeconomic variables to changes in the fiscal stance, the transmission channels of fiscal policy with authors arguing for the predominance of classical or Keynesian effects. To reach a consensus about the short-run effects and transmission channels of fiscal is of first importance. However, in recent years the literature turns to determine which elements drive the short-run effects of fiscal policy.

Beyond the general effects of fiscal policy, it is common wisdom that the size of the fiscal multipliers is greatly affected by many and varied elements. As pointed out by Favero, Giavazzi and Perego (2011), *"The main conclusion of our empirical analysis is that the question "what is the fiscal policy multiplier" is an ill-posed one. There is no unconditional fiscal policy multiplier. The effect of fiscal policy on output is different depending on the different debt dynamics, the different degree of openness and the different fiscal reaction functions across different countries"*. If the authors focus on the aforementioned structural aspects to explain differences on the country-specific fiscal multipliers, this statement can be extended to numerous other structural specifics and elements related to the current economic environment.

Some important examples are the behavior of the monetary policy, the position of the economy over the business, the size or the openness of the economy (among others aspects of an open economy), the speed and the composition of the fiscal adjustment, the dynamic of the debt etc. All these elements induce different output fiscal multiplier and these analysis are of first importance for policymakers since it gives some guidance about how to implement an effective fiscal policy along the business cycle, according to

the structural specifics of the economy and the current economic context. In this sens, a large part of the thesis is devoted to the respective effects on output and on the labor market of different sorts of fiscal instruments. While one large strand of the literature focuses on the effects of either a change in government consumption either a change in exhaustive government expenditure (the sum of public consumption, investment and employment), I participate to the body of papers which demonstrate that a government has a large panoply of levers, and that the different fiscal instruments affect very differently the economy. Forni, Monteforte and Sessa (2009) demonstrated that the different sorts of expenditure and taxes trigger different effects on output, and especially that rises in taxes are less costly than drops in expenditure. In the line with Bermperoglu, Pappa and Vella (2013), I attempt to demonstrate that the different fiscal instruments have various effects on the labor market. Especially, through different effects on employment and the labor force participation, the unemployment fiscal multiplier varies strongly according to the fiscal instrument. This is an important concern since the aim of a government can be to drop unemployment rather than implementing policies that promote GDP growth. Especially, in periods of jobless recoveries, policymakers would prefer fiscal instruments which are more effective in terms of job creations and not especially the expenditure and taxes with the larger output multipliers. Moreover, as detailed previously I conduct a similar analysis but focusing on the spillover effects and on the case of a fiscal transfers scheme. A standard new-Keynesian model reveals that the sign and the size of the spillovers very depend on the fiscal instrument. Economists often argue for more fiscal policy coordination in the Eurozone. During episodes of recovery plans, governments should coordinate by using expenditure and tax cuts which produce the largest aggregate effects and positive fiscal spillovers in the rest of the union.

Finally, the position of the economy over the business cycle seems to be one important determinant of the size of the fiscal multiplier. This point has been central in the debates around the adoption of austerity plans in the Eurozone. After recommending strong fiscal consolidations for some Eurozone members, IMF admitted that the size of the multiplier could have been underestimated, explaining forecast errors of GDP growth for economies in which the most severe fiscal contractions have been

implemented.[8] The fact that the fiscal multipliers have been unusually large is a crucial argument for the economists who criticized the effects of austerity plans: a large cost on GDP and on governments general revenues so that these fiscal consolidations have had only limited effects on deficit and debt levels.

[8]Beyond the public statements of Olivier Blanchard, chief economist at the IMF and of Christine Lagarde, managing director of the IMF, Blanchard and Leigh (2013) provide empirical evidence of forecast errors of GDP growth, errors that can be explained by an underestimation of the output fiscal multiplier in the recent years according to the author.

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Chapter 1

Assessing the effects of public expenditure shocks on the labor market

1.1 Introduction

A very extensive literature has grown up since the late nineties and deals with the effects of fiscal policy in the short run. Firstly, in the new-Keynesian paradigm, interesting questions have been investigated with the help of the well known DSGE models such as the size of the fiscal multiplier, the response of private consumption to a public expenditure shock,[1] or the effectiveness of fiscal policy during zero lower bound episodes.[2] Secondly, numerous empirical studies attempt to measure the effects of fiscal policy, with a large debate on the best way to identify fiscal shocks. Surprisingly, no real consensus arises due to methodological discrepancies, notably concerning the response of private consumption to public spending shocks.

Especially, with the recent crisis, the strong rise in unemployment and the implementation of austerity plans in most developed countries, issues concerning the effects of fiscal policy on the labor market particularly matter and are receiving new attention from economists.

Euro Area countries currently face very high rates of unemployment. It is com-

[1] See Coenen and Straub (2005) or Gali, Lopez-Salido and Valles (2007) among others.
[2] See Hall (2009) for a recent contribution.

plicated to know exactly to what extent current fiscal contractions contribute to this sharp degradation of the unemployment rate. Investigating this issue requires a precise knowledge as to the effects of fiscal policy on the labor market.

A large body of papers investigate the effects of fiscal policy shocks on key labor market variables. If some discrepancies exist within the literature, most of studies argue for a comovement of employment, labor force participation and real wage. Existing studies face difficulties to provide a unified answer about the response of the unemployment rate to fiscal policy shocks. While some papers argue for a decrease in unemployment following a positive fiscal policy shock, other papers find surprisingly a rise in unemployment. Before going further in the description of the recent literature, this is important to notice one crucial element that could explain a rise in unemployment following a rise in public expenditure. Even in the presence of some crowding-out effects of fiscal policy on private activity, a positive fiscal policy shock tends to rise employment. However, some recent papers argue for a rise in labor force participation and the real wage. Thus, the total effect on unemployment depends on the relative strength of the response of employment and labor supply and some papers, cited in what follows, argue for a larger positive response of the labor force participation so that unemployment increases.

Mayer, Moyen and Stähler (2010) develop a large-scale DSGE model with a search and matching model for the labor market and investigate what parameters of the model drive the response of the unemployment rate to a public spending shock. In all cases, their model predicts a rise in unemployment following an increase in public consumption. Moreover, the response of the unemployment rate is mainly driven by several elements. Among them, the degree of price stickiness, the degree of wage stickiness, the introduction of non-Ricardian households and the financing of public spending (debt or taxes). A positive response of unemployment following fiscal expansions would be confirmed in some empirical studies and notably in Brückner and Pappa (2010-2012). Using the Blanchard-Perotti SVAR approach for a panel of OECD countries, the authors find a significant increase in employment, the labor force participation and the unemployment rate. Then, in a new-Keynesian approach with matching frictions, the

authors argue that a positive response of the unemployment rate can be generated in a DSGE model by introducing a labor force participation decision and heterogeneity in the pool of workers (new vs. old job seekers).

However, some other papers find significantly different results and conclude for a rather strong decrease in unemployment following a rise in government expenditure. Monacelli, Perotti and Trigari (2010) explore both empirically and theoretically the response of the labor market to public spending expansions. The authors use a Choleski decomposition to identify the fiscal exogenous innovations for the US economy. The empirical findings indicate a large decrease in the unemployment rate with a peak at -0.6%.[3] However, developing a new-Keynesian model with matching frictions, authors argue that the model hardly reproduces this fact, suggesting a lower unemployment fiscal multiplier, around -0.2%.

Ramey (2012) points out that economists have to take into account the way the government intervenes in the economy: *"[...] an increase in government spending raises total employment. However, the extent to which government spending raises private employment depends on whether the increase in G is due more to an increase in purchases of private sector output or more to an increase in government output and employment. We would expect private sector employment to raise in the first case but to fall in the seconde case"*.

This is likely that changes on the different expenditure components and taxes trigger different effects on key macroeconomic variables. Forni, Monteforte and Sessa (2009), for instance, show that the effects of fiscal policy on output and employment depend on the fiscal instrument used by the government. Bermperoglu, Pappa and Vella (2013) estimate the effects of spending-based austerity measures and especially the effects of a decrease in government consumption and investment on unemployment. One important result is that, despite that a drop in government investment triggers a larger decline of output than public consumption, government investment affects less unemployment

[3] Ravn and Simonelli (2008) find rather similar results.

and real wage.

In this chapter, I introduce one non-productive spending (public consumption) and one productive public expenditure (public investment). The aim is to disentangle the respective effects of public consumption and public investment on the labor market. As said previously, Bermperoglu, Pappa and Vella (2013) estimated the effects of different fiscal shocks on the labor market thanks to a SVAR model. The contribution of this chapter is to investigate theoretically the respective transmission channels of public consumption and public investment. The methodology used in this paper is twofold. First, I use a new-Keynesian model very close to Gali, Smets and Wouters (2012), except for the fiscal side, more developed here. This model is relevant for these purposes since it introduces in a simple way a labor force participation decision and unemployment as an observable variable. The model is calibrated for the Euro Area, using the posterior means from Smets, Warne and Wouters (2013) who estimate the Gali-Smets-Wouters (2012) model for the Euro Area.

I simulate the model with both public expenditure in turn and assume that the VAT and a labor income tax respond to the degradation of deficit. In the case of a rise in (non-productive) government consumption, I observe a clear raise in employment, labor supply and real wages. Also, the unemployment rate falls, in the line with Monacelli, Perotti and Trigari (2010), with a peak at -0.51%.

Similarly to the empirical findings in Bermperoglu, Pappa and Vella (2013), I find for a rise in government investment a stronger effect on output but a lower unemployment fiscal multiplier than with a rise in government consumption. The main transmission channel at work is that, despite a strong and long-lasting effect on employment, a sharp increase in the real wage triggers a rise in the labor force participation in the long-run. I find an unemployment fiscal multiplier equals to -0.14 after ten quarters and equals to -0.25 in the long-run (ten years).

The raise in the VAT and in the labor income tax following the expansion in expen-

diture affects greatly the multipliers. the VAT raises the positive response of labor force participation *via* the existence of a wealth effect of consumption on the labor supply decision. Thus, the VAT tends to diminish the unemployment fiscal multiplier. A raise in the labor income tax decreases the marginal utility for work, thus drops the labor force participation. The unemployment fiscal multipliers are then amplified by the response of the labor income tax to the increase in deficit.

Second, in an empirical section I estimate for the Euro Area the effects of both public expenditure on a large set of macroeconomic variables with a structural vector autoregression model. I identify fiscal structural innovations with both a Choleski decomposition and the Blanchard-Perotti (2002) approach. In the case of the Choleski decomposition, a rise in government consumption triggers a slight increase in unemployment. Especially, both employment and the labor force participation increase but the final response of unemployment is slightly positive. A rise in government consumption produces an insignificant (slightly negative) response of employment and the labor force participation falls.

With the Blanchard-Perotti (2002) identification scheme, a rise in both expenditure produces a comovement of employment, labor force participation and real wage. Also, in both cases the unemployment rate falls. However, and in opposition with the theoretical exercise, a rise in government investment triggers a stronger fall in unemployment than government consumption. Also, impulse response functions indicate that the real wage and the labor force participation do not response more strongly in the case of government investment.

Section 1.2 presents the complete derivation of the model. Section 1.3 presents the results of the theoretical exercise. Section 1.4 describes the empirical approach and the obtained results. Finally, section 1.5 concludes this chapter.

1.2 The DSGE model

In order to investigate the effects of public consumption and investment shocks on the labor market, the model describes a closed economy with both fiscal and monetary authorities. The model described in this chapter is a medium-scale DSGE model with a detailed fiscal sector. The model is similar to Gali, Smets and Wouters (2012) except the fiscal side. In Gali, Smets and Wouters (2012), the authors add to the Smets and Wouters (2007) model the unemployment theory developed in Gali (2011). For the labor market, the unemployment rate is observable, a labor force participation decision is introduced quite simply and the nominal wage inflation is linked to the fluctuations of the unemployment rate.

1.2.1 Optimizing households

There is a continuum of Ricardian households on the interval $[0, 1[$ maximizing their preferences given the following lifetime utility function for the household i:

$$E_0 \sum_{t=0}^{\infty} \beta^t U_t(\tilde{C}_t(i), L_t(i)) = E_0 \sum_{t=0}^{\infty} \beta^t \left(log\tilde{C}_t(i) - \frac{\Delta_t(i) N_t(i)^{1+\phi}}{1+\phi} \right) \tag{1.1}$$

The households earn utility from consumption $\tilde{C}_t(i)$ and disutility of labor $N_t(i)$. $\tilde{C}_t(i)$ contains habit formations for consumption such as: $\tilde{C}_t(i) = C_t(i) - hC_{t-1}$ with C_{t-1} the aggregate (average) past consumption.β^t is the discount factor and ϕ denotes the labor elasticity of substitution.

For simplicity purposes, I can delete the subscript i for the next equations representing the problem as that of a representative agent. Aggregate employment is defined as $N_t = \int_0^1 N_t(i)\,\mathrm{d}i$ and with the assumption that there is a perfect risk-sharing for consumption between all the households in the spirit of Merz (1995). The optimization program for the representative household can be expressed as:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t (log\tilde{C}_t - \frac{\Delta_t N_t^{1+\phi}}{1+\phi}) \tag{1.2}$$

Δ_t introduces the wealth effect of consumption on disutility of work. Δ_t is function of households consumption, such as:

$$\Delta_t = Z_t/\tilde{C}_t \tag{1.3}$$

with $Z_t = Z_{t-1}^{1-\nu}(C_t - hC_{t-1})^{\nu}$. Z_t can be seen as a smoothed consumption index. If consumption hikes above its steady-state value, the marginal utility of labor decreases and the disutility of work increases. In the polar case where $\nu = 1$, the wealth effect is strong and the preferences are similar to the King-Plosser-Rebelo (1988) preferences In the other polar case, that is with $\nu = 0$, there is no wealth effect, thus consumption and labor are perfectly additively separable as in the Greenwood-Hercowitch-Huffman (1988) preferences. The size of the parameter ν thus defines the strength of the wealth effect on labor supply.

The representative household faces the following budget constraint:

$$(1+\tau_t^c)P_tC_t + P_tI_t + \frac{E_tB_{t+1}}{1+R_t} \leq (1-\tau_t^w)W_tN_t + B_t + R_t^kK_{t-1} + Div_t \tag{1.4}$$

P_t is the general level of prices, R_t the quarterly nominal interest rate, W_t is the nominal wage and B_t is the government bonds held by the households. They also invest in capital, I_t representing the level of investment and K_t the accumulated capital. They loan this capital to the firms at the rate R_t^k. Div_t is the profit of firms redistributed to the households.

The law of motion for private capital is described by:

$$K_t = (1-\delta)K_{t-1} + \left[1 - S(\frac{I_t}{I_{t-1}})\right] I_t \tag{1.5}$$

with $S(\frac{I_t}{I_{t-1}}) = \frac{\psi}{2}\left(\frac{I_t}{I_{t-1}}\right)^2$ a cost function related to changes in investment decisions with ψ a fixed cost, in line with Christiano, Eichenbaum and Evans (2005), and where δ defines private capital depreciation.

Maximizing (1.2) subjects to (1.4) and (1.5) yields the following FOCs respectively for C_t, B_t, I_t and K_t:

$$\lambda_t = \frac{U'_{C,t}}{P_t(1+\tau_t^c)} \tag{1.6}$$

$$\lambda_t = \lambda_{t-1}(1+R_t) \tag{1.7}$$

$$\lambda_t P_t = \Omega_t \epsilon_t^i \left(1 - S\left(\frac{I_t}{I_{t-1}}\right) - S'\left(\frac{I_t}{I_{t-1}}\right)\left(\frac{I_t}{I_{t-1}}\right)\right) + E_t \Omega_{t+1} \left(1 - S'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right) \tag{1.8}$$

$$\Omega_t = R_t^K \beta E_t[\lambda_{t+1} + \Omega_{t+1}(1-\delta)] \tag{1.9}$$

where λ_t and Ω_t are respectively the Lagrangian multipliers associated with the budget constraint and with the capital accumulation equation.

Including (1.6) in (1.7) gives the following consumption Euler equation:

$$\frac{U'_{c,t}}{U'_{c,t+1}} = \frac{1+R_t}{\Pi_{t+1}} \frac{1+\tau_t^c}{1+\tau_{t+1}^c} \tag{1.10}$$

where $\Pi_{t+1} = \frac{P_{t+1}}{P_t}$ represents the consumer price index inflation.

1.2.2 Labor force participation and wage-setting

The labor market and especially the introduction of the unemployment rate and of the labor force participation decision follow closely Gali, Smets and Wouters (2012).

Labor force participation decision. Following Gali, Smets and Wouters (2012), I assume that a worker i will accept to participate in the labor market if his utility for labor revenue is higher than his disutility of work, such as:

$$\left(\frac{1}{C_t(i) - hC_{t-1}(i)}\right)(1-\tau_t^w)\left(\frac{W_t(i)}{P_t}\right) \geq \Delta_t(i)(L_t(i))^\phi \tag{1.11}$$

with $L_t(i)$ the labor force participation decision of a worker (i).

Re-expressing equation (1.11) and saturing the condition, the (aggregate) labor force participation is defined by:

$$\frac{(1-\tau_t^w)W_t}{P_t} = Z_t(L_t)^{\phi} \tag{1.12}$$

The participation condition (1.12) triggers a labor force participation function of the net-of-tax real wage, the inverse of the Frisch elasticity of substitution of labor supply and of the wealth effect included through the variable Z_t.

Unemployment. Once we have defined the aggregate labor force participation, unemployment noted U_t^i is simply defined as:

$$U_t^i = L_t^i - N_t^i \tag{1.13}$$

Wage-setting. In a Calvo-style sticky wage model, workers can only reoptimize their nominal wage in each period with a probability $(1-\theta^w)$, regardless the number of periods since they last reoptimized. In this model, when a worker cannot reoptimize his nominal wage, there is a partial indexation of the nominal wage on past inflation, the degree of indexation being defined by the parameter γ^w. Wage in the period k of a worker who has not reoptimized his wage since the period t is of the form $W_{t+k/t}(i) = W_{t+k-1/t}(i)(\Pi_{t-1})^{\gamma^w}(\Pi)^{1-\gamma^w}$ with Π inflation at the steady-state. Since we assume a zero inflation steady-state such as $\Pi^p = 1$, nominal wages are only indexed on past inflation.

The individual worker faces the following sequence of isolelastic demand schedules:

$$N_{t+k/t}(i) = \left(\frac{W_{t+k/t}(i)}{W_{t+k}}\right)^{-\epsilon^w} N_{t+k} \tag{1.14}$$

The first order condition associated to the optimizing process is expressed as:[4]

$$\sum_{k=0}^{\infty}(\beta\theta_w)^k E_t\left[\left(\frac{N_{t+k/t}}{C_{t+k}}\right)\left(\frac{W^*_{t+k/t}}{P_{t+k}}-\frac{\epsilon^w}{\epsilon^w-1}MRS_{t+k/t}\right)\right]=0 \tag{1.15}$$

with W_t^* the optimal nominal wage, $MRS_t=-\frac{U_{N,t}}{U_{C,t}}$ the marginal rate of substitution between consumption and labor and where $\frac{\epsilon^w}{\epsilon^w-1}$ corresponds to the (constant) wage mark-up desired by the workers.

The wage inflation dynamic is based on fluctuation of the effective mark-up in relation to the natural mark-up $\frac{\epsilon^w}{\epsilon^w-1}$. In this case, the effective markup noted MU_t is expressed as:

$$MU_t=\frac{W_t}{P_t}-MRS_t \tag{1.16}$$

The marginal rate of substitution between consumption and labor MRS_t can be re-expressed as:

$$MRS_t=-\frac{U^i_{N,t}}{U^i_{C,t}}=Z_tN_t^{\phi} \tag{1.17}$$

After some algebra, one obtains:

$$MU_t=\frac{W_t}{P_t}-MRS_t=\phi U_t \tag{1.18}$$

Thus nominal wages are driven by the unemployment rate. This modeling can be seen as a microfoundation of the original Phillips curve, *i.e.* the link between nominal wages and unemployment.

The last step is to introduce the condition (1.15) in the following law of motion of the aggregate nominal wage that takes into account for the automatic indexation of the nominal wage on past inflation, that is:

$$W_t=[\theta_w(W_{t-1}(\Pi_{t-1})^{\gamma_w})^{1-\epsilon^w}+(1-\theta_w)(W_t^*)^{1-\epsilon^w}]^{\frac{1}{1-\epsilon^w}} \tag{1.19}$$

[4] A total derivation of this step can be found in Erceg, Henderson and Levin (2000).

1.2.3 Firms

Final goods firms

In this two-sector model, the final goods firms package the intermediate goods (j) produced in a final homogeneous commodity Y_t sold to the households and to the government. If intermediary firms evolve in a monopolistic environment, the final packagers are in a perfectly competitive environment.

For simplicity purposes, I do not include an exogenous shock on the aggregate function as is done in Smets and Wouters (2007) for instance. The firms seek to maximize their profit such as:

$$\max_{Y_t(j),Y_t} P_t Y_t - \int_0^1 P_t(j) Y_t(j)\,\mathrm{d}i \tag{1.20}$$

$$s.t. \left[\int_0^1 G\left(\frac{Y_t(j)}{Y_t}\right)\,\mathrm{d}i\right] = 1 \tag{1.21}$$

where G is a function characterizing the demand for the different goods i. In the spirit of Kimball (1995), I assume that G is increasing and strictly concave. Combining the two first-order conditions, the demand for an intermediary commodity i is:

$$Y_t(j) = Y_t G'^{-1}\left[\frac{P_t(j)}{P_t}\int_0^1 G'\left(\frac{Y_t(j)}{Y_t}\right)\frac{Y_t(j)}{Y_t}\,,di\right] \tag{1.22}$$

Thus, the demand for an input (j) is negatively function of its relative price $\frac{P_t(j)}{P_t}$.

The intermediary sector

A continuum of j differentiated intermediate firms over [0,1[produce goods in a monopolistic competition and thus are allowed to set their price in a Calvo-style price setting. Their production technology is a standard Cobb-Douglas function to which is added the public capital. The final firm then purchases a basket of the intermediate goods and retails a package of the goods at the consumers.

The technological process of the productive firms is defined by the following Cobb-

Douglas function:

$$Y_t(j) = K_{t-1}^{\alpha}(j) N_t^{1-\alpha-\alpha_g}(j)(K_{t-1}^{g}(j))^{\alpha_g} \tag{1.23}$$

As said previously in the chapter, public capital enters the production function assuming that this government investment is productivity-enhancing for the private sector. The parameter α^g defines the elasticity of output to public capital. Public capital has a demand effect (see the market clearing condition in which public investment appears) and also a supply effect by affecting the level of production of the intermediary firms. However, in a Cobb-Douglas production function, inputs are imperfectly substitutable. Thus, a raise in public capital triggers a decline in demand for private capital and labor. This channel is of first importance in the following analysis to explain the response of the labor market to a raise in public investment.

The profit of the firm is expressed as:

$$\Pi_t^f(j) = P_t(j)Y_t(j) - W_t N_t(j) - R_t^k K_{t-1}(j) \tag{1.24}$$

Maximization of (1.24) subject to (1.23) gives the following FOCs for capital and labor, such as for a representative firm:

$$\frac{\partial \Pi_t^f}{\partial N_t} = 0 \Leftrightarrow (1-\alpha) K_{t-1}^{\alpha} N_t^{-\alpha} (K_{t-1}^{g})^{\alpha_g} = \frac{W_t}{P_t} \nabla_t \tag{1.25}$$

$$\frac{\partial \Pi_t^f}{\partial K_t} = 0 \Leftrightarrow \alpha K_{t-1}^{\alpha-1} N_t^{1-\alpha} (K_{t-1}^{g})^{\alpha_g} = R_t^k \nabla_t \tag{1.26}$$

where ∇_t is the Lagrangian multiplier associated with the technological constraint (1.23). With equations (1.25) and (1.26) is determined the demand for inputs such as:

$$K_{t-1} = \frac{W_t}{P_t} \frac{N_t}{R_t^k} \tag{1.27}$$

By using and rearranging the two previous FOCs, the marginal cost for the firms can be expressed as:

$$MC_t = \frac{(R_t^k)^{\alpha} \left(\frac{W_t}{P_t}\right)^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}(K_{t-1}^g)^{\alpha_g}} \tag{1.28}$$

Price setting

Each firm seeks to maximize its future flow of profits by setting its optimal price $P_t^*(j)$. Under a Calvo price setting, there is only a fraction $(1-\theta^p)$ that can reoptimize their price at each period. Similarly to the wage-setting, I assume that in the absence of reoptimization, there is a partial indexation of prices on past aggregate inflation with a degree of indexation γ^p. In Smets and Wouters (2007), the authors assume that there is also an indexation on long term inflation at a degree $1-\gamma^p$. For simplicity purposes, I assume that the steady-state is non-inflationary so that I neglect this term in the following price-setting mechanism. The optimization problem for a firm j is:

$$\max_{P_t^*(j)} E_t \sum_{k=0}^{\infty} \theta^p \frac{\beta^k \lambda_{t+k} P_t}{\lambda_t P_{t+k}} [P_t^*(j)(\Pi_{l=1}^k \Pi_{t+l-1}^{\gamma^p}) - MC_{t+k}] Y_{t+k}(j) \tag{1.29}$$

subject to the demand function of the final firms for the individual commodity j function of the level of the aggregate demand and of the real price for the commodity j:

$$Y_{t+k}(j) = Y_{t+k} F'^{-1} \left(\frac{P_t(j) X_{t,k}}{P_{t+k}} \int_0^1 G' \left(\frac{Y_t(j)}{Y_t} \right) \frac{Y_t(j)}{Y_t} \, \mathrm{d}j \right) \tag{1.30}$$

where $X_{t,k}$ denotes the automatic indexation on past inflation. Since the indexation only begins at the second period, $X_{t,k} = 1$ for $k = 0$ and $X_{t,k} = \Pi_{l=1}^k \pi_{t+l-1}^{\gamma^p}$ for all the following periods.

Maximization of (1.29) subject to (1.30) yields the following first-order condition:

$$E_t \sum_{k=0}^{\infty} \theta^p \frac{\beta^k \lambda_{t+k} P_t}{\lambda_t P_{t+k}} Y_{t+k}(j) \left[X_{t,k} P_t^*(j) + (P_t^*(j) X_{t,k} - MC_{t+k}) \frac{G'(F_{t+k})}{G'^{-1}(H_{t+k}) G''(F_{t+k})} \right] = 0 \tag{1.31}$$

with $F_t = G'^{-1}(H_t)$ and $H_t = \frac{P_t(j)}{P_t} \int_0^1 G'\left(\frac{Y_t(j)}{Y_t}\right) \frac{Y_t(j)}{Y_t} \, \mathrm{d}j$.

Finally, the law of motion of the general level of prices, P_t, is defined as:

$$P_t = (1-\theta^p) P_t(j) G'^{-1}\left[\frac{P_t(j) \int_0^1 G'\left(\frac{Y_t(j)}{Y_t}\right) \frac{Y_t(j)}{Y_t} \, \mathrm{d}j}{P_t}\right] + \theta^p \Pi_{t-1}^{\gamma^p} P_{t-1} G'^{-1}\left[\frac{\Pi_{t-1}^{\gamma^p} P_{t-1} \int_0^1 G'\left(\frac{Y_t(j)}{Y_t}\right) \frac{Y_t(j)}{Y_t} \, \mathrm{d}j}{P_t}\right] \quad (1.32)$$

1.2.4 Market clearing condition

The aggregate demand for goods is defined such as:

$$Y_t = C_t + I_t + C_t^g + I_t^g \quad (1.33)$$

with C_t^g and I_t^g public consumption and public investment.

1.2.5 Economic policies

The monetary policy is introduced in the usual manner, namely a Taylor rule. The nominal interest R_t reacts to the variations of output and to the price inflation, such as:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\Phi^r} \left(\frac{Y_t}{\bar{Y}}\right)^{\Phi^y} \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\Phi^\pi} \quad (1.34)$$

where Φ^r is a degree of inertia of the nominal interest rate. Φ^y and Φ^π define respectively the weight given in the Taylor rule for the stabilization of output and of inflation. A constant $\bar{X}$ defines the steady-state value of the variable X_t.

As previously said, the fiscal spending is composed of public consumption and public investment, respectively defined by C_t^g and I_t^g.

Each spending is introduced as an AR(1) shock, such as:

$$\frac{C_t^g}{\bar{C^g}} = \left(\frac{C_{t-1}^g}{\bar{C^g}}\right)^{\rho^{c,g}} + \exp(\xi^{Cg}) \tag{1.35}$$

$$\frac{I_t^g}{\bar{I^g}} = \left(\frac{I_{t-1}^g}{\bar{I^g}}\right)^{\rho^{i,g}} + \exp(\xi^{Ig}) \tag{1.36}$$

where $\rho^{c,g}$ and $\rho^{i,g}$ are the parameters defining the duration of the exogenous shocks.

The budget constraint in nominal terms for the government is expressed as:

$$P_t C_t^g + P_t I_t^g = P_t \tau_t^c C_t + \tau_t^w W_t + P_t D_t \tag{1.37}$$

with D_t the deficit of the government. The accumulation of debt is predetermined such as:

$$B_t = (1 + R_t)B_{t-1} + D_t \tag{1.38}$$

I assume that VAT and the labor income tax respond to the dynamic of deficit, such as:

$$\frac{\tau_t^c}{\bar{\tau^c}} = \left(\frac{\tau_{t-1}^c}{\bar{\tau^c}}\right)^{\rho^{\tau,c}} \left(\frac{D_t}{\bar{D}}\right)^{\alpha^{\tau,c}} + \exp(\xi^{\tau^c}) \tag{1.39}$$

$$\frac{\tau_t^w}{\bar{\tau^w}} = \left(\frac{\tau_{t-1}^w}{\bar{\tau^w}}\right)^{\rho^{\tau,w}} \left(\frac{D_t}{\bar{D}}\right)^{\alpha^{\tau,w}} + \exp(\xi^{\tau^w}) \tag{1.40}$$

with $\rho^{\tau,c}, \rho^{\tau,w}, \alpha^{\tau,c}, \alpha^{\tau,w} \in [0; 1]$. The introduction of such rules is relevant theoretically to mimic the real behavior of a government. It is also relevant to introduce a degree of inertia in the tax-rules, defined by the parameters $\rho^{\tau,c}$ and $\rho^{\tau,w}$ since tax rates can not change dramatically in a few quarters.

For public investment, the law of motion of the public capital accumulation is similar to the capital accumulation of private capital. For simplicity purposes, I assume that the depreciation rates of capital are identical across sectors.

$$K_t^g = (1 - \delta)K_{t-1}^g + \left[1 - S\left(\frac{I_t^g}{I_{t-1}^g}\right)\right] I_{t-k}^g \tag{1.41}$$

Following recent contributions on the effects of public investment on economic activity, like Leeper, Walker and Yang (2010) or Bouakez, Guillard and Roulleau-Pasdeloup (2014), I introduce a "time-to-build" delay for the formation of public capital, associated with the completion of public investment projects (building highways and bridges may take up to 10 years). This assumption has a significant effect on the results obtained when one simulates the model with a public investment shock. For the first ten quarters (a bit less due to expectations), a raise in public investment will trigger only demand effects, similarly to a public consumption shock. Then, when public capital is effective, it impacts the supply side of the economy including a negative impact on marginal cost and prices.

1.3 Effects of public expenditure shocks

1.3.1 Calibration of the model

The model is calibrated for the Euro Area following Smets, Warne and Wouters (2013) who estimate a similar model for the Euro Area. All parameters values are given in Table (1.1). In comparison with the estimation of the model for the US in Gali, Smets and Wouters (2012), some significant differences exist between the US and the Euro Area. For instance, according to the estimations the Euro Area faces a larger price and wage rigidity than the US (respectively the parameters θ_p and θ_w) and a greater share of capital α in the production function.

For comparison purposes, the public expenditure shocks have the same duration with $\rho^{c,g} = \rho^{c,g} = 0.6$. For the parameters included in the tax rules, I follow Forni, Monteforte and Sessa (2009) who estimate a DSGE model for the Euro Area with tax rules close to those introduced in this chapter.[5] I set $\rho^{\tau,c} = 0.96$ and $\rho^{\tau,w} = 0.91$. For the parameters which determine the response of taxes to the government deficit, I set $\alpha^{\tau,c} = 0.25$ and $\alpha^{\tau,w} = 0.25$.

[5]Forni, Monteforte and Sessa (2009) estimate tax rules in which the tax rates respond to debt and not to deficit. However, I use same values for the AR(1) coefficients and set close values for the response of taxes to the deficit

There is little guidance about the value of the parameter α^g which captures the productivity effects of public capital. Leeper, Walker and Yang (2010) discuss this issue and point out that available micro and macro estimates do not reach a conclusion. However in new-Keynesian models a value of $\alpha^g = 0.05$ is often used. This value for the elasticity of output to public capital is sufficiently large to produce a significant rise in productivity of inputs and long-term effects of government investment on output and employment. Also, the depreciation rate of capital is assumed to be the same in both sectors even if the depreciation rate could be slightly different between sectors.

In what follows, the model is firstly simulated with both public expenditure shocks in turn. As said previously, VAT and the labor income tax respond to the degradation of the deficit. Parameters in the simple rules of both taxes are calibrated such as the deficit is half its value without rises in taxes. Then, in order to discuss the importance of the financing following the expenditure shocks, the model is simulated with a positive exogenous shock for each tax in turn.

Parameter	Value	Definition
Households preferences		
h	0.65	Habit formation
ϕ	4,65	Frish elasticity of substitution
ν	0.1	Degree of wealth effect on labor supply
β	0.995	Discount factor
Price and wage setting		
θ_p	0.5	Price rigidity
γ_p	0.5	Indexation of prices on past inflation
θ_w	0.5	Wage rigidity
γ_w	0.16	Indexation of wages on past inflation
Investment and capital		
ψ	6	Constant investment cost
δ	0.025	Depreciation of private and public capital
α	0.18	Share of capital in the production function
Monetary and Fiscal policy		
Φ^y	0.19	Output elasticity of the Taylor rule
Φ^π	1.25	Inflation elasticity of the Taylor rule
Φ^r	0.9	Degree of smoothing of the Taylor rule
$\rho^{c,g}$	0.6	Duration of the public consumption shock
$\rho^{i,g}$	0.6	Duration of the public investment shock
$\rho^{\tau,c}$	0.96	AR(1) parameter of the VAT rule
$\rho^{\tau,w}$	0.91	AR(1) parameter of the labor income tax rule
$\alpha^{\tau,c}$	0.25	Response of VAT to government deficit
$\alpha^{\tau,w}$	0.25	Response of labor income tax to government deficit
α^g	0.05	Elasticity of output to public capital

Table 1.1: Model calibration

1.3.2 A rise in public consumption

The cumulative multipliers on Table (1.2) are computed following Mountford and Uhlig (2009). For instance, the cumulative multiplier after k quarters for output following a government consumption shock is equal to:

$$\frac{\sum_{i=1}^{k}\left(\prod_{i=1}^{k}(R_{t+i-1})^{-1}\right)\Delta Y_{t+i-1}}{\sum_{i=1}^{k}\left(\prod_{i=1}^{k}(R_{t+i-1})^{-1}\right)\Delta C^{g}_{t+i-1}} \tag{1.42}$$

	Output	Unemployment
5 periods	0.6	-0.51
10 periods	0.44	-0.36
20 periods	0.43	-0.38
40 periods	0.4	-0.38

Table 1.2: Cumulative output and unemployment multipliers for a 1% of GDP increase in public consumption

The short-run (5 periods) output multiplier is equal to 0.6 and the unemployment multiplier to $-0,51$, as shown in Table (1.2). This value for the unemployment multiplier is in line with the empirical findings found in Monacelli, Perotti and Trigari (2010) or Ravn and Simonelli (2008). Figure (1.1) displays the impulse response functions following a 1% of GDP increase in government consumption. Basically, the rise in demand through government spending rises employment thanks to the presence of nominal rigidities on prices. The negative wealth effect and the rise in the real interest rate triggers a decrease in consumption and an increase in labor supply. In addition, the positive effect on employment produces a rise in the real wage in the short run, which puts an upward pressure on labor supply. The rise in labor supply is however limited so that the unemployment rate decreases significantly. As said in introduction, other studies[6] argue for a positive response of the unemployment rate following a government expenditure shock. In the model this is hardly feasible to generate a positive response of unemployment.

[6]Mayer, Moyen and Stähler (2010) in a new-Keynesian model with matching frictions and Brückner and Pappa (2010) among others.

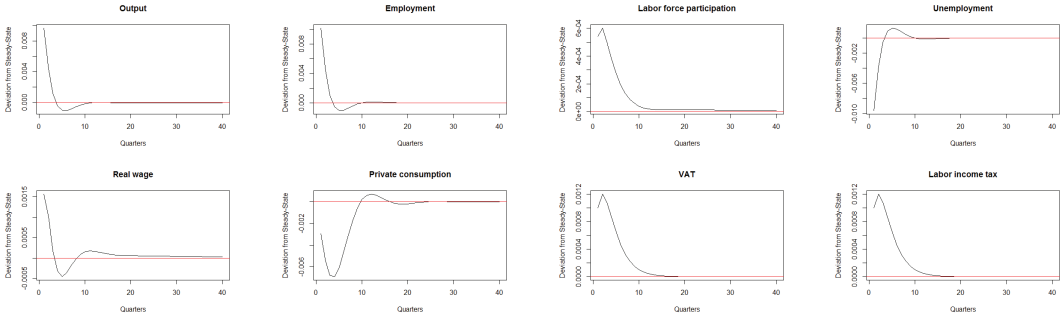

Figure 1.1: Effects of an increase in public consumption (corresponding to 1% of GDP)

The response of unemployment and the value of the related multiplier are obviously function of the calibration. However, alternative calibrations have been tested and even if increasing the Frisch elasticity of substitution of labor supply, the wealth effect of consumption on labor supply or decreasing the level of price rigidities, the response of the unemployment rate remains negative although weaker[7].

1.3.3 A rise in government investment

Since is introduced an implementation delay for building public capital (10 periods), the effects of government investment for the first periods are similar to those of a government consumption shock. Output and employment increase despite a crowding out effect on private consumption and investment. The negative wealth effect and the slight increase in the real wage trigger a higher labor force participation in the short run.

The progressive accumulation of public capital triggers two additional effects on output as highlighted already in Straub and Tchakarov (2007) or Leeper, Walker and Yang (2010). First, the accumulation of public capital increases production and the marginal of product of labor and private capital. With a sufficient value for the elasticity of production to public capital, this rise in productivity triggers a long-run positive effect on output and employment. Secondly, public capital enters negatively in the marginal cost function so that it triggers a drop in prices (or at least, a lower rise in prices with

[7]I do not report impulse response functions for these alternative calibrations. However, they can be sent upon request.

lower values for α^g). Then, the real interest rate decreases which generates a rise in private consumption.

	Output	Unemployment
5 periods	0.23	-0.13
10 periods	0.08	-0.14
20 periods	4.94	-0.11
40 periods	10.95	-0.25

Table 1.3: Cumulative output and unemployment multipliers for a 1% of GDP increase in public investment

However, and as shown in Figure (1.2), employment decreases just after the beginning of the public capital accumulation and for only few periods. This temporary drop in employment is similar to the case of a total factor productivity shock in the short run. Production rises more sharply than demand so that public capital crowds out the two other inputs in the production function.[8] Despite this drop in employment during few quarters, the cumulative response of employment is unambiguously positive.

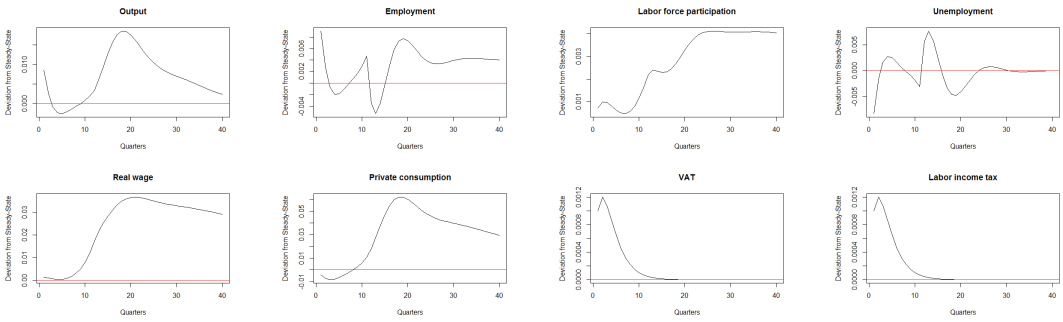

Figure 1.2: Effects of an increase in public investment (corresponding to 1% of GDP)

The key point for explaining the negative but low unemployment fiscal multipliers reported in Table (1.3) is the response of the real wage and of the labor force participation. In contrary to government consumption, government investment triggers a strong increase in the real wage in the long run.

[8] See for instance Barnichon (2012) for a discussion about the existence of a positive unemployment-productivity correlation in the short run.

Figure 1.3: Response of the real wage to a rise in government investment in a search and matching model without nominal rigidities (the model used is described in Betti and Coudert, 2015)

With a rather high elasticity of output to public capital, a rise in public investment generates a long-lasting decrease in the marginal cost and then in prices. The drop in unemployment triggers an upward pressure on the nominal wage and in addition, with a low indexation of the nominal wage on past inflation ($\gamma_w = 0.16$), the nominal wage responds only slightly to the drop in prices. Since the downward pressures on prices are long-lasting, the real wage increases sharply in the long run. It should be noted that this channel could be strongly dependent to the presence of nominal rigidities on the nominal wage. However, even in the absence of nominal wage rigidities, the real wage tends to rise in the long run following a rise in government investment. In the following chapter, we use a new-Keynesian framework with a search and matching model for the labor market. The real wage is set with a traditional efficient Nash bargaining process and no nominal rigidities on wages exist.

Figure (1.3) indicates the response of the real wage to a government investment shock in a search and matching model. Despite a decrease in the short-run, the model produces also a rise in the real wage in the long run.

As a consequence and despite the positive wealth effect on labor supply, the labor force participation increases significantly in the long run. Then, this rise in labor force participation offsets the positive long-run effects on employment.

1.3.4 The importance of financing

The fiscal policy literature has pointed out the crucial role of the fiscal adjustment to explain the effects of fiscal expansions on output and employment at the different time horizons. For instance the speed of the fiscal adjustment and the fiscal instrument used for this purpose influence the dynamic of the economy following a fiscal shock. In this model, VAT and a labor income tax respond to the rise in government deficit. In DSGE models other taxes are often introduced such as a tax on capital or social security contributions but fiscal adjustments can be also expenditure-based (for instance the case of a spending reversal) or even deficit-based.

This section aims at showing that a rise in VAT or in the labor income tax following the expansion in government expenditure trigger different effects on the labor market and especially on the unemployment rate. I simulate the model with a 1% rise in VAT then with a 1% rise in the labor income tax. Results are reported in Figures (1.4) and (1.5).

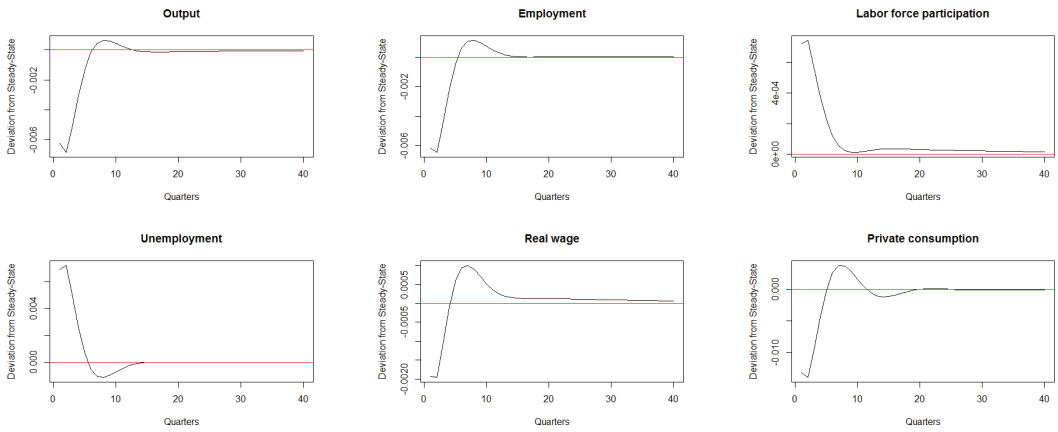

Figure 1.4: Effects of a 1% increase in VAT

A 1% increase in VAT decreases private consumption, output and employment. This negative aggregate demand shock implies a drop in prices and the real interest rates according to the Taylor principle. This decrease in real interest rates eases the drop in private consumption which triggers a slightly positive response of output and em-

ployment for a few periods. The response of the real wage can be explained as follows: the rise in unemployment implies a drop in nominal wage in the short run despite the existence of nominal rigidities on wages. However, Figure (1.4) indicates that the real wage goes up from the fifth period. First, the weak indexation of nominal wages on past inflation ($\gamma_w = 0.16$) triggers an automatic rise in real wages following the drop in prices. Also, the slight rise in employment after a few periods triggers an upward pressure on the nominal wage. The mixed response of the real wage and the drop in private consumption implies a slight increase in the labor force participation.

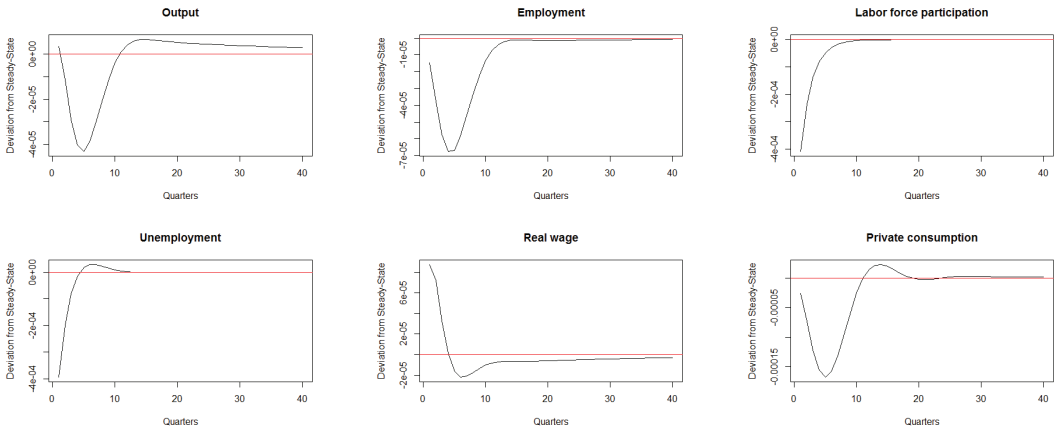

Figure 1.5: Effects of a 1% rise in labor income tax

In this case, the tax on labor income produces a higher unemployment fiscal multiplier. With the tax, the marginal utility from working is lower, thus the households address a lower labor supply. However, the drop in disposable income reduces private consumption causing a lower GDP fiscal multiplier and a lower labor demand than in the initial (debt-based) case. The consequence on the labor supply is larger in absolute value than the consequence on the labor demand, producing higher negative effects on the unemployment rate in the case of a shock partly funded by a tax on labor income.

1.4 Empirical framework

1.4.1 Data descpription

In the spirit of Fatas and Mihov (2001) or Blanchard and Perotti (2002) among others, I apply a structural vector autoregression approach in order to estimate the effects of fiscal policy shocks on a large set of variables including labor market variables for the Eurozone as a closed economy. It is common in the literature to consider public expenditure as the sum of government consumption and government investment. I attempt to disentangle the effects of these two components of public spending by estimating the baseline VAR with each fiscal variable in turn. Other variables included in the SVAR are general government total tax revenue, real GDP, the GDP deflator, the short-term nominal interest rate, real compentations to employees, total employment, the labor force and the unemployment rate. All variables are taken in logs.

Quarterly data for the general government are extracted from the new data set contructed by Paredes, Pedregal and Pérez (2009, PPP hereinafter)[9]. Public expenditure is defined either as public consumption (GCR) or as public investment (GIN). Euro-Area general government public consumption is directly computed in real terms in PPP (2009). However, EA general government public investment is in nominal terms and I use the GDP deflator to express it in real terms. For the rest of the variables, time series come from the Area Wide Model (AWM) database.[10] The table (1.4) summarizes the set of variables considered in the SVAR.

For simplicity purposes, each labor market variable is introduced in turn. Thus, each estimated SVAR contains 6 variables: the government expenditure (public consumption or public investment), tax revenues, real GDP, the GDP deflator, the nominal interest rate and finally the labor market variables.

The Phillips-Perron and Augmented Dickey-Fuller tests indicate unit roots for al-

[9] I am grateful to the authors for providing me the data set

[10] See Fagan and al. (2005) for a clear description of the different variables.

most all series. Series are taken in log difference.[11]

Variables	Source	Code	Symbol in the paper
Public consumption	PPP (2009)	GCN	C^g
Public investment	PPP (2009)	GIN	I^g
Total direct taxes	PPP (2009)	DTX	t^d
Total indirect taxes	PPP (2009)	TIN	t^i
Real GDP	FHM (2005)	YER	Y
GDP deflator	FHM (2005)	YED	Π
Short term interest rate	FHM (2005)	STN	R
Unemployment rate	FHM (2005)	URX	U
Labor force participation	FHM (2005)	LFN	L
Employment	FHM (2005)	LNN	N
Compensation to employees	FHM (2005)	WIN	W

Table 1.4: Data description

1.4.2 Identification methodology

Following Fatas and Mihov (2001), Blanchard and Perotti (2002) or Perotti (2005), structural fiscal shocks are identified using a Structural VAR model. By ordering first public expenditure, one assumes that the government cannot react contemporaneously to changes in economic variables. First, I identify the SVAR with a Choleski decomposition. Then, I use the methodology introduced by Blanchard and Perotti (2002). If discretionary decisions taken by the government cannot occur within a quarter, changes in economic variables can automatically and contemporaneously impact the level of public expenditure and of tax revenues. In this sense, I use informations on elasticities of expenditure and tax revenues to the different economic variables to impose constraints in the SVAR.

Let us represent the following baseline VAR process:

$$X_t = A(L)X_{t-1} + U_t \tag{1.43}$$

[11] I also run estimates with data detrended with the Hodrick-Prescott filter. Results are very close.

In the following, I consider the case of a public consumption shock and in which the real wage is introduced, such as $X_t \equiv (C_t^g, T_t, Y_t, \Pi_t, R_t, W_t)$ defines the vector of variables, $A(L)$ is a autoregressive lag polynomial and $U_t \equiv [u_t^{cg}, u_t^t, u_t^y, u_t^\pi, u_t^r, u_t^w]$ the vector of residuals associated with each variable. According to the LM tests and the Akaike and Schwarz information criteria, 4 lags are included in the VAR.

Choleski decomposition

First, I identify structural government spending shocks *via* a Choleski decomposition. The AB model[12] can be defined as: $AU_t = Be_t$, with $e_t \equiv [e_t^{cg}, e_t^t, e_t^y, e_t^\pi, e_t^r, e_t^w]$ the vector of structural innovations. Applying a Cholesky decomposition yields the following constraints:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ . & 1 & 0 & 0 & 0 & 0 \\ . & . & 1 & 0 & 0 & 0 \\ . & . & . & 1 & 0 & 0 \\ . & . & . & . & 1 & 0 \\ . & . & . & . & . & 1 \end{bmatrix} \tag{1.44}$$

and

$$B = \begin{bmatrix} . & 0 & 0 & 0 & 0 & 0 \\ 0 & . & 0 & 0 & 0 & 0 \\ 0 & 0 & . & 0 & 0 & 0 \\ 0 & 0 & 0 & . & 0 & 0 \\ 0 & 0 & 0 & 0 & . & 0 \\ 0 & 0 & 0 & 0 & 0 & . \end{bmatrix} \tag{1.45}$$

where A is a upper triangular matrix and B a diagonal matrix. The model is just-identified with a number of contraints equal to $2k^2 - \frac{k(k+1)}{2}$ with k the number of variables.

[12] See Lütkepohl (2007) for details about the SVAR modeling and the AB model.

The Blanchard-Perotti approach

The reduced-form residuals u_t^{cg} and u_t^t can be expressed as:

$$u_t^{cg} = a_{cg,y}u_t^y + a_{cg,\pi}u_t^\pi + a_{cg,r}u_t^r + a_{cg,w}u_t^w + \beta_{cg,cg}e_t^{cg} + \beta_{cg,t}e_t^t \tag{1.46}$$

and

$$u_t^t = a_{t,y}u_t^y + a_{t,\pi}u_t^\pi + a_{t,r}u_t^r + a_{t,w}u_t^w + \beta_{t,t}e_t^t + \beta_{t,cg}e_t^{cg} \tag{1.47}$$

Similarly, residuals for the remaining variables can be expressed as:

$$u_t^y = b_{y,cg}u_t^{cg} + b_{y,t}u_t^t + \beta_{y,y}e_t^y \tag{1.48}$$

$$u_t^\pi = b_{\pi,cg}u_t^{cg} + b_{\pi,t}u_t^t + b_{\pi,y}u_t^y + \beta_{\pi,\pi}e_t^\pi \tag{1.49}$$

$$u_t^r = b_{r,cg}u_t^{cg} + b_{r,t}u_t^t + b_{r,y}u_t^y + b_{r,\pi}u_t^\pi + \beta_{r,r}e_t^\pi \tag{1.50}$$

$$u_t^w = b_{w,cg}u_t^{cg} + b_{w,t}u_t^t + b_{w,y}u_t^y + b_{w,\pi}u_t^\pi + b_{w,r}u_t^r + \beta_{w,w}e_t^w \tag{1.51}$$

In equation (1.46), and similarly for u_t^t in equation (1.47), reduced-form residual of public consumption is expressed as linear combination of the residuals of the other variables, the structural innovation of tax revenues e_t^t and its own structural innovation e_t^{cg}. The different parameters "a" can capture two different effects: the automatic response of the public spending and taxes to the economic variables and the discretionary decisions of the government following changes in economic variables. By ordering first the fiscal variables, one makes the assumption that a government cannot react to changes on the economic variables within a quarter. Thereafter the parameters "a" only capture the automatic response of the fiscal variables to the economic variables. These parameters are set thanks to institutional informations about elasticities of government expenditure and tax revenues to the different economic variables.

Elasticities of public expenditure This is commonly accepted that output elasticities of public consumption and public investment $a_{cg,y}$ and $a_{ig,y}$ are set to 0. However, it is likely that changes in prices affect contemporaneously public consumption

and investment. Following Perotti (2005), I set $a_{cg,\pi} = a_{ig,\pi} = -0.5$. Then, since our definition of public expenditure do not include interest payments, interest rate elasticities $a_{cg,r}$ and $a_{ig,r}$ are also set to 0. For real wage elasticities, this is unlikely than purchases of goods *via* public consumption or public investment react to changes in real wage, thereafter wage elasticities are also set to 0. Similarly, it is unlikely that public expenditure react to changes on other labor market variables, such as $a_{cg,n} = a_{ig,n} = a_{cg,l} = a_{ig,l} = a_{cg,u} = a_{ig,u} = 0$.

Elasticities of general government tax revenues. It is common practice to represent output and price elasticities of tax revenue as the sum of the elasticities of its different components such as, for a_{t_y}:

$$a_{t_y} = \sum_i \xi_{T_i,B_i} \xi_{B_i,y} \frac{T_i}{T} \tag{1.52}$$

with T_i the different tax components, ξ_{T_i,B_i} the elasticity of the tax component T_i to its tax base and $\xi_{B_i,y}$ the elasticity of the tax base i to output. Giorno (1995) splits total tax revenue in 4 components: revenues from personal income tax, corporate income tax, indirect tax and social security contribution. The tax base for both personal income tax and social security contribution are compensations to employees. For the corporate income tax, the tax base is the gross operating surplus and for indirect tax the tax base is private consumption.

Following Burriel and al. (2010),[13] output elasticity is set to $a_{t,y} = 1,54$ and price elasticity is set to $a_{t,\pi} = 1,14$. For interest rate elasticity, similarly to public expenditure, I set $a_{t,r} = 0$.

In contrary to public expenditure, changes on labor market variables can impact most likely tax revenues. First, changes in the unemployment rate can alter the EA general government tax revenue. For instance, according to the different tax components highlighted above, personal income tax and social security contribution could fall

[13]The authors estimate the effects of fiscal policy using a SVAR for the Euro Area following also Blanchard and Perotti (2002).

following a rise in unemployment. To compute the unemployment elasticity of general government total tax revenue, I use the following formula:

$$a_{t,u} = \xi_{t,y}\xi_{y,u} = \frac{\xi_{t,y}}{\xi_{u,y}} \tag{1.53}$$

To set $\xi_{u,y}$, the output elasticity of unemployment, I use computations found in Girouard and André (2005). The authors estimate the elasticities for a set of OECD countries including the 12 former EA members. I compute an elasticity for the Euro-Area as a whole by averaging the elasticities of individual members weighted by the share of each member state GDP in total Euro-Area GDP. I find an elasticity of unemployment to output equal to $\xi_{u,y} = -4,26$.[14] With $\xi_{t,y} = 1,54$ as defined previously, the unemployment elasticity of EA general government total tax revenue is set to $a_{t,u} = -0,36$.

Similarly to the unemployment elasticity, the employment elasticity of total tax revenue can be expressed as:

$$a_{t,n} = \frac{\xi_{t,y}}{\xi_{n,y}} \tag{1.54}$$

The output elasticity of labor is set to $\xi_{n,y} = \frac{1}{\alpha}$ with α the labor elasticity of output as it can be found in a Cobb-Douglas production function. According to different estimates and in line with European Commission (2010), $\xi_{n,y}$ is set to $1,53$. I thus compute $a_{t,n} = 1$.

Compensations to employees affect at least directly two tax components: the personal income tax revenue and the social security contribution. Price, Dang and Guillemette (2014) produce new estimates for these two tax components to earnings for OECD countries. I compute an average for the Euro Area and I obtain an elasticity of personal income tax to earnings equal to $1,89$ and an elasticity of social security contribution to

[14] Price, Dang and Guillemette (2014) compute new estimates for the output elasticity of unemployment for OECD countries. An average for the Euro Area according to these estimates yields $\xi_{u,y} = -3,67$. In this case $a_{t,u} = -0,43$. Results with this value are however very close.

earnings equal to 0.91.[15] Furthermore, I assume that the corporate income tax revenue and the indirect tax revenue are not influenced by compensations to employees. Finally, using equation (1.52) yields $a_{t,w} = 0.68$.

The last elasticity to set is $a_{t,l}$ which defines the automatic response of the EA general government revenue to a change in the labor force participation. I set $a_{t,l} = 0$ since this is unlikely that a rise or a drop in the labor force participation affects the different tax components. On the expenditure side it could affect transfers and unemployment benefits, however I do not consider these public expenditure in this chapter.

With the help of these estimates, the cyclically-adjusted reduced form tax and spending residuals can be expressed as:

$$\bar{u}_t^{cg} = u_t^{cg} - a_{cg,y}u_t^y - a_{cg,\pi}u_t^\pi - a_{cg,r}u_t^r - a_{cg,w}u_t^w = \beta_{cg,cg}e_t^{cg} + \beta_{cg,t}e_t^t \tag{1.55}$$

and

$$\bar{u}_t^{t} = u_t^{t} - a_{t,y}u_t^y - a_{t,\pi}u_t^\pi - a_{t,r}u_t^r - a_{t,w}u_t^w = \beta_{t,t}e_t^{t} + \beta_{t,cg}e_t^{cg} \tag{1.56}$$

Finally, I set $\beta_{cg,t} = 0$ and $\beta_{t,cg} \neq 0$, which means that the government decides the level of public expenditure first and that taxes respond to changes in public expenditure.[16] $\bar{u}_t^{cg}$ and $\bar{u}_t^t$ can then be used to estimate the "b" parameters by OLS.

All the previous constraints yield the following A and B matrix for the baseline case,

[15] Van den Noord (2000) and Bouthevillain (2001) find close estimates: an elasticity of personal income tax equals to 2 and an elasticity of social security contribution equals to 1.

[16] The opposite case where $\beta_{cg,t} \neq 0$ and $\beta_{t,cg} = 0$ is also tested and it provides very close results.

so that $X_t \equiv (C_t^g, T_t, Y_t, \Pi_t, R_t, W_t)$:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0.5 & 0 & 0 \\ 0 & 1 & -1.54 & -1.14 & 0 & -0.68 \\ -b_{y,g} & -b_{y,t} & 1 & 0 & 0 & 0 \\ -b_{\pi,g} & -b_{\pi,t} & -b_{\pi,y} & 1 & 0 & 0 \\ -b_{r,g} & -b_{r,t} & -b_{r,y} & -b_{r,\pi} & 1 & 0 \\ -b_{w,g} & -b_{w,t} & -b_{w,y} & -b_{w,\pi} & -b_{w,r} & 1 \end{bmatrix} \tag{1.57}$$

and

$$B = \begin{bmatrix} \beta_{cg,cg} & 0 & 0 & 0 & 0 & 0 \\ \beta_{t,cg} & \beta_{t,t} & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{y,y} & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{\pi,\pi} & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{r,r} & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{w,w} \end{bmatrix} \tag{1.58}$$

The A and B matrix contain 51 constraints, that makes the SVAR model just-identified.

1.4.3 Results

First, figures (1.6) and (1.7) display the impulse response functions from the Choleski decomposition. A rise in government consumption triggers a slight rise in unemployment (with a cumulative multiplier equals to 0.12). At the opposite, in the case of government consumption, unemployment falls with a cumulative multiplier equals to -0.24. Government consumption has a negative effect on employment. As pointed out in Ramey (2012), a rise in government spending could produce an increase in public employment but a fall in private employment.[17] Moreover, the labor force participation also decreases despite a slight increase after 7 periods. This is particularly surprising since the real wage increases and that public consumption tends to produce a negative wealth effect so that private spending fall (not estimated here). This is at odds with results found in Brückner and Pappa (2012) who estimate for most of countries a rise

[17] In Ramey (2012), the author uses several specifications and this result holds in most cases.

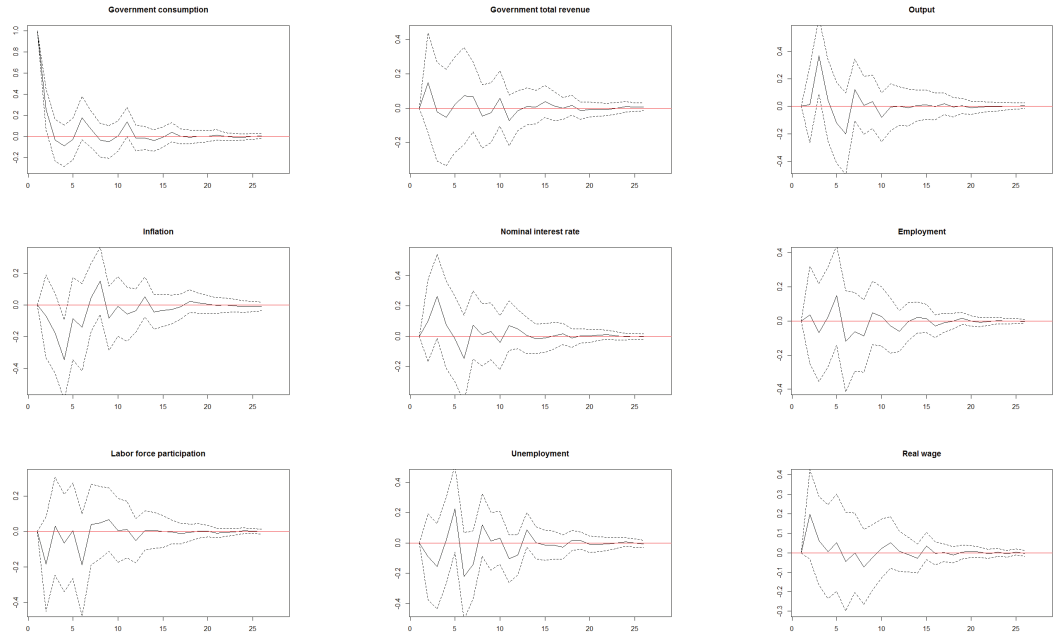

Figure 1.6: Effects of a 1% rise in government consumption (Choleski decomposition)

in the labor force participation following an increase in government spending. However, this is close to the estimates in Berperoglou, Pappa and Vella (2013), who find with a Choleski identification a rise in the labor force participation after both government consumption and investment cuts.[18]

As already said, with the Choleski identification government investment triggers a slight rise in unemployment. In contrary to the case of government consumption, public investment generates a rise in both employment and of the labor force participation.These results confirm partly at this stage the results from the DSGE model. We observe a comovement of employment, the labor force participation and the real wage but the effect on unemployment is lower (and even positive) than in the case of government consumption. In other words, the rise in employment is counteracted by the rise in the labor force participation. As a consequence, impulse response functions indicate a slight rise in the unemployment rate. However, our theoretical explanation is based

[18]The authors also show that, with a sign-restriction approach, the participation rate decreases significantly following the public expenditure cuts.

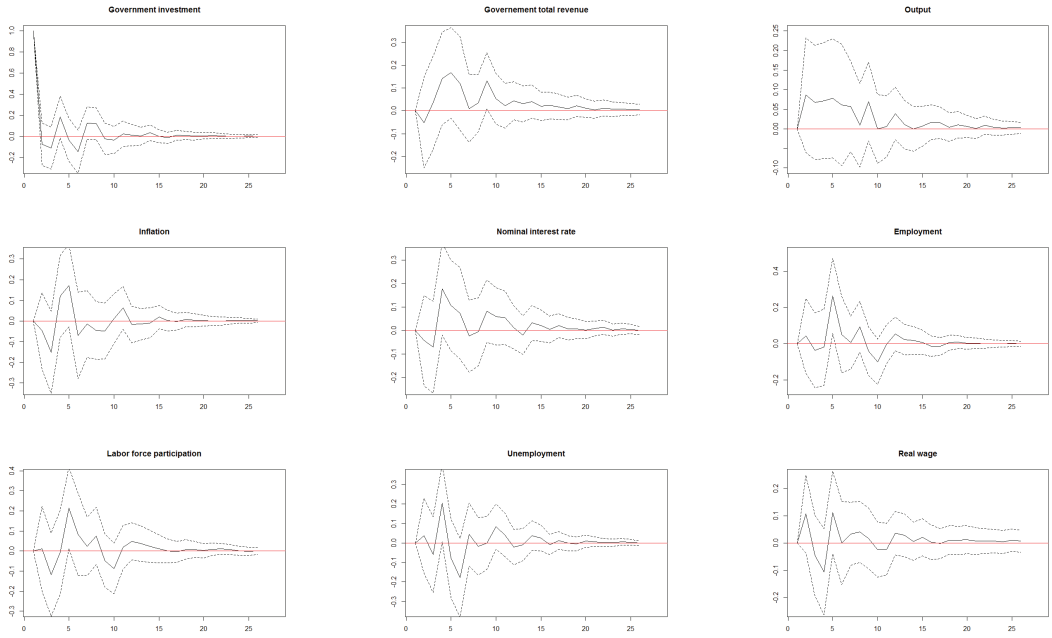

Figure 1.7: Effects of a 1% rise in government investment (Choleski decomposition)

on a strong and long-lasting rise in the real wage while the SVAR with the Choleski identification does not produce a larger rise the real wage in the case of government investment compared to government consumption.

Figure (1.8) summarizes the impulse response functions of the key variables following a government consumption shock with the Blanchard-Perotti approach. In contrary to the Choleski identification, we observe the comovement of output, employment, the labor force participation and of the real wage.[19] A negative effect on employment for the first few periods combined with a rise in the labor force participation trigger a rise in unemployment for the first five periods. However, the cumulative response of unemployment is negative.

In the case of a rise in government investment shock (see Figure (1.9)), the fiscal shock also triggers a comovement of employment, the labor force participation and of

[19]In the presents IRFs, the real wage is considered as compensations to employees and unemployment as the unemployment rate. Estimates using the wage rate and the number of unemployed provide similar results.

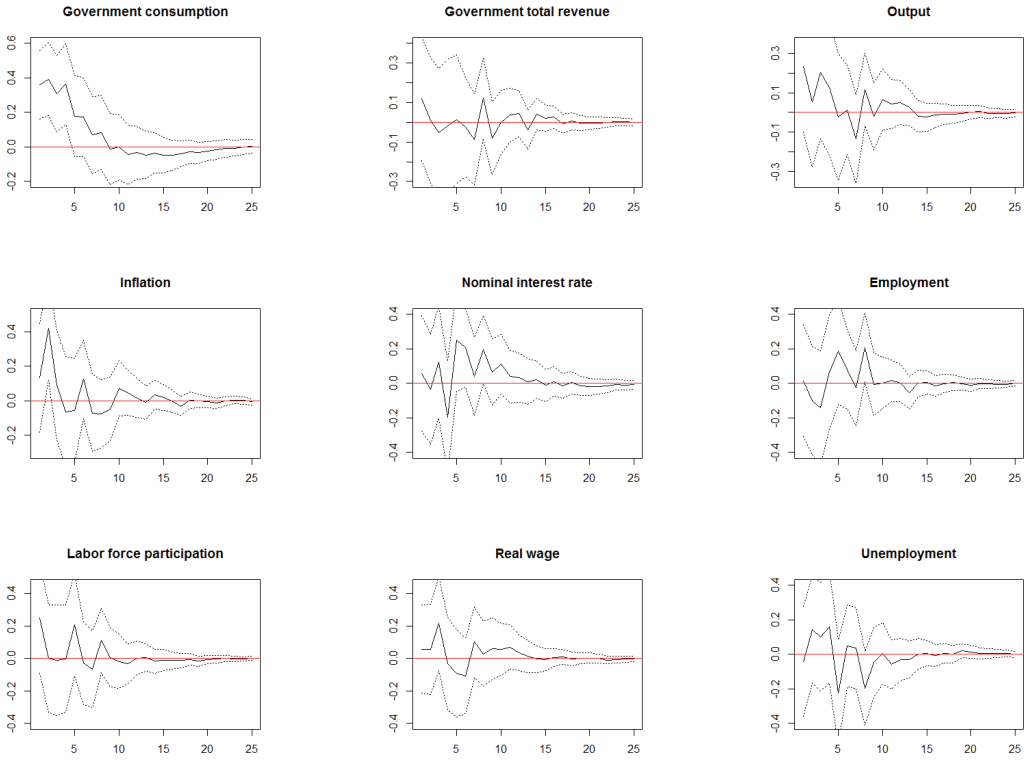

Figure 1.8: Effects of a 1% rise in government consumption (Blanchard-Perotti approach)

the real wage. The response of unemployment is negative and short-lasting. However, the decline in unemployment is stronger in the case of government investment, which is at odds with the results from both the Choleski decomposition and the theoretical exercise.

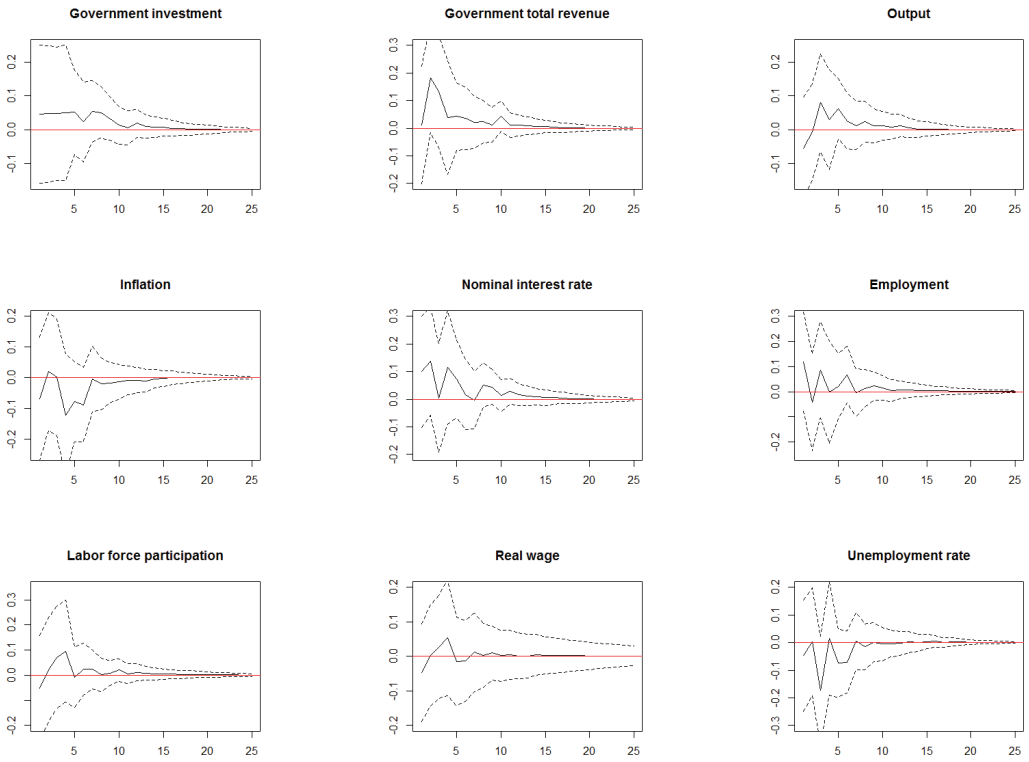

Figure 1.9: Effects of a 1% rise in government investment (Blanchard-Perotti approach)

1.5 Conclusion

The aim of this chapter is to disentangle the effects of government consumption and investment on output and the labor market in a closed economy. I provide in a new-Keynesian model with a labor force participation decision and unemployment an explanation as to a higher response of output but a lower effect on unemployment in the case of a rise in government investment. To produce this stylized fact, a positive and long-lasting response of the real wage and of the labor force participation is needed. However, public consumption, despite the presence of a labor force participation decision, triggers a significant decrease in unemployment.

The empirical section hardly support these results. In the case of the Choleski identification, unemployment decreases in the case of a rise in government consumption

while the unemployment rate increases slightly with government investment. Especially, one observes a positive comovement of employment, the labor force and the real wage with government investment while employment is reduced with government consumption. However, the Blanchard-Perotti approach yields different results, with the latter comovement observed for both government expenditure but with a higher effect on unemployment in the case of government investment. As it has been pointed out many times in the literature, the identification scheme influences greatly the results. Moreover, an observation of the other empirical contributions quoted in this paper argue for a large range of results. A future research would be to consider other identification schemes, for instance a sign-restrictions approach, or other economies.

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Chapter 2

How can the labor market account for the effectiveness of fiscal policy over the business cycle?[1]

2.1 Introduction

Recent literature indicates that the position over the business cycle greatly influences the size of the fiscal multiplier. Empirical studies show that the output fiscal multiplier is larger in periods of economic downturn.[2] However, the theoretical mechanisms behind this result still needs to be evidenced. If some intuitive mechanism could support this result,[3] explanations based on theoretical frameworks are still rare. The aim of this chapter is to contribute to this theoretical literature. More precisely, our analysis focuses on the response of the labor market to fiscal policy shocks assuming different values of the steady-state unemployment rate, thus to different positions of the economy over the business cycle. Especially, we attempt to show that the labor market dynamics, and especially the response of real wage, can explain different output fiscal multipliers according to the unemployment rate at the steady state.

Sims and Wolff (2013) and Michaillat (2014) have attempted to investigate the

[1] This chapter has circulated as a paper co-written with Thomas Coudert.

[2] See Creel et al. (2011) and Auerbach and Gordnichenko (2012) among others

[3] We could expect a higher price stickiness during economic downturn that produces greater real effects of spending expansion or a higher share of non-Ricardian households that diminish the crowding out effect of public consumption on private consumption.

non-linear effects of fiscal policy theoretically. Sims and Wolff (2013) investigate in a standard DSGE model the effects of fiscal policy on private consumption for different positions of the economy over the business cycle. Without the presence of private investment, the size of the multiplier only depends on the response of private consumption. After the estimation of the model at the first-order, authors compute the output fiscal multiplier for each position over the business cycle. Their main finding is that the marginal utility of consumption is greater during economic downturn (since the level of consumption is lower), so that the crowding-out effect of public spending on private consumption is reduced. This explanation of a greater fiscal multiplier in the trough of the economic cycle is an interesting first step. However, other aspects of an economy in a period of economic downturn must be taken into account, includind the presence of non-Ricardian households [4] or the potential different dynamics of the labor market. Michaillat (2014) focuses on the response of the labor market following a rise in public employment in a DSGE model with a search and matching labor market. The main result is that when the unemployment rate is high (8% in the paper), a rise in public employment has a greater effect on total employment than in the case of a low unemployment rate (4%). By construction the model produces a crowding-out effect of public employment on private employment, as it has been shown in empirical studies and notably in Ramey (2012). In Michaillat (2014), the crowding-out effect is based on a lower pool of unemployed searching for a job in the private sector following the rise in public vacancies. When the pool of job seekers is high at the steady state, this crowding out effect is then lower. However, the author does not consider the role of the wage channel since the real wage law of motion is assumed as exogenous.

Our work follows Michaillat (2014) by focusing on the effects of fiscal policy on the labor market according to the steady-state value of the unemployment rate. In comparison to this paper, we introduce a Nash efficient bargaining process that determines the law of motion of real wage. This is of first importance since our main result is based on the response of the real wage. Also, Michaillat (2014) introduces only non-Ricardian

[4] See for instance Coenen and Straub (2005) for discussions about the impact of the presence of non-Ricardian households on fiscal multipliers.

households while we introduce both optimizing and *hand-to-mouth* households. Moreover, we show that the introduction of Ricardian households is necessary to produce higher output fiscal multipliers.

In this chapter we construct a new-Keynesian model with a search and matching framework for the labor market. Workers can find a job in both the private and the public sector. Our modeling of the dual labor market is close to other papers like Brückner and Pappa (2012) and Afonso and Gomes (2014). Four fiscal instruments are introduced: a labor income tax, a social protection tax paid by firms, the public wage and public vacancies. The first part of the chapter is dedicated to analyzing the effects of these four fiscal instruments on the labor market. To achieve this investigation, we use a first-order approximation of the model. A main result is that the four fiscal expansions generate a drop in unemployment and a drop in private real wage, except for the cut in social protection tax. We disentangle the different transmission channels specific to each fiscal instrument.

The main contribution of the chapter is to solve the model at the second-order in order to analyze the non-linear effects of fiscal policy according to two different steady-state levels of unemployment, in the spirit of Michaillat (2014). A first result is that the four fiscal instruments triggers a larger rise in employment in the case of a high steady-state unemployment rate (12% in this chapter, in comparison with a lower unemployment rate of 6%). The explanation for this result is close to the one highlighted in Michaillat (2014). A larger pool of job seekers at the steady state generates more job creations following the fiscal shocks.

This higher rise in private employment is the starting point for explaining a larger output fiscal multiplier during economic downturn. This stronger effect on employment when unemployment is high engenders a larger degradation of marginal productivity of labor and then a larger degradation of real wage. The greater drop in real wage implies a lower consumption for the non-Ricardians. However it also implies a lower marginal cost, inflation and a lower rise in interest rates. In this case, consumption of

Ricardian households is less reduced than in the case of a low unemployment rate at the steady state. The total effect on aggregate demand depends on the relative strength of these two opposite effects on private consumption. Under our standard calibration, the higher consumption of Ricardian households prevails over the lower consumption of non-Ricardian households. It finally induces a larger output fiscal multiplier in the case of a high steady-state unemployment rate.

Thus, this chapter attempts to offer a new theoretical explanation for variations of the output fiscal multiplier over the business cycle. Sims and Wolff (2013) argue for a larger output fiscal multiplier during economic downturn due to a larger marginal utility of consumption. It is important to note that our model does not include this transmission channel. On the contrary, the definition of steady-state values for both types of consumption implies a lower marginal utility of consumption for the Ricardian households during economic downturn. The wage channel we highlight in this chapter is not in contradiction with the explanation found in Sims and Wolff (2013). Especially, the coexistence of these two effects could partly explain the sizable difference found in the literature about the size of the output fiscal multiplier according to the position of the economy over the business cycle.

The rest of the chapter is organized as follows: section 2.2 presents the model, section 2.3 presents the calibration and the results. Section 2.4 highlights the main results of the chapter and section 2.5 concludes.

2.2 The DSGE model

The model used in this chapter features nominal rigidity on prices and matching frictions on the labor market. Since the focus is on the effects of the public sector on the economy, two sectors coexist on the labor market, namely a public and a private sector. We make explicit the choice to work in the private sector or in the public sector. Also, we introduce an efficient Nash wage bargaining in which the public wage directly affects the determination of the private wage and thus employment in both sectors.

The model features also a rich fiscal side, with several types of expenditure/taxes in order to investigate the second-order effects of fiscal policy on the labor market according to the fiscal tool considered. On the expenditures side, we consider the effects of a rise of the public wage and of the public vacancies. On the taxes side, we investigate the effects of a labor revenue tax cut and a social protection tax cut.

2.2.1 Definitions and the matching process

Let us first define the non-employed pool $1-(1-\rho)E_t^{tot}$ such as:

$$1-(1-\rho)E_t^{tot} = U_t + \rho E_t^{tot}, \tag{2.1}$$

where E_t^{tot} denotes the employed workers and U_t the pool of unemployed workers. The destruction rate ρ is assumed to be exogenous.

Moreover, the pool of job seekers S_t is expressed as

$$S_t = U_t + \rho E_t^{tot}. \tag{2.2}$$

Also, in the spirit of Trigari (2006), assuming that a new job becomes productive only in the following period and assuming that a match can be instantaneously broken, employment in a particular sector E_t^i can be expressed as:

$$E_t^i = (1-\rho)E_{t-1}^i + p_{t-1}^i(1-\rho)S_{t-1}, \tag{2.3}$$

with $i = p, g$ that denotes both the public and private sectors. These definitions are common to both sectors. The job-finding probability in the sector i, p_t^i, is defined later on. With these definitions, it is important to note that total employment is a predetermined variable.

Finally, the dynamic of job seekers is given by

$$S_t = (1 - p^p_{t-1} - p^g_{t-1})S_{t-1} + \rho(p^p_{t-1} + p^g_{t-1})S_{t-1} + \rho(E^p_{t-1} + E^g_{t-1}). \tag{2.4}$$

According to equation (2.4), the number of job seekers in the current period is equal to the number of job seekers who did not find a job either in the private sector or in the public sector in the previous period plus the number of job seekers is increased by the number of jobs which are destroyed in the previous period. Finally, we assume that there is a kind of trial period: a worker can match a firm in the beginning of the period but the relationship can be broken at the end of the period exogeneously.

Let us now define the matching process occurring on a specific labor market, such as:

$$M^i_t = \kappa^i_e (S_t)^{\varphi^i} (V^i_t)^{(1-\varphi^i)}, \tag{2.5}$$

where κ^i_e denotes the matching technology in a particular sector while φi denotes the elasticity of employment for a supplementary unemployed worker. V^i_t is the number of vacancies in the sector i.

We can therefore set the following usual definitions:

$$p^i_t = \frac{M^i_t}{S_t}, \tag{2.6}$$

$$\text{and} \quad q^i_t = \frac{M^i_t}{V^i_t} \tag{2.7}$$

with p^i_t the job finding probability in the sector i as previously introduced; q^i_t is the probability for a firm to fill the posted vacancy.

The labor market tightness (LMT thereafter) can be defined as

$$\theta^i_t = \frac{V^i_t}{S_t} = \frac{p^i_t}{q^i_t}. \tag{2.8}$$

2.2.2 Households' decisions

In this model two different types of agents are introduced. We assume a share μ of non-Ricardian (*hand-to-mouth*) households and a share $(1-\mu)$ of Ricardian households. The difference between both types of households is their ability to participate in financial markets. Non-Ricardian can neither loan nor save so that they simply consume their disposable income in each period. On the contrary, Ricardian households can hold a riskless asset that allows them to optimize their consumption inter-temporally. Also, Ricardian households invest in physical capital that they then loan to firms. Both types of households formulate similar labor market decisions.

Ricardian households

A representative Ricardian household maximizes its lifetime utility and its utility function is defined as:

$$u(C_t^o, C_{t-1}^o, G_t, e_{jt}) = \frac{(C_t^o - HC_{t-1}^o)^{1-\sigma_c} - 1}{1-\sigma_c} + M^o(e_{jt}) \tag{2.9}$$

where C_t^o denotes consumption of Ricardian households. Additively separable preferences of consumption and labor are introduced in an usual manner with σ_c the inter-temporal elasticity of substitution for consumption. The consumption decision is subject to a degree H of habit formation. The function $M^o(e_{jt})$ represents the amount of leisure in terms of utility with regard to the presence of the household member on the labor market.

Following Ravn (2005, 2008), e_{jt} with $j = n, u, l$ denoting the level of leisure according to the status of the household on the labor market *i.e.* e_{nt} for an employed worker, e_{ut} for an unemployed worker and e_{lt} for an inactive household such as:

$$e_{nt} = 1 - h - s, \tag{2.10}$$

$$e_{ut} = 1 - s, \tag{2.11}$$

$$e_{lt} = 1, \tag{2.12}$$

where h denotes hours worked that we assume as exogenous and s a fixed cost in the participate to labor market.

We consider the case of a representative worker in the spirit of Merz (1995), so that the function $M^o(e_{it})$ contains the different possible statuses of a worker on the labor market, such as:

$$M^o(e_{jt}) = \frac{[(E_t^{op} + E_t^{og})(1-h-s)^{1-\zeta} + S_t^o(1-s)^{1-\zeta} + (1-(E_t^{op} + E_t^{og}) - S_t^o)]}{1-\zeta} \tag{2.13}$$

where $-1/\zeta$ defines the Frisch elasticity of labor supply and S_t^o is the share of Ricardians seeking employments in period t. E_t^{op} denotes employment of Ricardian households in the private sector while E_t^{og} denotes employment of Ricardian households in the public sector.

The optimization problem for the representative Ricardian household is expressed as:

$$\max_{C_t^o, K_t^o, B_t, E_t^o, S_t^o, I_t^o} E_t \sum_{s=t}^{\infty} \beta^s u(C_{t+s}^o, C_{t-1+s}^o, G_{t+s}, e_{j,t+s}). \tag{2.14}$$

subject to

$$(1+\tau^c)C_t^o + \frac{B_t}{P_t} + I_t^o \leq R_{t-1}^k K_{t-1} + \frac{R_{t-1}B_{t-1}}{P_t} + b(S_t^o) + (1-\tau_t^w)[W_t^g h E_t^{og} + W_t^p h E_t^{op}] \tag{2.15}$$

$$K_t^o = (1-\delta^k)K_{t-1}^o + [1 - A(I_t^o/I_{t-1}^o)]I_t^o \tag{2.16}$$

$$E_t^{op} = (1-\rho)E_{t-1}^{op} + p_{t-1}^p(1-\rho)S_{t-1}^o \tag{2.17}$$

$$E_t^{og} = (1-\rho)E_{t-1}^{og} + p_{t-1}^g(1-\rho)S_{t-1}^o \tag{2.18}$$

$$S_t^o = (1-p_{t-1}^p-p_{t-1}^g)S_{t-1}^o + \rho(p_{t-1}^p+p_{t-1}^g)S_{t-1}^o + \rho(E_{t-1}^{op}+E_{t-1}^{og}) \tag{2.19}$$

that can be reduced to the following Bellman equation:

$$\Omega_t^o(K_t^o, E_t^o, B_t, I_t^o) = \max_{C_t^o, K_t^o, S_t^o, n_t^o, B_t, I_t} \left\{ \frac{(C_t^o - HC_{t-1}^o)^{1-\sigma_c}}{1-\sigma_c} + \frac{\zeta_g g_t^{1-\sigma_c} - 1}{1-\sigma_c} + \frac{[(E_t^{op}+E_t^{og})(1-h-s)^{1-\zeta} + S_t^o(1-s)^{1-\zeta} + (1-(E_t^{op}+E_t^{og})-S_t^o)]}{1-\zeta} \right\} + \beta\Omega_{t+1}^o(K_{t+1}^o, E_{t+1}^o, B_t, I_t^o), \tag{2.20}$$

subject to the previous set of constraints with β the discount factor. Equation (2.15) is the budget constraint for the household. The optimizing household has access to perfect financial markets and can thus hold a riskless asset B_t. Furthermore, the household invests I_t^o in physical capital K_t^o and loan it to the firms at a rate R_t^k. δ^k defines the depreciation rate of capital, R_t the nominal interest rate equals to $\frac{1}{\beta}$ at the steady state and b the unemployment benefits. W_t^g and W_t^p are the real wages respectively in the public and the private sector. P_t defines the consumer price index (CPI thereafter). We note the appearance of two taxes, a constant VAT τ^C and a labor revenue tax τ_t^w. Equation (2.16) represents the law of motion of capital accumulation. We introduce an adjustment cost to investment changes with $A(I_t^o/I_{t-1}^o) = \frac{\kappa}{2}(I_t^o/I_{t-1}^o - 1)^2$ similarly to Christiano et al. (2005) or Smets and Wouters (2007) among others with κ a constant cost associated to investment decisions.

First order conditions with respect to respectively C_t^o, B_t, I_t^o, K_t^o, E_t^{op}, E_t^{og} and S_t^o

yield:

$$\lambda_t^{rio} = \frac{[C_t^o - HC_{t-1}^o]^{-\sigma_c} - \beta H E_t\{[C_{t+1}^o - HC_t^o]^{-\sigma_c}\}}{1+\tau^c} \tag{2.21}$$

$$\lambda_t^{rio} = r_t \beta E_t \left[\frac{\lambda_{t+1}^{rio}}{\pi_{t+1}}\right], \tag{2.22}$$

with $\pi_{t+1} = p_{t+1}/p_t$ defining the CPI inflation rate.

$$1 = Q_t[1 - A(I_t/I_{t-1})] \tag{2.23}$$

$$Q_t = \beta E_t \left[\frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}}[(1-\delta^k)Q_{t+1} + R_t^k]\right] \tag{2.24}$$

$$\begin{aligned}\lambda_t^{E_{op}} = (1-\tau_t^w)\lambda_t^{rio} W_t^p h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} \\ +\beta E_t[(1-\rho)(\lambda_{t+1}^{E_{op}} - \lambda_{t+1}^{S_o}) + \lambda_{t+1}^{S_o}]\end{aligned} \tag{2.25}$$

$$\begin{aligned}\lambda_t^{E_{og}} = (1-\tau_t^w)\lambda_t^{rio} W_t^g h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} \\ +\beta E_t[(1-\rho)(\lambda_{t+1}^{E_{og}} - \lambda_{t+1}^{S_o}) + \lambda_{t+1}^{S_o}]\end{aligned} \tag{2.26}$$

$$\begin{aligned}\lambda_t^{S_o} = b\lambda_t^{rio} - \frac{1-(1-s)^{1-\zeta}}{1-\zeta} \\ +(1-p_t^p - p_t^g)\beta E_t[\lambda_{t+1}^{S_o}] + \rho(p_t^p + p_t^g)\beta E_t[\lambda_{t+1}^{S_o}] \\ +(1-\rho)\beta E_t[p_t^p \lambda_{t+1}^{E_{op}} + p_t^g \lambda_{t+1}^{E_{og}}]\end{aligned} \tag{2.27}$$

with λ_t^{rio} the marginal utility of consumption for Ricardians, $\lambda_t^{E_{op}}$ the marginal utility of working in the private sector, $\lambda_t^{E_{op}}$ the marginal utility of working in the public sector and $\lambda_t^{S_o}$ the marginal utility to be currently a job seeker.

Equation (2.25) defines the value of a job for a Ricardian household in the private sector while equation (2.26) determines the value of a job in the public sector. Also, equation (2.27) determines the decision for a Ricardian worker to participate in the labor market.

***Hand-to-mouth* consumers**

Non-Ricardian households do not maximize consumption inter-temporally and then simply consume their disposable income in each period. For a representative non-Ricardian household, net VAT consumption is given by:

$$(1+\tau^c)C_t^r = (1-\tau_t^w)[W_t^g hE_t^g + W_t^p hE_t^p] + bS_t^r \tag{2.28}$$

with C_t^r the consumption level for non-Ricardians. The choices made by this class of households concerning the labor market is similar to the Ricardian case.

Similarly to Ricardian households, the utility function for this class of households is expressed as:

$$u(C_t^r, C_{t-1}^r, G_t, e_{jt}) = \frac{(C_t^r - HC_{t-1}^r)^{1-\sigma_c} - 1}{1-\sigma_c} + \frac{\zeta_g G_t^{1-\sigma_c}}{1-\sigma_c} + M^r(e_{jt}) \tag{2.29}$$

with

$$M^r(e_{jt}) = \frac{[(E_t^{rp} + E_t^{rg})(1-h-s)^{1-\zeta} + S_t^r(1-s)^{1-\zeta} + (1-(E_t^{op} + E_t^{rg}) - S_t^r)]}{1-\zeta} \tag{2.30}$$

The corresponding Bellman equation and constraints for this optimization program is

therefore:

$$\Omega_t^r = \max_{S_t^r, E_t^r, E_t^g} \left\{ \frac{(C_t^r - HC_{t-1})^{1-\sigma_c}}{1-\sigma_c} + \frac{[(E_t^{rp} + E_t^{r,g})(1-h-s)^{1-\zeta} + S_t^r(1-s)^{1-\zeta} + (1-(E_t^{rp} + E_t^{rg}) - S_t^r))]}{1-\zeta} \right\} + \beta\Omega_{t+1}^r \tag{2.31}$$

s.t.

$$(1+\tau^c)C_t^r \leq (1-\tau_t^w)[W_t^g h E_t^{rg} + W_t^p h E_t^{rp}] + bS_t^r \tag{2.32}$$

$$E_t^{rp} = (1-\rho)E_{t-1}^{rp} + p_{t-1}^p(1-\rho)S_{t-1}^r \tag{2.33}$$

$$E_t^{rg} = (1-\rho)E_{t-1}^{rg} + p_{t-1}^g(1-\rho)S_{t-1}^r \tag{2.34}$$

$$S_t^r = (1-p_{t-1}^p - p_{t-1}^g)S_{t-1}^r + \rho(p_{t-1}^p + p_{t-1}^g)S_{t-1}^r + \rho(E_{t-1}^{rp} + E_{t-1}^{rg}) \tag{2.35}$$

First order conditions with rapport to E_t^{rp}, E_t^{rg} and S_t yield:

$$\lambda_t^{E_{rp}} = (1-\tau_t^w)\lambda_t^{rir} W_t^p h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + \beta E_t[(1-\rho)(\lambda_{t+1}^{E_{rp}} - \lambda_{t+1}^{S_r}) + \lambda_{t+1}^{S_r}] \tag{2.36}$$

$$\lambda_t^{E_{rg}} = (1-\tau_t^w)\lambda_t^{rir} W_t^g h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + \beta E_t[(1-\rho)(\lambda_{t+1}^{E_{rg}} - \lambda_{t+1}^{S_r}) + \lambda_{t+1}^{S_r}] \tag{2.37}$$

$$\lambda_t^{S_r} = b\lambda_t^{rir} - \frac{1-(1-s)^{1-\zeta}}{1-\zeta} + (1-p_t^p-p_t^g)\beta E_t[\lambda_{t+1}^{S_r}] + \rho(p_t^p+p_t^g)\beta E_t[\lambda_{t+1}^{S_r}] + (1-\rho)\beta E_t[p_t^p\lambda_{t+1}^{E_{rp}} + p_t^g\lambda_{t+1}^{E_{rg}}] \tag{2.38}$$

with $\lambda_t^{E_{rp}}$ the marginal utility of working in the private sector for a non-Ricardian household, $\lambda_t^{E_{rg}}$ similarly in the public sector and $\lambda_t^{S_r}$ the marginal utility for a non-Ricardian to seek employment on the labor market.

Equation (2.36) defines the value of a job in the private sector for a non-Ricardian household while (2.37) defines the value of a job in the public sector. Also, equation (2.38) relates to the decision of a non-Ricardian worker to seek a job.

Even if non-Ricardian households do not maximize consumption intertemporally, maximization of (2.31) with rapport to C_t^r enables to obtain their marginal utility of consumption such as:

$$\lambda_t^{rir} = \frac{(C_t^r - HC_{t-1}^r)^{\sigma_c} - \beta E_t[H(C_{t+1}^r - HC_t^r)^{\sigma_c}]}{1+\tau^c} \tag{2.39}$$

2.2.3 Firms

For the purposes of the model, we need to introduce three kinds of firms as in Trigari (2006). First, some firms we refer as "producers" produce goods with labor and private capital in a competitive environment. The producers then sell their aggregate goods to "intermediate firms", transforming the aggregate good on a continuum of differentiated goods in a monopolistic competition environment. The intermediate firms are the price-setters and set their optimal price subject to nominal rigidity as in Calvo (1983). Finally, a continuum of "final goods firms" in a competitive environment purchase the differentiated intermediate goods and package them to sell it to consumers. This dissociation between producers and intermediate firms is necessary because introducing the price-setting at the producers level would greatly complicate the decision of these

firms on the labor market. However, this simplifying assumption has no important consequences either on the price dynamic or on the labor market dynamics.[5]

The producers

Since the producers evolve in a competitive environment, they all behave similarly and we can consider the following optimization program with a representative firm, such as:

$$\max_{\tilde{K}_t, E_t^p, V_t} E_0 \sum_{t=0}^{\infty} \beta_{t,t+1} \{ Y_t - R_t^k \tilde{K}_t - (1 + \tau_t^{sp}) W_t^p E_t^p h - \kappa^v V_t \} \tag{2.40}$$

s.t.

$$Y_t = \epsilon_t^A (K_{t-1}^g)^{\alpha^g} [\tilde{K}_t]^{\alpha} [E_t^p h]^{1-\alpha-\alpha^g} \tag{2.41}$$

$$E_t^p = (1-\rho) E_{t-1}^p + q_{t-1}^p V_{t-1}^p \tag{2.42}$$

where τ_t^{sp} in equation (2.40) denotes a tax on labor paid by the firms for security protection purposes. The discount factor is $\beta_{t,t+1} = \beta \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}}$. Moreover, the producers take the probability of filling a vacancy q_t^p as given. V_t denotes the vacancies posted by the producers and κ^v the unitary cost of vacancy posting. We assume that the accumulated capital becomes effective for production after one quarter $\tilde{K}_t = K_{t-1}$. K_{t-1}^g defines public investment in the production function with a public capital elasticity of output equals to α^g. The Total-Factor Productivity (TFP thereafter) ϵ_t^A is driven by the following AR(1) process

$$\left(\frac{\epsilon_t^A}{\epsilon_s^A} \right) = \left(\frac{\epsilon_{t-1}^A}{\epsilon_s^A} \right)^{\rho_\epsilon} exp(\varepsilon_t^a),$$

where ϵ_s^A stands for the TFP at the steady-state, $exp(\varepsilon_t^a)$ is a *iid* exogenous disturbance and ρ_ϵ the duration of the shock.

Equation (2.41) represents the production function of the representative producer.

[5]For more details, Christoffel et al. (2009a) made a survey on the implication of this assumption. In the spirit of Kuester (2010), Sveen and Weinke (2007) and Thomas (2011), Christoffel et al. (2009b) demonstrate that the dissociation assumption not only has no spurious consequences but also helps the standard Keynesian model to match stylized facts in terms of inflation reactions to monetary shocks.

Equation (2.42) represents the dynamic of employment from the producers' point of view.

The problem (2.40) can be represented as a Bellman equation such as:

$$V(\Omega_t) = \max_{k_t, E_t^p, V_t} \{Y_t - R_t^k k_t - (1+\tau_t^{sp}) W_t^p E_t^p h - \kappa^v V_t + \beta \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} V(\Omega_{t+1})\} \tag{2.43}$$

Under the free entry condition, the first order conditions with respect to vacancy posting and employment yield:

$$\frac{\kappa^v}{q_t^p} = \beta_{t,t+1} \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} \lambda_{t+1}^{E_f} \tag{2.44}$$

$$\lambda_t^{E_f} = (1-\alpha)\frac{Y_t}{E_t^p} - (1+\tau_t^{sp}) W_t^p h + (1-\rho)\beta_{t,t+1} \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} \lambda_{t+1}^{E_f} \tag{2.45}$$

Equation (2.44) defines the value of a posted vacancy and (2.45) the value of a job for a producer.

Cost minimization subject to equation (2.41) implies the following factor demand conditions,

$$R_t^k = \frac{\alpha Y_t}{K_t} mc_t \tag{2.46}$$

$$x_t = (1-\alpha) mc_t \frac{Y_t}{E_t^p h} - (1+\tau_t^{sp}) W_t^p h, \tag{2.47}$$

where mc_t represents the level of producers' marginal costs. Equation (2.46) characterizes the demand of capital by the producers and equation (2.47) defines the marginal cost of labor x_t.

Intermediate firms, final goods firms and Calvo price-setting

There is a continuum k of intermediate firms that purchase the homogeneous goods from the producers at their marginal cost since the producers are in a competitive environment. The intermediate firms then transform the homogeneous goods on a continuum j of differentiated goods and sell them at the final goods firms.

Final goods firms produce a package of the intermediate differentiated goods according to:

$$Y_t = \left[\int_0^1 Y_{kt}^{\frac{\varepsilon - 1}{\varepsilon}} dk \right]^{\frac{\varepsilon}{\varepsilon - 1}}, \tag{2.48}$$

where ε is the elasticity of substitution across intermediate goods. Demand for each intermediate good is of the form:

$$Y_{jt} = \left(\frac{P_{kt}}{P_t} \right)^{-\varepsilon} Y_t, \tag{2.49}$$

with the following definition for the CPI P_t:

$$P_t = \left[\int_0^1 P_{kt}^{1-\varepsilon} dk \right]^{\frac{1}{1-\varepsilon}}, \tag{2.50}$$

and with P_{kt} the price of good k in the period t.

Following Calvo (1983), intermediate firms are allowed to re-optimize their price only with a probability $\theta_p \in [0, 1)$ in each period. This probability is assumed to be independent from the re-optimization decision taken in the last period.

Intermediate firms seek to maximize their lifetime profit according to their own price level such as:

$$E_t \sum_{k=0}^{\infty} (\beta \theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} \left[\frac{P_{k,t}}{P_{t+s}} - mc_{t+s} \right] Y_{k,t+s}, \tag{2.51}$$

subject to the demand function expressed in the equation (2.49). The first order condition yields:

$$P_{kt}^{*} = \frac{\varepsilon}{\varepsilon - 1} \frac{E_t \sum_{s=0}^{\infty} (\beta\theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} [mc_{t+s} P_{t+s}^{\varepsilon} Y_{t+s}]}{E_t \sum_{s=0}^{\infty} (\beta\theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} [P_{t+s}^{\varepsilon-1} Y_{t+s}]} \tag{2.52}$$

where P_{kt}^{*} is the optimal price of the intermediate firm k and $\frac{\varepsilon}{\varepsilon - 1}$ the desired (natural) mark-up. The law of motion for aggregate prices is given by

$$P_t = [(1 - \theta_p) P_t^{*1-\varepsilon} + \theta_p P_{t-1}^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}. \tag{2.53}$$

Equations (2.52) and (2.53) yield the New-Keynesian Phillips Curve once log-linearized and after some mathematical rearrangements.

2.2.4 Wage bargaining

Following Stähler and Thomas (2012) the union utility corresponds to the mean of the surplus on employment of all its members. With μ the share of non-Ricardian households, let us express the union utility Υ_t as:

$$\Upsilon_t = (1 - \mu)[\lambda_t^{E_{op}} - \lambda_t^{S_o}] + \mu[\lambda_t^{E_{rp}} - \lambda_t^{S_r}] \tag{2.54}$$

Let us now describe the surplus for both sorts of households. The surplus for a Ricardian household to stay employed and accept the wage level agreed during the wage bargaining rather than seek for a new job in both sectors is, after some re-arrangements and calculations:

$$\begin{aligned} \lambda_t^{E_{op}} - \lambda_t^{S_o} = (1 - \tau_t^w) \lambda_t^{rio} W_t^p h - \lambda_t^{rio} b + \frac{(1 - h - s)^{1-\zeta} - (1 - s)^{1-\zeta}}{1 - \zeta} \\ + \beta E_t[(1 - p_t)(1 - \rho)(\lambda_{t+1}^{E_{op}} - \lambda_{t+1}^{S_o}) - p_t^g (1 - \rho)(\lambda_{t+1}^{E_{og}} - \lambda_{t+1}^{S_o})] \end{aligned} \tag{2.55}$$

and for the non-Ricardian workers:

$$\lambda_t^{E_{rp}} - \lambda_t^{S_r} = (1-\tau_t^w)\lambda_t^{rir} W_t^p h - \lambda_t^{rir} b + \frac{(1-h-s)^{1-\zeta} - (1-s)^{1-\zeta}}{1-\zeta} + \beta E_t[(1-p_t)(1-\rho)(\lambda_{t+1}^{E_{rp}} - \lambda_{t+1}^{S_o}) - p_t^g(1-\rho)(\lambda_{t+1}^{E_{rg}} - \lambda_{t+1}^{S_r})] \tag{2.56}$$

Nash product and efficient bargaining

Under the free entry condition, the Nash product can be expressed as:

$$\mathcal{N}_t = \Upsilon_t^{\eta}[\lambda_t^{E_f}]^{1-\eta}, \tag{2.57}$$

with η the union bargaining power.

In the case of efficient bargaining, firms and union jointly determine the real wage but not the hours worked in our model since we assume them as exogeneously fixed.

Maximization of the Nash product with respect to the private real wage leads to the following optimal rule for the surplus allocation:

$$\eta \frac{\partial \Upsilon_t}{\partial W_t^p} \lambda_t^{E_f} = (1-\eta)\frac{-\partial \lambda_t^{E_f}}{\partial W_t^p}\Upsilon_t \tag{2.58}$$

After several calculation steps (fully described in appendix 2.4), we finally obtain this rule for the private real hourly wage (net of the income tax):

$$\begin{aligned}(1-\tau_t^w)W_t^p h = \eta\frac{(1-\alpha)(1-\tau_t^w)}{(1+\tau_t^{sp})}\frac{Y_t}{E_t^p} \\ +(1-\eta)\left[b + \frac{(1-s)^{1-\zeta} - (1-h-s)^{1-\zeta}}{(1-\zeta)(\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio})}\right] \\ +\eta(1-\rho)E_t\left\{\beta_{t,t+1}\left[1-(1-p_t^p)\frac{(1-\tau_{t+1}^w)}{(1+\tau_{t+1}^{sp})}\tilde{\Lambda}_{t+1}\right]\lambda_{t+1}^{E_f}\right\} \\ +(1-\eta)(1-\rho)p_t^g\beta E_t[\Lambda_t(\lambda_{t+1}^{E_{rg}} - \lambda_{t+1}^{S_r}) + (1-\Lambda_t)(\lambda_{t+1}^{E_{og}} - \lambda_{t+1}^{S_o})],\end{aligned} \tag{2.59}$$

with $\Lambda_t = \dfrac{\mu\lambda_t^{rir}}{\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio}}$ the relative part of non-Ricardian consumers in the consumer pool and $\tilde{\Lambda}_t = \dfrac{\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio}}{\mu\lambda_{t-1}^{rir} + (1-\mu)\lambda_{t-1}^{rio}}$.

2.2.5 Monetary and fiscal policies

In each period, the monetary authority set the nominal interest rate according to the following standard Taylor rule:

$$\frac{R_t}{R_s} = \left(\frac{R_{t-1}}{R_s}\right)^{\alpha^r} \left(\frac{Y_t}{Y_s}\right)^{\alpha^y} \left(\frac{\pi_t}{\pi_s}\right)^{\alpha^\pi} \tag{2.60}$$

with α^r the degree of inertia of the nominal interest rate and α^y and α^π the relative weights given by the monetary authority to the stabilization of output and inflation. R_s represents the steady-state value of the variable R_t.

The budget constraint in each period for the government equals to:

$$\tau_t^c C_t + (\tau_t^w + \tau_t^{sp})(W_t^p E_t^p h) + D_t = W_t^g E_t^g h + C^g + I^g + bS_t \tag{2.61}$$

The government is allowed to create a deficit D_t to finance supplementary expenditure or deterioration of the tax bases. The debt dynamic for the government can be expressed as:

$$B_t = (1 + R_t)B_{t-1} + D_t \tag{2.62}$$

Public wage and public vacancies are considered as an AR(1) process such as:

$$\frac{W_t^g}{W_s^g} = \left(\frac{W_{t-1}^g}{W_s^g}\right)^{\rho^g} \exp(\xi_t^{Wg}) \tag{2.63}$$

$$\frac{V_t^g}{V_s^g} = \left(\frac{V_{t-1}^g}{V_s^g}\right)^{\rho^g} \exp(\xi_t^{Vg}) \tag{2.64}$$

where ρ^g denotes the duration of the shock. The terms ξ_t are the white noises associated with the shocks. One can notice that we assume a purely exogenous dynamic of the public wage. In Afonso and Gomez (2014) for instance, the dynamic of the public wage is partly endogenous since function of the dynamic of the real wage. In order to analyze the effects of a rise in public wage all things being equal, we assume a purely exogenous level of public wage.

Each tax is also considered as an AR(1) process such as:

$$\frac{\tau_t^w}{\tau_s^w} = \left(\frac{\tau_{t-1}^w}{\tau_s^w}\right)^{\rho^g} \exp(\xi^{\tau^w}) \tag{2.65}$$

$$\frac{\tau_t^{sp}}{\tau_s^{sp}} = \left(\frac{\tau_{t-1}^{sp}}{\tau_s^{sp}}\right)^{\rho^g} \exp(\xi^{\tau sp}) \tag{2.66}$$

2.2.6 Aggregation and market clearing condition

In order to clear the model, total demand addressed by both government and households to firms is expressed as:

$$Y_t = C_t + I_t + C^g + I^g \tag{2.67}$$

Given the previous description, aggregation yields

$$\begin{aligned} E_t^{tot} &= E_t^p + E_t^g, && (2.68)\\ E_t^g &= E_t^{og} + E_t^{rg}, && (2.69)\\ E_t^p &= E_t^{op} + E_t^{rp}, && (2.70)\\ S_t &= S_t^o + S_t^r && (2.71)\\ \theta_t &= \theta_t^p + \theta_t^g && (2.72) \end{aligned}$$

2.3 The effects of fiscal policy over the business cycle

2.3.1 Calibration and comments

We calibrate our model to a quarterly frequency. Some parameters are chosen so that long-run targeted values are reproduced. Table (2.1) presents the baseline calibration.

The time-discount factor β is set to 0.997 in order to match an average annual real rate of 3%. According to Chetty et al. (2013) and to Peterman (2012), we set $-\zeta$ to 1/3 in order to match the macro estimates of the Frisch elasticity. This parameter is slightly higher than the calibration chosen by Smets and Wouters (2007) which is around 2. Following Smets and Wouters (2003) and Stähler and Thomas (2012), we set the value of the risk aversion coefficient to $\sigma_c = 2$. Knowing that we set $h = 0.33$, we set the value of the fixed cost of participating in the labor market to $s = 7.5\%$ of the time endowment. This value is halfway between Burnside and Eichenbaum (1996)'s value and Ravn (2005)'s value which are respectively equal to 5% and 9.9% of the time endowment. Following Smets and Wouters (2003) and Stähler and Thomas (2012), we set $H = 0.85$. Finally, we set $\mu = 0.3$ which is quite similar to Coenen and Straub (2005).

Regarding the monetary policy's parameters, we set the coefficient response to the output gap and to inflation to the respective values $\alpha^y = 0.5$ and $\alpha^\pi = 1.5$ as in Clarida et al. (2000) and Trigari (2006). The nominal interest rate smoothing coefficient is set to $\alpha^r = 0.8$ as in Christoffel et al. (2009a).

Following Stähler and Thomas (2012), we set the public capital elasticity of output $\alpha^g = 0.015$, the adjustment cost parameter $\kappa = 2.48$. The share of the public sector in the whole economy is equal to $fracpub = 0.19$. Following Afonso and Gomes (2014) and Stähler and Thomas (2012), we set the elasticity of matches to unemployment in the public sector $\varphi^g = 0.3$ in order to give greater importance to vacancies in the public sector. However, the elasticity of matches to unemployment in the private sector is equal to $\varphi^p = 0.5$. Finally, in order to satisfy the Hosios (1990) condition, we set the bargaining power as equal to the elasticity of matches to unemployment in the private

sector.

Preferences		
β	0.997	Time-discount factor
$-\zeta$	1/3	Reverse of Frisch elasticity
σ^c	2	Risk aversion
h	0.33	Worked hours
s	0.075h	Fixed cost of participating in the labor market
H	0.85	Degree of Consumption habits
μ	0.3	Share of non-Ricardian workers in the economy
Production		
ε	7	Elasticity of substitution of goods
δ^k	0.025	Depreciation rate of capital
α	0.3	Private sector capital influence
κ^v	0.2	Vacancies posting costs
Monetary Policy		
α^r	0.8	Interest rate smoothing
α^y	0.5	Response coefficient to the output gap
α^π	1.5	Response coefficient to inflation
Fiscal Policy		
ρ^g	0.6	Duration of the fiscal policy shock
Labor market and wage bargaining		
κ	2.48	Adjustment cost parameter
η	0.5	Workers' bargaining power
ρ	0.06	Job destruction
φ^p	0.5	Elasticity of matches to unemployment in the private sector
φ^g	0.3	Elasticity of matches to unemployment in the public sector
$fracpub$	0.19	Share of the public sector in the whole e conomy

Table 2.1: Parameters and their calibrated values I

Regarding the production side, we set the elasticity of substitution between differentiated goods at $\varepsilon = 7$ in order to obtain an optimal markup of around 17%. The depreciation rate of capital is set to $\delta^k = 0.025$ just as in Moyen and Stähler (2010) and Stähler and Thomas (2012). The private sector capital influence coefficient follows the choice of Moyen and Stähler (2010) and it is set to $\alpha = 0.3$.

Table 2.2 displays the targeted values.

Table 2.2: Targeted Values

π_s	1	Inflation
p_s	1	Prices
Y_s	1	Output
C_s^g	0.2	Public Consumption
I_s^g	0.03	Public Invesment
b_s	$0.3Y_s$	Unemployement benefit
τ_s^c	0.20	VAT
τ_s^w	0.16	Income tax
τ_s^{sp}	0.16	Social Protection tax
U_s	0.08	Unemployment
q_s^p	0.7	Job filling probability in private sector
q_s^g	0.8	Job filling probability in public sector

2.3.2 The effects of fiscal policy on the labor market and output in normal times

We simulate the model with all fiscal shocks in turn. We begin by using a first-order approximation of the model in order to emphasize the transmission channels of the different fiscal instruments. Also, in the case of the public wage, we compare our results with those of Afonso and Gomes (2014). Then, the model is solved at the second-order in order to analyze the effects of the different fiscal shocks according to two steady-states for the unemployment rate. The low unemployment rate state consists in $U_s = 6\%$ while the labor market in bad times is represented by $U_s = 12\%$.

The IRFs for the first order simulations are presented in appendix 2.4 and 2.4.

Public wage expansion financed by debt

A rise in W_t^g has a direct positive impact on consumption of non-Ricardian households. This effect is amplified by a rise in employment. On the other hand, we observe a drop in private real wage that produces downward pressures on non-Ricardian consumption. However, total response is unambiguously positive.

Output thus increases right at the moment of the shock. However, the rise in prices generates higher interest rates that progressively crowds out Ricardian consumption and investment. This crowding-out effect on private activity produces a negative response of output in the mid-term, as shown in the IRFs.

In contrast with Afonso and Gomes (2014), a rise in public wage produces a drop in private real wage and a rise in employment. In Afonso and Gomes (2014), authors explain a higher private real wage through three different channels. First, a higher public wage increases the value of being unemployed, and we also share this channel. Secondly, their model generates a rise in marginal productivity of labor which creates upward pressures on private real wage. In our model, marginal productivity of labor clearly decreases due to a negative total effect on output and a clear rise in employment. This important aspect partly explains the different dynamics of private real wage produced by our model following a rise in public wage. Thirdly, Afonso and Gomes (2014) assume that the wage bill is entirely financed by a rise in labor income tax. The authors argue that this rise in the labor income tax has contradictory effects on real wage. In this simulation, we assume that the supplementary spending is financed by debt. Indeed, in our model, all things being equal, an increase in the labor income tax triggers a raise in private real wage. Thus, introducing the labor income tax as financing the wage bill puts upward pressures on private real wage. For comparison purposes, we modify the government budget constraint (2.61) by excluding the deficit D_t and we assume that the labor income tax τ^w is now a variable which is adjusted in order to finance the rise in government expenditure.

As shown in appendix 2.4, our model reproduces similar results in this case. Employment falls, unemployment rises and private real wage increases. We conclude that the rise in private real wage following a rise in public real wage strongly depends on the assumption made about the financing. As shown before, in case of a debt-based public wage expansion, our model produces a clear decrease in private real wage.

Public vacancies expansion

Following Michaillat (2014), a rise in public vacancies triggers a positive effect on total employment despite a crowding-out effect on private employment. The hiring of job seekers by the public sector increases the labor market tightness and thus triggers less job creation in the private sector. Since in our model a rise in public vacancies is wasteful (the public sector is unproductive), the effect on output is clearly negative because of a crowding-out effect on Ricardian households' consumption since real interest rate increases. Consumption of non-Ricardian households increases with the rise in total employment despite the decrease in real wage. For the first few periods, the response of output is positive, thanks to a rise in private investment. This rise in aggregate demand triggers a rise in private employment. However, after few periods the crowding-out effect of public employment on private employment prevails over the positive effect induced by the aggregate demand.

Labor income tax cut

First, the cut in the labor income tax yields a drop in private real wage. This drop can be explained thanks to a direct impact of the labor income tax on the wage dynamic. Indeed, the drop in the labor income tax increases the match surplus going to the worker. In the bargaining process, it puts a downward pressure on private sector wage. It induces a raise in private sector employment. Also, marginal productivity of labor is reduced, which causes additional downward pressures on private sector wage.

Following the increase in private employment and despite the drop in private sector wage, consumption of non-Ricardian households increases. With a rise in inflation and interest rates, Ricardian consumption drops and this crowding-out effect triggers a drop in output at the mid-term.

Social protection tax cut

Following the cut in social protection tax, the match surplus going to the firm hikes which induces an upward pressure on the private sector wage. As a consequence, con-

sumption of non-Ricardians rises. There is a limited crowding-out effect on Ricardians consumption. On the labor market, the decrease in τ_t^{sp} rises directly the present and future value of a job for firms. The marginal productivity of labor decreases slightly but the response of private real wages remains unambiguously positive. Employment in the private sector increases while in the public sector the rise in private real wages and the drop in unemployment reduce employment. However, total employment increases strongly.

2.3.3 What impact over the business cycle?

For all simulations in this chapter we use the Dynare program created by the CEPREMAP team. The algorithm used by Dynare for the second order approximation of our model is very close to the one developed in Schmitt-Grohé and Uribe (2004). In addition, the simulations are done by using the pruning method[6], in order to avoid triggering polynomials of increasing degrees when simulating the model. The IRFs of the second order simulations are presented in appendix 2.4.

For all the fiscal shocks considered, we find a similar result: fiscal policies have a greater effect on employment, unemployment and output in the case of the high steady-state value for the unemployment rate. As we will see throughout this section, these results are driven by two main elements: a wider pool of job seekers and the crucial role of the wage channel.

The wage channel: The starting point is that with a higher unemployment rate ($U_s = 12\%$), the pool of job seekers is wider at the steady state. In the case of expansionary fiscal shocks, the rise in private vacancies generates more matches when the initial pool of job seekers is wider. This channel is similar to the mechanism expounded by Michaillat (2014).

From then on, since employment increases more when $U_s = 12\%$, all things being equal, marginal productivity of labor also decreases more sharply. Indeed, even if the

[6]See for instance Lombardo and Uhlig (2014) for a presentation of the pruning method.

better response of output when $U_s = 12\%$ eases this channel, the response of marginal productivity of labor remains stronger when unemployment is high. It causes larger downward pressures on real wage, as shown in the IRFs.

Effects on output fiscal multipliers: Moreover, the wage channel is a crucial element for understanding and comparing the response of output according to different steady-state unemployment rates. We now explore the conditions under which we obtain a better response of output in the case of a high unemployment rate, thanks to a higher degradation of real wage .

First, except for the social protection tax shock, the greater degradation of real wage when $U_s = 12\%$, principally driven by the decrease in productivity, has a direct negative effect on consumption of the non-Ricardians. Indeed, non-Ricardian households' consumption increases more when $U_s = 6\%$ than when $U_s = 12\%$. The case for the social protection tax shock is different in the sense that a decrease in the social protection tax produces a positive response of private wage. However, this positive response is larger when unemployment is low than when unemployment is high so that the non-Ricardian households' consumption reacts in the same way as previously.

The consequence of the previous result is the following: if our economy were composed only of non-Ricardian households, like in Michaillat (2014) for instance, our model would produce higher output fiscal multipliers with the low steady-state unemployment rate. In that sense, we need to introduce Ricardian households to produce higher output multipliers at the bad state of the economy. As observed in the IRFs, consumption of the Ricardians is higher when the unemployment rate is high, which produces better output fiscal multipliers. This is due to the greater degradation of real wage, causing lower inflation pressures for the firms and thus, a lower rise of the interest rate in the medium and long term.

Thus, when $U_s = 12\%$ the larger negative response of real wage produces a higher response of Ricardians' consumption but a lower non-Ricardians' consumption, in com-

parison with the simulations when $U_s = 6\%$. Total response of aggregate consumption and output depends on the strength of these two opposite effects and of the relative share of both types of households in the economy. With a share of non-Ricardians in line with previous estimates[7], that is $\mu = 0.3$, the response of aggregate demand is better when the unemployment rate is high. With this model calibration, the positive effect of a lower inflation on Ricardians' consumption when the unemployment rate is high prevails over the weaker response of non-Ricardian's consumption due to a greater degradation of real wage.

It is important to notice that the more positive response of consumption of the Ricardians is not due in our model to a higher marginal utility of consumption in economic downturns, as this is the case in Sims and Wolff (2013). The authors highlight this transmission channel for explaining different output fiscal multipliers over the business cycle. This is not the case in our model according to the definition of the steady-states. The value of Ricardian consumption at the steady state is obtained residually with the steady-state value of non-Ricardian consumption such as:

$$C_s^o = \frac{C_s - \mu C_s^r}{1 - \mu}, \tag{2.73}$$

whith C_s^o, C_s^r and C_s respectively the steady-state value of C_t^o, C_t^r and C_t.

The steady-state value of non-Ricardian consumption is lower with $U_s = 12\%$ since real wage is larger than unemployment benefits at the steady state. It triggers a higher marginal utility of consumption for this class of households but it has no impact on their consumption behavior since they simply consume their disposable income. However, a lower level of consumption at the steady state for the non-Ricardian households implies a higher consumption for the Ricardians in bad times so that the the transmission channel highlighted in Sims and Wolff (2013) is not present in our model.

[7] See for instance Coenen and Straub (2005)

We can also notice that the transmission channel present in Sims and Wolff (2013) is based on the presence of Ricardian households in the model, similarly to our work.

2.4 Conclusion

This chapter attempts to investigate the non-linear effects of fiscal policy over the business cycle with a focus on the labor market. A first part of the results section is dedicated to the analysis of the effects of different fiscal instruments on the labor market and on output. We use a first-order approximation of the model in order to disentangle the main transmission channels at work. The main result is that all fiscal instruments increase employment and decrease unemployment. Also, response of output is positive in the short term but negative in the medium term because of a strong and permanent crowding-out effect on Ricardian consumption.

Using a second-order approximation of the model, we show that all fiscal shocks are more effective when the steady-state unemployment rate is high: both employment and output increase more. Following Michaillat (2014), the stronger effect on employment is due to a larger pool of job seekers when the shocks occur. We then investigate the assumptions needed to produce a better response of output. In our model, if we introduced only non-Ricardian households, the output fiscal multiplier would be lower when the unemployment rate is at 12%.

The introduction of Ricardian households is necessary to produce a higher output fiscal multipliers as explained in the results section. However, the transmission channel is very different from the one in Sims and Wolff (2013). In our model, it is the wage channel and a lower rise in interest rates that produce the larger output fiscal multiplier during economic downturn while it is a higher marginal utility of consumption during bad times that mitigates the degradation of consumption of the Ricardian households in Sims and Wolff (2013). On the contrary, our definition of the steady states triggers a lower marginal utility of consumption for the Ricardians when the unemployment rate is high. We can expect that when introducing a higher marginal utility of consumption

for the Ricardians during economic downturn at the steady-state, this result would be amplified.

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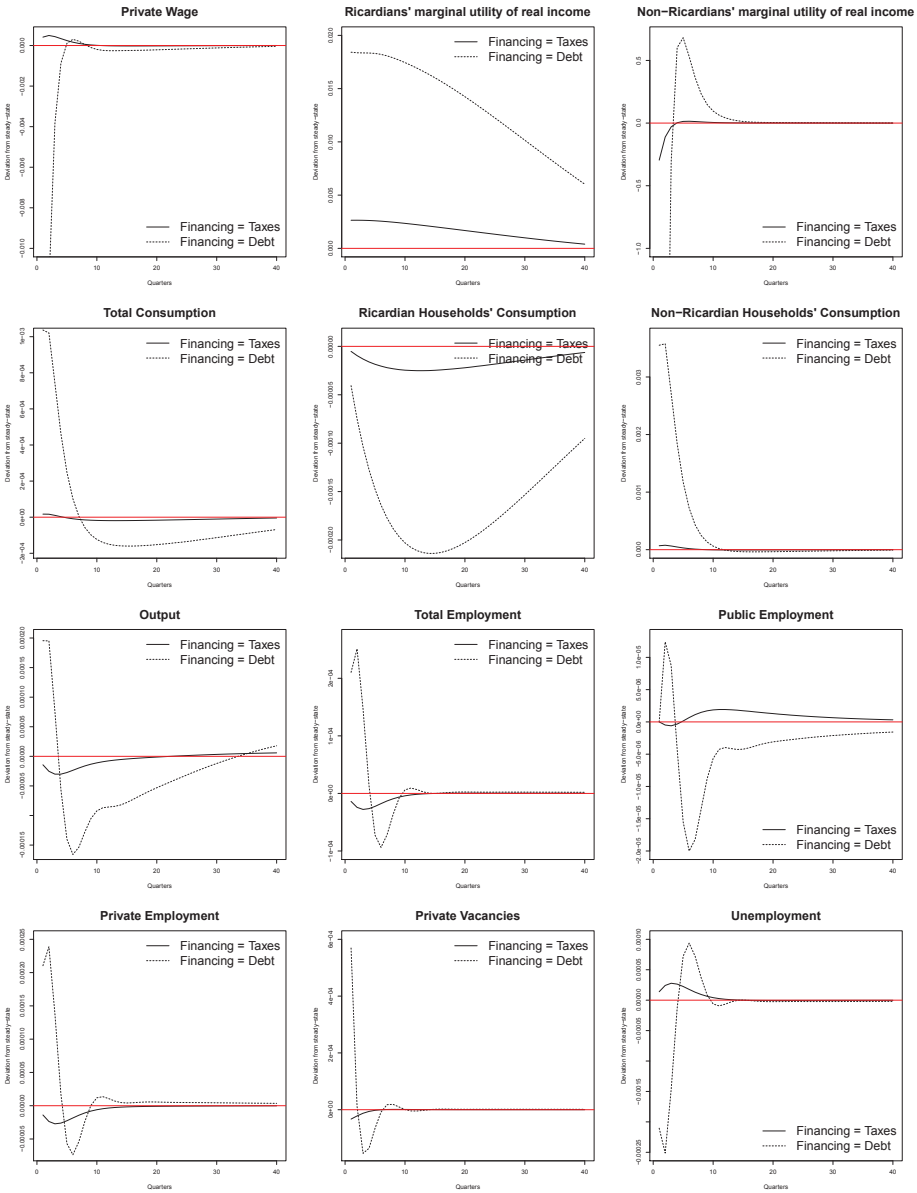
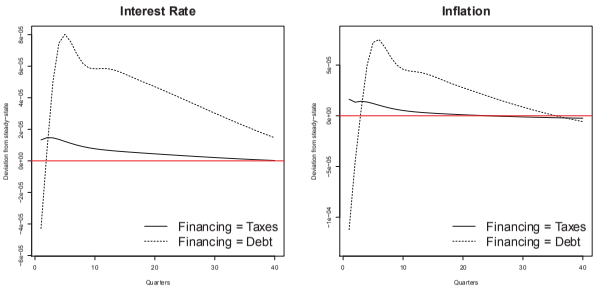
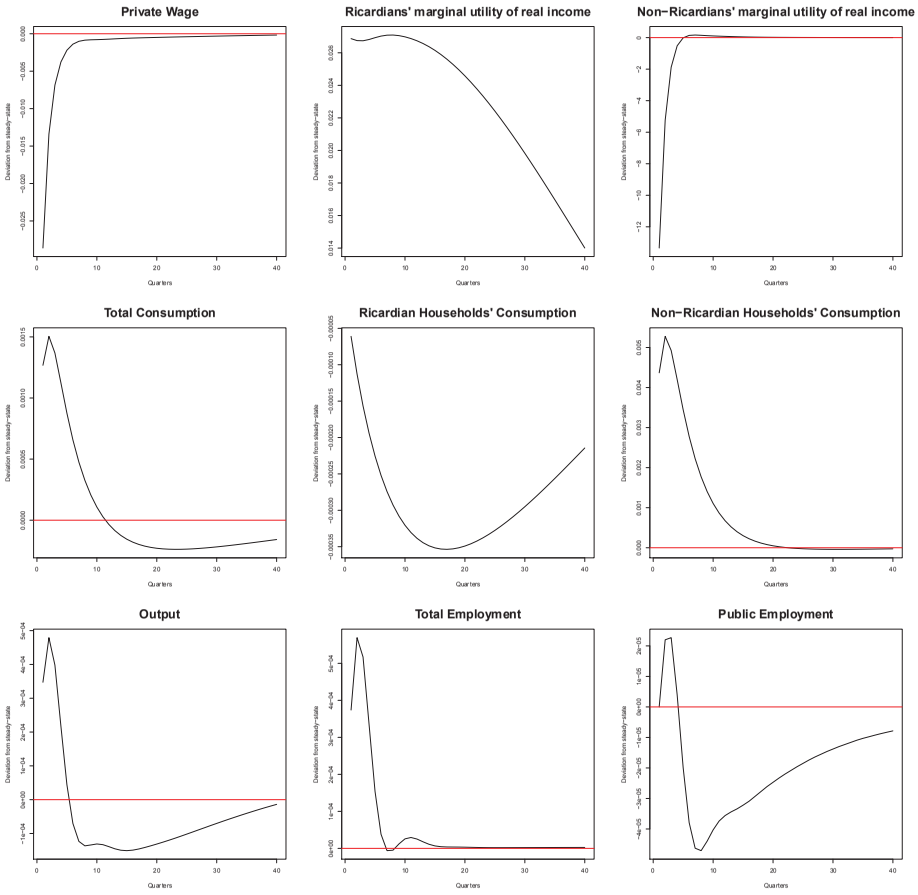
A Comparison with Afonso and Gomes (2014)

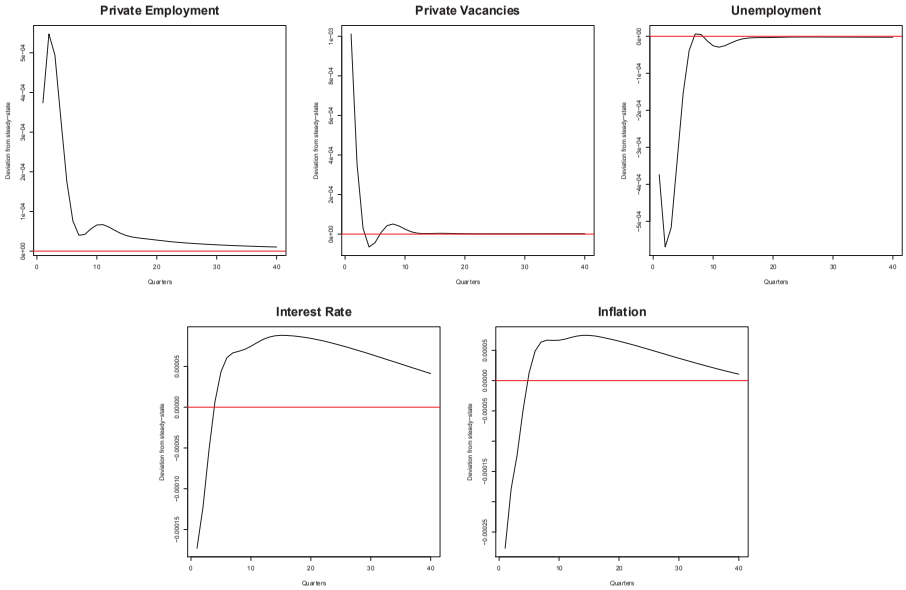




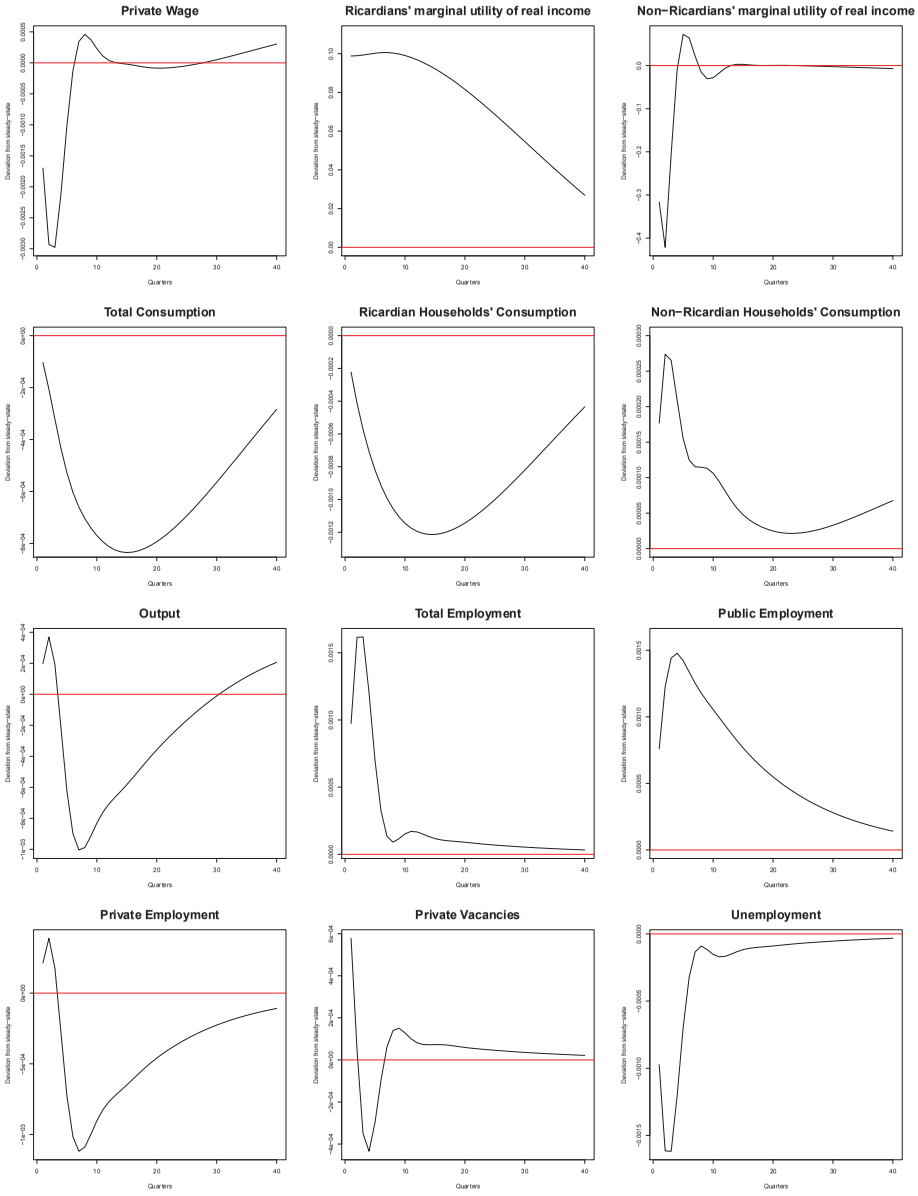
B The IRFs of the model at the first order

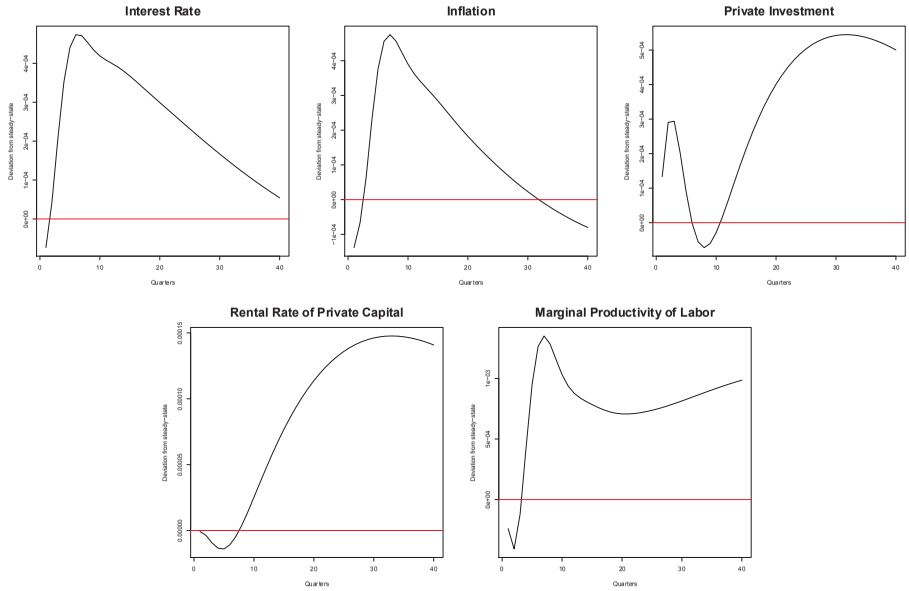
B.1 The Wage Tax Shock



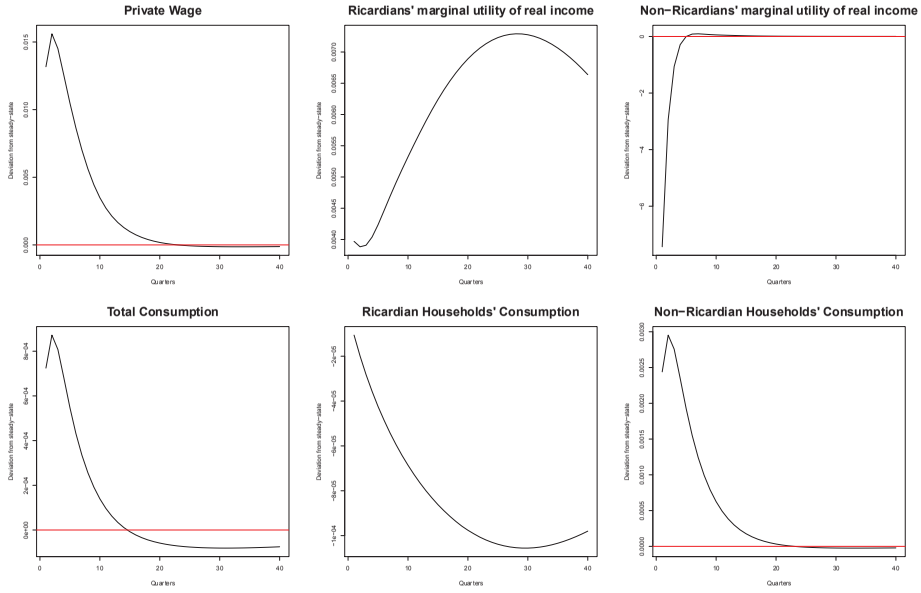

Private Employment
Private Vacancies
Unemployment
Interest Rate
Inflation
Deviation from steady−state
Quarters

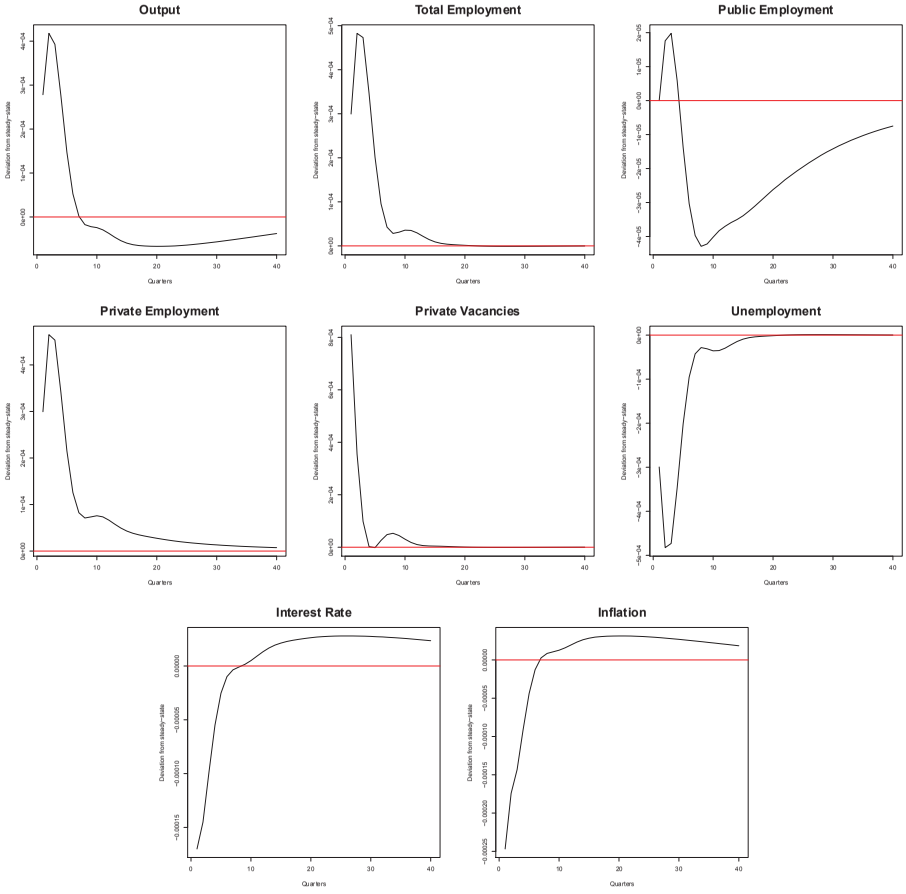
B.2 The Public Vacancies Shock





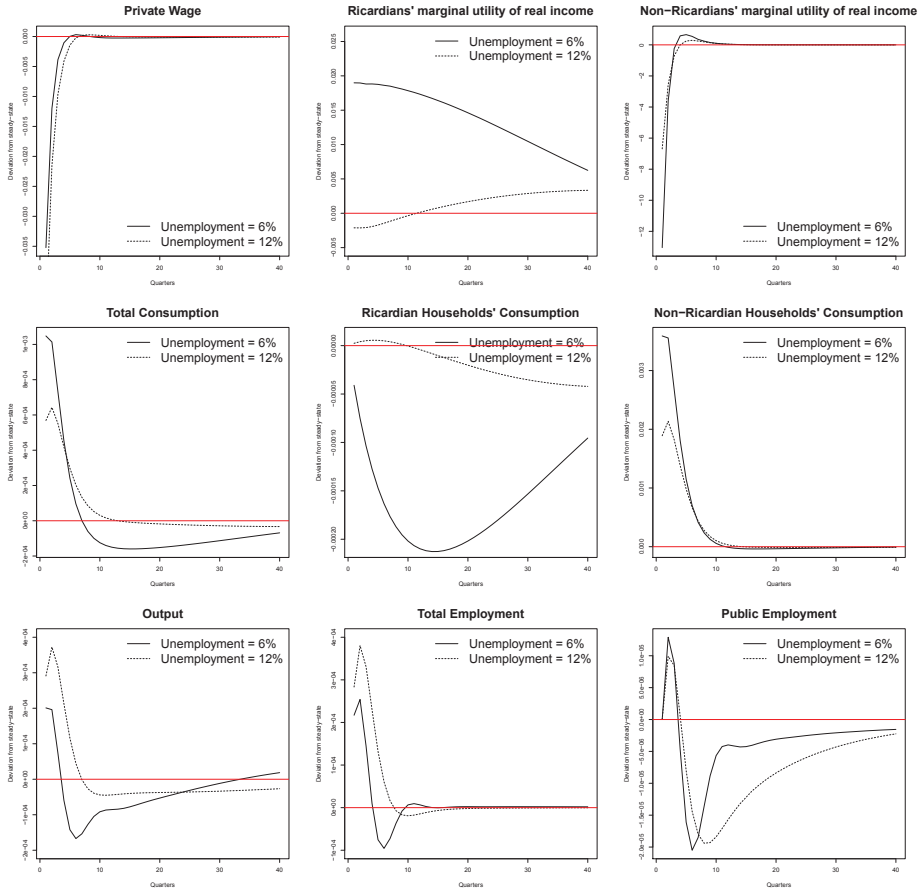
B.3 The Social Protection Tax Shock

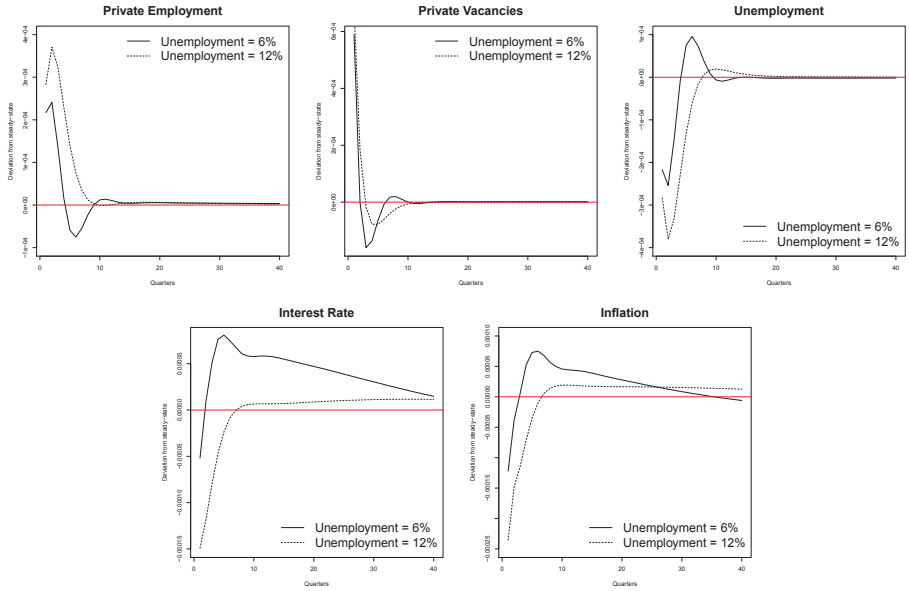



Output
Total Employment
Public Employment
Private Employment
Private Vacancies
Unemployment
Interest Rate
Inflation
Deviation from steady−state
Quarters

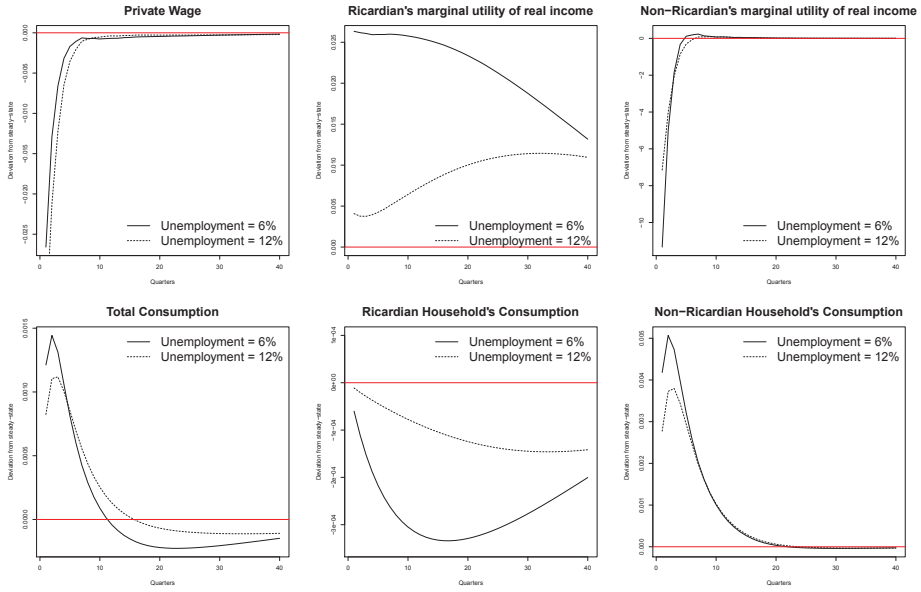
C The IRFs for the different shocks over the business cycle

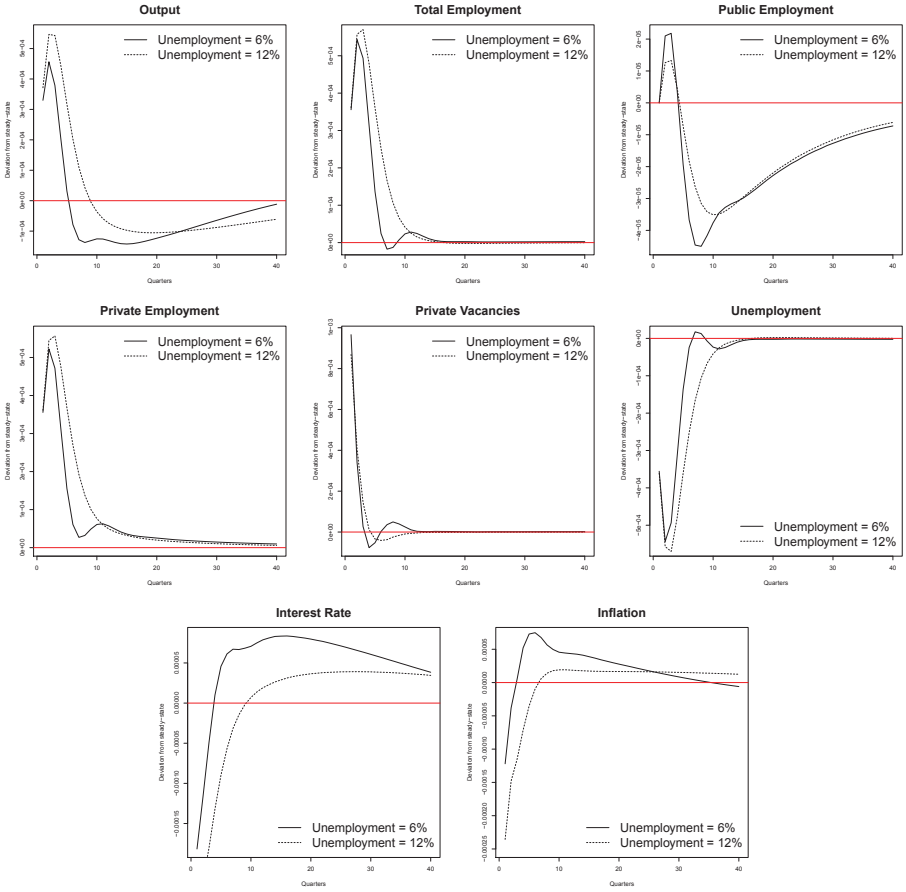
C.1 The Public Wage Shock



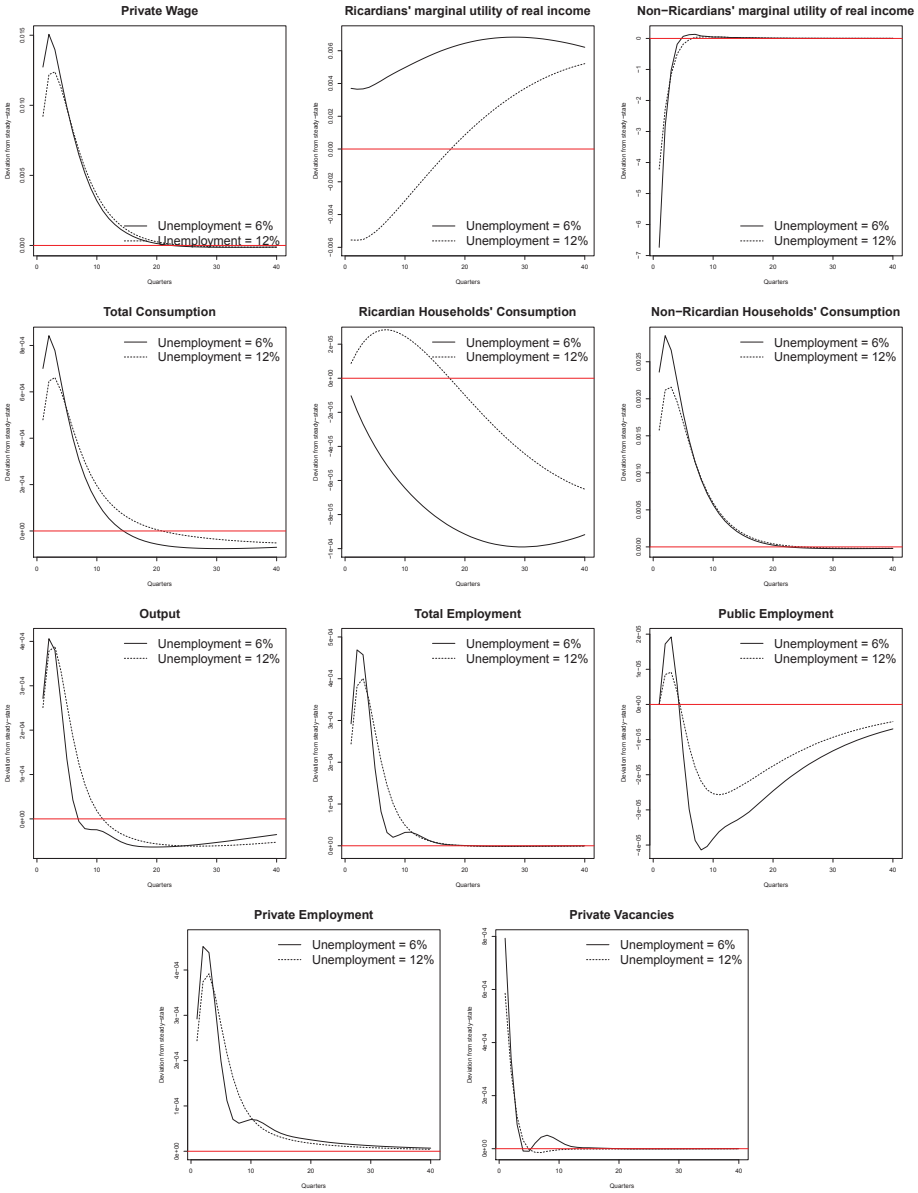


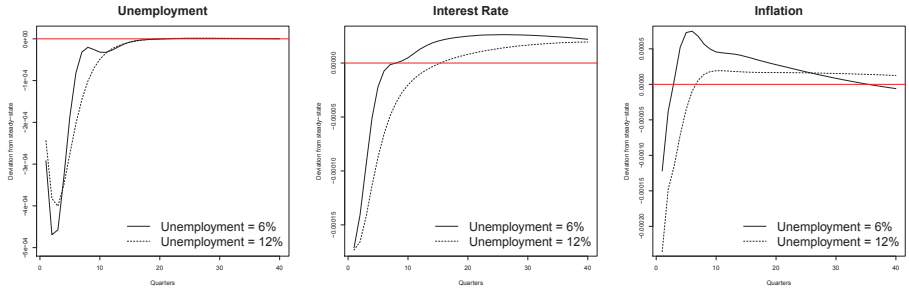
C.2 The Wage Tax Shock



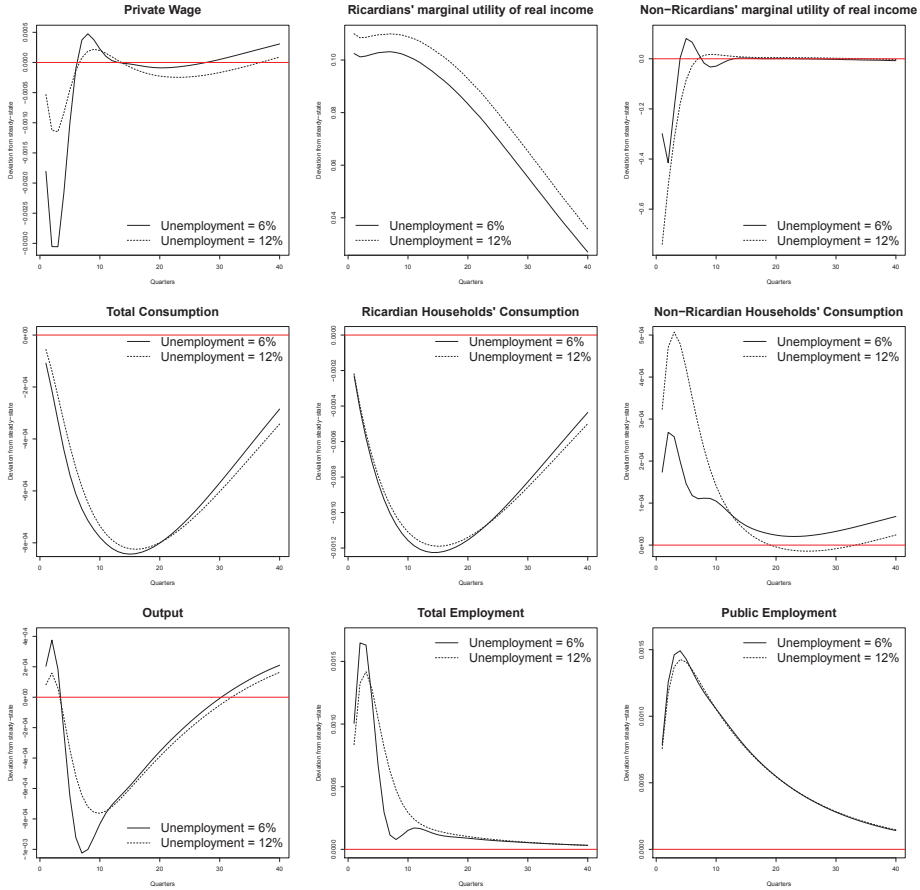

Output
Total Employment
Public Employment
Private Employment
Private Vacancies
Unemployment
Interest Rate
Inflation
Unemployment = 6%
Unemployment = 12%
Deviation from steady−state
Quarters

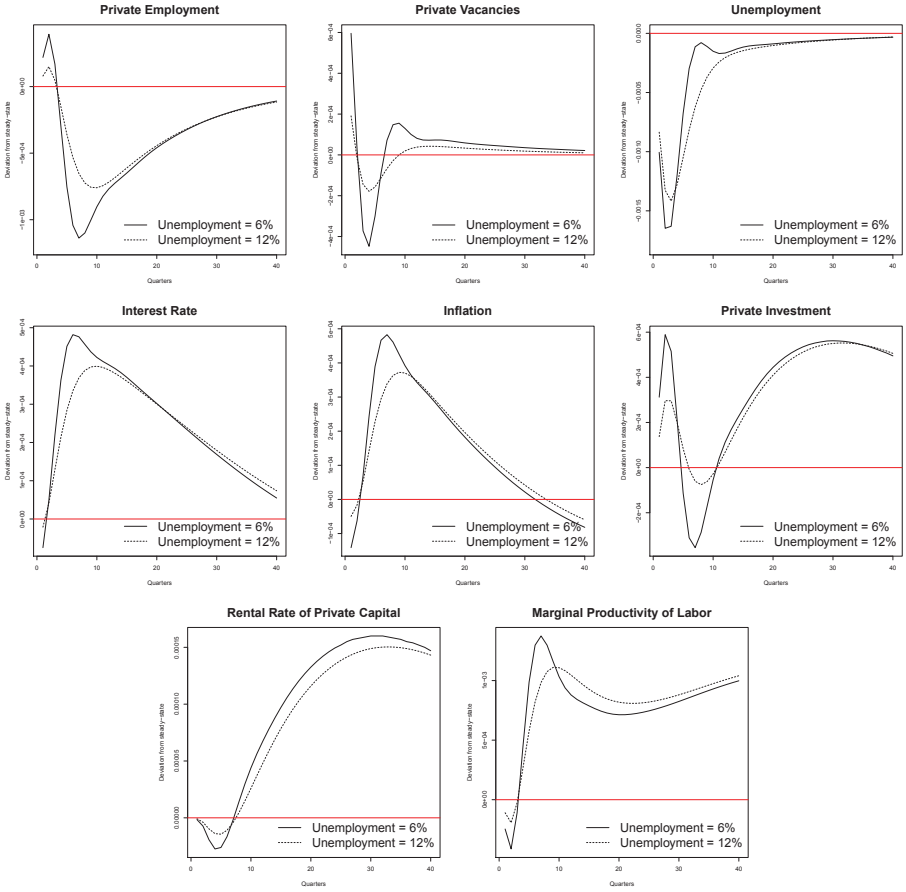
C.3 The Social Protection Tax Shock





C.4 The Public Vacancies Shock




Private Employment
Private Vacancies
Unemployment
Interest Rate
Inflation
Private Investment
Rental Rate of Private Capital
Marginal Productivity of Labor
Unemployment = 6%
Unemployment = 12%
Quarters
Deviation from steady−state

D Wage equation calculation

We start from the optimal sharing rule given by the equation (2.58). Knowing that

$$\frac{\partial \Upsilon_t}{\partial W_t^p} = (1-\mu)(1-\tau_t^w)\lambda_t^{rio}h + \mu(1-\tau_t^w)\lambda_t^{rir}h, \tag{2.74}$$

and

$$\frac{\partial \Upsilon_t^{E_f}}{\partial W_t^p} = -(1+\tau_t^{sp})h, \tag{2.75}$$

and after giving to Υ_t and $\lambda_t^{E_f}$ their respective value described by equations (2.54) and (2.45), (2.58) yields

$$\begin{aligned}
&\eta\left[(1-\mu)(1-\tau_t^w)\lambda_t^{rio} + \mu(1-\tau_t^w)\lambda_t^{rir}\right] \\
&\times\left[(1-\alpha)\frac{Y_t}{E_t^p} - (1+\tau_t^{sp})W_t^p h + (1-\rho)\beta_{t,t+1}\lambda_{t+1}^{E_f}\right] \\
=(1-\eta)(1+\tau_t^{sp})&\left\{\mu\left[(1-\tau_t^w)\lambda_t^{rir}W_t^p h - \lambda_t^{rir}b + \frac{(1-h-s)^{1-\zeta}-(1-s)^{1-\zeta}}{1-\zeta}\right.\right. \\
&\left.+\beta E_t\left[(1-\rho)(1-p_t^p)(\lambda_{t+1}^{E_{rp}} - \lambda_{t+1}^{S_r}) - p_t^g(1-\rho)(\lambda_{t+1}^{E_{rg}} - \lambda_{t+1}^{S_r})\right]\right] \\
&+(1-\mu)\left[(1-\tau_t^w)\lambda_t^{rio}W_t^p h - \lambda_t^{rio}b + \frac{(1-h-s)^{1-\zeta}-(1-s)^{1-\zeta}}{1-\zeta}\right. \\
&\left.\left.+\beta E_t\left[(1-\rho)(1-p_t^p)(\lambda_{t+1}^{E_{op}} - \lambda_{t+1}^{S_o}) - p_t^g(1-\rho)(\lambda_{t+1}^{E_{og}} - \lambda_{t+1}^{S_o})\right]\right]\right\}
\end{aligned}$$

$$\begin{aligned}
&\Leftrightarrow (1+\tau_t^{sp})(1-\tau_w)(\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio})W_t^p h \\
&= \eta(1-\tau_t^w)(\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio})\left[\frac{(1-\alpha)Y_t}{E_t^p} + (1-\rho)\beta_{t,t+1}\lambda_{t+1}^{E_f}\right] \\
&+(1-\eta)(1+\tau_t^{sp})\left[[\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio}]b + \frac{(1-s)^{1-\zeta}-(1-h-s)^{1-\zeta}}{1-\zeta}\right] \\
&-(1-\eta)(1+\tau_t^{sp})(1-\rho)(1-p_t^p)\beta E_t[\Upsilon_{t+1}] \\
&+(1-\eta)(1+\tau_t^{sp})(1-\rho)p_t^g\beta E_t[\mu(\lambda_{t+1}^{E_{rg}} - \lambda_{t+1}^{S_r}) + (1-\mu)(\lambda_{t+1}^{E_{og}} - \lambda_{t+1}^{S_o})]
\end{aligned}$$

Moreover, since equation 2.58 yields

$$\beta E_t[\Upsilon_{t+1}] = \frac{\eta}{(1-\eta)} E_t\left[\beta_{t,t+1}\frac{(1-\tau^w_{t+1})(\mu\lambda^{rir}_{t+1}+(1-\mu)\lambda^{rio}_{t+1})}{(1+\tau^{sp}_{t+1})}\lambda^{E_f}_{t+1}\right],$$

we finally obtain

$$\begin{aligned}
&\Leftrightarrow (1+\tau^{sp}_t)(1-\tau_w)(\mu\lambda^{rir}_t+(1-\mu)\lambda^{rio}_t)W^p_t h \\
&= \eta(1-\tau^w_t)(\mu\lambda^{rir}_t+(1-\mu)\lambda^{rio}_t)\left[\frac{(1-\alpha)Y_t}{E^p_t}+\frac{1-\rho}{1+\tau^{sp}_t}E_t[\beta_{t,t+1}\lambda^{E_f}_{t+1}]\right] \\
&+(1-\eta)(1+\tau^{sp}_t)\left[(\mu\lambda^{rir}_t+(1-\mu)\lambda^{rio}_t)b+\frac{(1-s)^{1-\zeta}-(1-h-s)^{1-\zeta}}{1-\zeta}\right] \\
&-\eta(1+\tau^{sp}_t)(1-p^p_t)(1-\rho)E_t\left[\beta_{t,t+1}\frac{(1-\tau^w_{t+1})}{(1+\tau^{sp}_{t+1})}(\mu\lambda^{rir}_{t+1}+(1-\mu)\lambda^{rio}_t)\lambda^{E_f}_{t+1}\right] \\
&+(1-\eta)(1+\tau^{sp}_t)(1-\rho)p^g_t\beta E_t[\mu(\lambda^{E_{rg}}_{t+1}-\lambda^{S_r}_{t+1})+(1-\mu)(\lambda^{E_{og}}_{t+1}-\lambda^{S_o}_{t+1})]
\end{aligned}$$

and

$$\begin{aligned}
(1-\tau^w_t)W^p_t h = \eta\frac{(1-\alpha)(1-\tau^w_t)}{(1+\tau^{sp}_t)}\frac{Y_t}{E^p_t}+(1-\eta)\left[b+\frac{(1-s)^{1-\zeta}-(1-h-s)^{1-\zeta}}{(1-\zeta)\mu\lambda^{rir}_t+(1-\mu)\lambda^{rio}_t}\right] \\
+\eta(1-\rho)E_t\left\{\beta_{t,t+1}\left[1-(1-p^p_t)\frac{(1-\tau^w_{t+1})}{(1+\tau^{sp}_{t+1})}\tilde{\Lambda}_{t+1}\right]\lambda^{E_f}_{t+1}\right\} \\
+(1-\eta)(1-\rho)p^g_t\beta E_t[\Lambda_t(\lambda^{E_{rg}}_{t+1}-\lambda^{S_r}_{t+1})+ \\
(1-\Lambda_t)(\lambda^{E_{og}}_{t+1}-\lambda^{S_o}_{t+1})]
\end{aligned}$$

E Steady-State calculations

Starting from the long-run targeted values described in table (2.2), we now describe the steady-state calculations. We first assume that $W^g_s = W^p_s$.

From equation (2.2), one can easily define the value of total employment at the steady-state such as

$$E^{tot}_s = 1 - U_s. \tag{2.76}$$

From equation (2.3), the number of job seekers in the economy as a whole is equal to

$$S_s = U_s + \rho E_s^{tot}. \tag{2.77}$$

By definition, assuming that $fracpub$ is the size of the public sector on the labor market, we can define the value of public employment as

$$E_s^g = E_s^{tot} \times fracpub. \tag{2.78}$$

Then, from equations (2.78) and (2.67), we define the value of private employment at the steady state as

$$E_s^p = E_s^{tot} - E_s^g. \tag{2.79}$$

By definition we have

$$E_s^r = \mu E_s^{tot} \tag{2.80}$$

$$\text{and} \quad E_s^o = (1-\mu) E_s^{tot} \tag{2.81}$$

Thanks to equation (2.40), we can define

$$V_s^p = \rho \frac{E_s^p}{q_s^p} \tag{2.82}$$

and we assume similarly that

$$V_s^g = \rho \frac{E_s^g}{q_s^g}. \tag{2.83}$$

Joining the matching functions and the definition of the probability for a firm to fill its job, described by the equations (2.5) and (2.7) we are able to define the matching

technology in each sector as

$$\kappa_e^p = \frac{V_s^p q_s^p}{S_s^{\varphi^p}(V_s^p)^{1-\varphi^p}} \tag{2.84}$$

$$\kappa_e^g = \frac{V_s^g q_s^g}{S_s^{\varphi^g}(V_s^g)^{1-\varphi^g}} \tag{2.85}$$

Thanks to the previous equations and to the equation (2.5), we can define the number of matches in each sector at the steady state as

$$M_s^p = \kappa_e^p S_s^{\varphi^p}(V_s^p)^{1-\varphi^p} \tag{2.86}$$

$$\text{and} \quad M_s^g = \kappa_e^g S_s^{\varphi^g}(V_s^g)^{1-\varphi^g}. \tag{2.87}$$

Thanks to equations (2.77), (2.86) and (2.87), we can define the probability for a worker to find a job in each sector at the steady state as

$$p_s^p = \frac{M_s^p}{S_s} \tag{2.88}$$

$$\text{and} \quad p_s^g = \frac{M_s^g}{S_s}. \tag{2.89}$$

According to equation (2.24) we have

$$R_s^k = r_s + \delta^k - 1. \tag{2.90}$$

We assume that at the steady-state, marginal cost is equal to the desired (flexible prices) markup such as

$$mc_s = \frac{\varepsilon}{\varepsilon - 1}. \tag{2.91}$$

Thanks to the previous equations and using equation (2.47), we can define the marginal cost of labor at the steady state such as

$$x_s = (1-\alpha)mc_s\left(\frac{Y_s}{E_s^p h}\right) - (1 + \tau_s^{sp} W_s^p h. \tag{2.92}$$

From equation (2.25) and the definition of $S\left(\frac{I_t^o}{I_{t-1}^o}\right)$, the steady-state of Tobin's Q is:

$$Q_s = 1. \tag{2.93}$$

According to equation (2.46), we have

$$k_s = \alpha mc_s \frac{Y_s}{R_s^k}, \tag{2.94}$$

while from aggregation we have

$$k_s^o = \frac{k_s}{(1-\mu)} \tag{2.95}$$

$$\text{and} \quad I_s^o = \frac{I_s}{(1-\mu)}. \tag{2.96}$$

Thanks to the equation (2.41), we can define the TPF at the steady-state as

$$\epsilon_s^a = \frac{Y_s}{(K_s^g)^{\alpha^g} k_s^\alpha (E_s^p h)^{1-\alpha}}. \tag{2.97}$$

According to the market clearing condition defines by equation (2.66), we have

$$C_s = Y_s - C^g - I^g - Is. \tag{2.98}$$

The definition of the LMT given by equation (2.8) yields

$$\theta_s^p = \frac{V_s^p}{S_s} \tag{2.99}$$

$$\text{and} \quad \theta_s^g = \frac{V_s^g}{S_s}. \tag{2.100}$$

Aggregation yields

$$\theta_s = \theta_s^p + \theta_s^g. \tag{2.101}$$

By construction, we have

$$q_s^1 = \frac{\lambda_s^{rio} Y_s mc_s}{1 - \beta\theta^p \pi_s^{\epsilon-1}} \tag{2.102}$$

$$q_s^2 = \frac{\lambda_s^{rio} Y_s}{1 - \beta\theta^p \pi_s^{\epsilon-1}}, \tag{2.103}$$

and thanks to equation (2.52)

$$p_s^{opt} = \frac{\varepsilon}{\varepsilon - 1} \frac{q_s^1}{q_s^2}. \tag{2.104}$$

The value of a job at the steady-state for a firm is equal to

$$\lambda_s^{Ef} = \frac{1-\alpha}{1-(1-\rho)\beta} \frac{Y_s}{E_s^p} - \frac{1+\tau_s^{sp}}{1-(1-\rho)\beta} W_s^p h. \tag{2.105}$$

Thanks to the previous equations we can now define the value of posting a vacancy

$$\kappa^v = \beta \left(\frac{(1-\alpha)Y_s}{E_s^p} - (1 + \tau_s^{sp} W_s^p h + (1-\rho)\beta \lambda_s^{Ef} \right) q_s^p. \tag{2.106}$$

The utility function of the union at the steady state can be defined as

$$\Upsilon_s = (1-\mu)(\lambda_s^{E_{op}} - \lambda_s^{S_o}) + \mu(\lambda_s^{E_{rp}} - \lambda_s^{S_r}). \tag{2.107}$$

Finally, by definition,

$$mpl_s = \frac{(1-\alpha)Y_s}{E_s^p h}. \tag{2.108}$$

E.1 Marginal utility of real income in terms of non-Ricardian consumption

If we admit that $W_s^g = W_s^p$, the non-Ricardian consumption at the steady state can be expressed as

$$C_s^r = \{(1-\tau_s^w)[E_s^r W_s^p h + (1-E_s^r)b]\}^(1+\tau_s^c) \tag{2.109}$$

We express the Ricardians' consumption at the steady state in terms of wage as

$$C_s^o = \frac{C_s - muC_s^r}{1 - mu} \tag{2.110}$$

Then, the marginal utility of real income for Ricardian and non-Ricardian households can be expressed as

$$\lambda_s^{rio} = \frac{1-\beta H}{1+\tau_s^c}[(1-H)C_s^o]^{-\sigma_c} \Leftrightarrow \lambda_s^{rio} = \frac{1-\beta h}{1+\tau_s^c}$$
$$\left\{(1-H)\frac{1}{1-\mu}\left\{C_s - \frac{\mu}{1+\tau_s^c}[(1-\tau_s^w)E_s^r W_s^p h + (1-E_s^r)b]\right\}\right\}^{-\sigma_c} \tag{2.111}$$

$$\lambda_s^{rir} = (1-\beta H)[(1-H)C_s^r]^{-\sigma_c}$$
$$\Leftrightarrow \lambda_s^{rir} = \frac{1-\beta H}{1+\tau_s^c}\{(1-H)\{(1-\tau_s^w)[E_s^r W_s^p h + (1-E_s^r)b]\}\}^{-\sigma_c} \tag{2.112}$$

E.2 Workers' marginal utilities in terms of unemployment marginal utility

For Ricardian workers

$$\lambda_s^{E_{op}} = (1-\tau_s^w)\lambda_s^{rio} W_s^p h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + (1-\rho)\beta\lambda_s^{E_o p} + \rho\beta\lambda_s^{S_o}$$
$$\Leftrightarrow [1-(1-\rho)\beta]\lambda_s^{E_{op}} = (1-\tau_s^w)\lambda_s^{rio} W_s^p h -$$
$$\frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + \rho\beta\lambda_s^{S_o} \Leftrightarrow \lambda_s^{E_{op}} = \frac{1}{1-(1-\rho)\beta}$$
$$\left[(1-\tau_s^w)W_s^p h\lambda_s^{rio} - \frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)} + \beta\rho\lambda_s^{S_{os}}\right]$$

$$\lambda_s^{E_{og}} = (1-\tau_s^w)\lambda_s^{rio}W_s^g h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + (1-\rho)\beta\lambda_s^{E_{og}} + \rho\beta\lambda_s^{S_o}$$

$$\Leftrightarrow [1-(1-\rho)\beta]\lambda_s^{E_{og}} = (1-\tau_s^w)\lambda_s^{rio}W_s^g h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + \rho\beta\lambda_s^{S_o}$$

$$\Leftrightarrow \lambda_s^{E_{og}} = \frac{1}{1-(1-\rho)\beta}\left[(1-\tau_s^w)W_s^g h\lambda_s^{rio} - \frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)} + \beta\rho\lambda_s^{S_{os}}\right]$$

$$\Leftrightarrow \lambda_s^{E_{og}} = \frac{1}{1-(1-\rho)\beta}\left[(1-\tau_s^w)W_s^p h\lambda_s^{rio} - \frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)} + \beta\rho\lambda_s^{S_{os}}\right] \quad (2.113)$$

$$\lambda_s^{S_o} = b\lambda_s^{rio} - \frac{1-(1-s)^{1-\zeta}}{1-\zeta} + (1-p_s^p-p_s^g)\beta\lambda_s^{S_o} + \rho(p_s^p+p_s^g)\beta\lambda_s^{S_o}$$
$$+ (1-\rho)\beta[p_s^p\lambda_s^{E_{op}} + p_s^g\lambda_s^{E_{og}}]$$
$$\Leftrightarrow \lambda_s^{S_o}[1-\beta+\beta(1-\rho)(p_s^p+p_s^g)] = b\lambda_s^{rio} - \frac{1-(1-s)^{1-\zeta}}{1-\zeta}$$
$$+ \frac{\beta(1-\rho)(p_s^p+p_s^g)}{1-\beta(1-\rho)}\left[(1-\tau_s^w)\lambda_s^{rio}W_s^p h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta} + \beta\rho\lambda_s^{rio}\right]$$
$$\Leftrightarrow \lambda_s^{S_o}\left[1-\beta+\beta(1-\rho)(p_s^p+p_s^g)\left(1-\frac{\beta\rho}{1-\beta(1-\rho)}\right)\right] = b\lambda_s^{rio} - \frac{1-(1-s)^{1-\zeta}}{1-\zeta}$$
$$+ \frac{\beta(1-\rho)(p_s^p+p_s^g)}{1-\beta(1-\rho)}$$
$$\left[(1-\tau_s^w)\lambda_s^{rio}W_s^p h - \frac{1-(1-h-s)^{1-\zeta}}{1-\zeta}\right]$$

$$\Leftrightarrow \lambda_s^{S_o} = \frac{b\lambda_s^{rio} - B_1^S + B_2^S W_s^p h\lambda_s^{rio}}{B_3^S} \quad (2.114)$$

with

$$B_1^S = \frac{1-(1-s)^{1-\zeta}}{1-\zeta} + \frac{\beta(1-\rho)(p_s^p+p_s^g)}{1-(1-\rho)\beta}\frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)}$$

$$B_2^S = \frac{\beta(1-\rho)(p_s^p+p_s^g)}{1-\beta(1-\rho)}(1-\tau_s^w)$$

$$B_3^S = 1-\beta+\beta(1-\rho)(p_s^p+p_s^g)\left(1-\frac{\beta\rho}{1-\beta(1-\rho)}\right)$$

For non-Ricardian workers

In a similar way, we obtain

$$\lambda_s^{E_{rp}} = \frac{1}{1-(1-\rho)\beta}\left[(1-\tau_s^w)W_s^p h\lambda_s^{rir} - \frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)} + \beta\rho\lambda_s^{S_{rs}}\right] \quad (2.115)$$

$$\lambda_s^{E_{rg}} = \frac{1}{1-(1-\rho)\beta}\left[(1-\tau_s^w)W_s^p h\lambda_s^{rir} - \frac{1-(1-h-s)^{1-\zeta}}{(1-\zeta)} + \beta\rho\lambda_s^{S_{rs}}\right] \quad (2.116)$$

$$\lambda_s^{S_r} = \frac{b\lambda_s^{rir} - B_1^S + B_2^S W_s^p h\lambda_s^{rir}}{B_3^S} \quad (2.117)$$

Chapter 3

Spillover effects in a monetary union: why do fiscal policy instruments matter?[1]

3.1 Introduction

Since the Eurozone was launched in 1999, inter-relations between national economies have strengthened. In such an integrated context, damaging effects of non-coordinated national fiscal policies may potentially be very high. However, despite the growing role of the European Commission in the monitoring of national budgets, fiscal policy remains a national area of competence. A deep knowledge of the effects of a national fiscal policy on the other Member States of the monetary union is fundamental to reach an effective fiscal policy at the monetary union level. Actually, economists have long established that expansionary fiscal policies have tangible effects on the other partner countries. These are the so-called "spillover effects" or "cross-border effects" of fiscal policy.

For instance, positive spillover effects may cause a coordination problem. Some countries could benefit from expansionary fiscal policies conducted in other countries without creating deficit themselves. On the contrary, if spillover effects are negative, it militates for the suitability of the recent restrictive fiscal policies conducted within the Euro Area. In this case, it could partly explain the weakness of GDP growth within the

[1]This chapter has circulated as a paper co-written with Amélie Barbier-Gauchard and Giuseppe Diana.

Euro Area, each national restrictive fiscal policy decreasing GDP growth in the other member states.[2] In this context, both sign and size of spillover effects are to be taken into account.

An extensive literature has investigated the cross-border effects of fiscal policy. Despite abundance of studies on this subject, both the sign and the size of these spillover effects remain uncertain.

Two main transmission channels have been underlined. Firstly, a trade channel: a rise in public expenditure in one country triggers increased imports in this country and symmetrically increased exports in the foreign economy. Also, a real appreciation in the home economy puts an upward pressure on foreign exports.[3] In the Euro Area, such an effect should be high since national markets, notably for goods and services, have become more and more integrated over time. In a monetary union, a second transmission channel appears: the interest rate channel. When one country implements an expansionary fiscal policy, it tends to create inflation pressures so that the central bank may react by raising its interest rate. The consequence is a crowding-out effect on private demand in the whole union.

Beetsma, Giuliodori and Klassen (2006) investigate the trade transmission channel by estimating a panel VAR reduced form with a panel trade model for 14 European countries from 1965 to 2004. The authors argue for significantly positive effects of an expansionary fiscal policy on foreign exports and GDPs of the cross-border economies. A 1% of GDP rise in public expenditure in Germany would increase foreign exports in other countries by 2.2% in one year. This effect would have a final effect of 0.13% on foreign GDP. In the case of a tax cut of the same size, the authors find weaker effects, with a rise in foreign exports of 0.8% and a rise in GDP of 0.07%. Hollmayr (2012) built a multi-country DSGE model (for the seven initial members of the Euro Area) coupled

[2]This may be an explanation of the underestimation of fiscal multiplier in the recent Adjustment programs financed by IMF and the EC and implemented in some European countries like Hungary, Latvia and Greece among other. See, for instance, Blanchard and Leigh (2013).

[3]However, Corsetti, Meier and Müller (2010) show that the real appreciation is not a key element for producing positive spillovers.

with a GVAR methodology in order to take into account the trade weights between the different economies. He finds that both transmission channels exist (trade and interest rate channels) but the negative spillover effect induced by the rise in interest rate is predominant. The model thus produces a slightly negative total spillover effect.

Also, Corsetti, Meier and Müller (2010) investigate the role of the financing on the fiscal spillover. The authors consider the traditional case in which current and future lump sum taxes respond to deficit and consider also the case of a spending reversal. A main result is that a spending reversal triggers a fall in real long-term interest rates and then a positive output spillover for the foreign country. The behavior of the monetary authority and the degree of price stickiness influence greatly the response of real long-term interest rates. Also, the authors highlight key structural parameters which drive the size and the sign of the fiscal spillovers. Trade elasticities, the size and the openness of economies and the presence of financial imperfections greatly influence the quantitative spillover effects of fiscal policy shocks.

Moreover, Auerbach and Gorodnichenko (2013) estimate spillover effects for several OECD countries. The authors show that spillovers are more important (and positive) when the economy in which the expansionary fiscal policy is implemented is in recession.[4]

The added value of this chapter is threefold. First, we assess the impact of different fiscal policy instruments. Indeed, different forms of fiscal spending and taxes could cause different effects on both the home and foreign economies. Most of studies previously quoted generally consider an exhaustive government expenditure shock or a rise in government consumption. Since the effects of fiscal policy shocks depend on the fiscal instrument in a closed economy as shown in chapters 1 and 2,[5] this is likely that

[4]See also Sims and Wolff (2013), Michaillat (2014) and Betti and Coudert (2015) for theoretical analysis of the effects of fiscal policy on the labor market over the Business Cycle.

[5]For instance, Forni, Monteforte and Sessa (2007) investigate the effects of a large set of government expenditure and taxes in a close economy. Both the output multipliers and transmission channels differ greatly between fiscal instruments.

the spillover effects also depend on the fiscal instrument used by the government.

Second, we explicitly take into consideration the effects of fiscal policy on labor market. Following Gali, Smets and Wouters (2012), we introduce a simple device for the labor market with a labor force participation decision and unemployment. Some recent studies point out the important role of labor supply for analyzing the effects of fiscal shocks on the unemployment rate.[6]

Although many studies assess the spillover effects of fiscal policy, they generally do not focus on the response of key labor market variables, *i.e.* the responses of employment, real wages, the labor force participation and the unemployment rate. One of the aim of this analysis is to fill this gap.

Third, we compare spillovers according to the behavior of the monetary policy. Without introducing a clear description of a Zero Lower Bound (ZLB) episode, we use two different calibrations for the Taylor rule which allow us to introduce an active or a more passive monetary policy.

More precisely, The core of the chapter is to study the spillover effects of a domestic fiscal policy in a monetary union on the foreign economy according to five different fiscal instruments. The government has at its disposal various fiscal policy instruments, both in terms of public expenditure and taxation. On the expenditure side, we analyze the effects of public consumption, public investment and transfers to households. On the revenue side, we consider two taxes, a labor income tax paid by households and a social protection tax paid by firms. We assume that VAT responds to the degradation of domestic deficit. We will see throughout this analysis that these different fiscal components trigger quite heterogeneous effects on key macroeconomic variables.

This study shows that both sign and size of the spillover effects of fiscal policy widely

[6]See for instance Brückner and Pappa (2010). The authors found that unemployment tends to increase following government expenditure shocks. In a new-Keynesian framework, they highlight the crucial role of labor supply for explaining the rise in unemployment. More recently, Betti (2014) focuses on the respective effects of government consumption and investment on the labor market.

depend on which expenditure or tax component is considered. With a standard Taylor rule, the interest rate channel appears stronger than the trade channel in all cases except in the case of an increase in transfers to households. The introduction of a more passive monetary policy influences the size and the sign of the spillovers. Interestingly, since the fiscal instruments trigger different effects on inflation, the introduction of a passive monetary passive triggers different effects on the spillovers according to the fiscal instrument.

The rest of this chapter is organized as follows. Section 3.2 presents the analytic framework. Section 3.3 presents an in-depth analysis of spillover effects of a domestic fiscal policy on foreign activity, inflation and employment. Finally, we conclude in section 3.4.

3.2 The monetary union framework

In this model, we consider a monetary union composed of two countries. The introduction of the price index and the real exchange rate follows Rabanal (2009). It is assumed that each country contains two different production sectors: one producing non-tradable goods and one producing perfectly tradable goods. Within the four different production sectors, the technology is assumed to be identical and the production functions incorporate private capital, domestic labor and public capital. All firms are monopolistic suppliers of differentiated goods and thus set their price following a standard Calvo price setting. Moreover, the model includes two kinds of households: Ricardian households and non-Ricardian households that do not have access to financial markets.

3.2.1 Monetary union, price index and real exchange rate

The model describes a monetary union composed of two similar economies. The monetary union is normalized to 1. The size of the home country is s and the size of the foreign country is $(1-s)$. The variables denoted by "H" are for the home country while those denoted by "F" are for the foreign country. The exponent "EMU" is used for the

union-wide variables.

Each country produces two kinds of goods: perfectly tradable (within the union) goods and non-tradable goods. Thus, each kind of households of the monetary union typically purchases three types of goods: the tradable goods produced in the two countries and the non-tradable goods produced in his home country.

Let C_t^i defines the total consumption of households in country i for $i, j = H, F$ with $i \neq j$. This aggregate consumption is a basket of goods represented by a standard CES function such as:

$$C_t^i = [\gamma^{\frac{1}{\epsilon}}(C_t^{T,i})^{\frac{\epsilon-1}{\epsilon}} + (1-\gamma)^{\frac{1}{\epsilon}}(C_t^{NT,i})^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}} \tag{3.1}$$

with:

$$C_t^{T,i} = [\lambda^{\frac{1}{\zeta}}(C_t^{i,i})^{\frac{\zeta-1}{\zeta}} + (1-\lambda)^{\frac{1}{\zeta}}(C_t^{i,j})^{\frac{\zeta-1}{\zeta}}]^{\frac{\zeta}{\zeta-1}} \tag{3.2}$$

$C_t^{T,i}$ defines the consumption of tradable goods by the households in country i, $C_t^{NT,i}$ the consumption of non-tradable goods and finally $C_t^{i,i}$ and $C_t^{i,j}$ define respectively the home consumption of home and foreign tradable goods. Moreover, $\gamma \in [0;1[$ denotes the share of tradable goods, $\epsilon \in [0;1[$ the elasticity of substitution between tradable and non-tradable goods, $\lambda \in [0;1[$ the share of home-produced goods in the total basket of tradable goods and $\zeta \in [0;1[$ the elasticity of substitution between home and foreign tradable goods.

P_t^i corresponds to the consumer price index in country i for $i, j = H, F$ with $i \neq j$ (the index introduced in the maximization process of households) and is expressed as:

$$P_t^i = [\gamma(P_t^{T,i})^{1-\epsilon} + (1-\gamma)(P_t^{NT,i})^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \tag{3.3}$$

with:

$$P_t^{T,i} = [\lambda(P_t^{i,i})^{1-\zeta} + (1-\lambda)(P_t^{j,i})^{1-\zeta}]^{\frac{1}{1-\zeta}} \tag{3.4}$$

$P_t^{T,i}$ defines the price index of tradable goods for the consumer in country i, $P_t^{NT,i}$ the price index of non-tradable goods and finally $P_t^{i,i}$ and $P_t^{j,i}$ define respectively the price

index of home and foreign tradable goods bought by households in country i.

Finally, we can express the union-wide price index as:

$$P_t^{EMU} = (P_t^H)^s (P_t^F)^{(1-s)} \tag{3.5}$$

The real exchange rate defined as the price ratio between the two countries can be expressed as:

$$S_t = \frac{P_t^F}{P_t^H} \tag{3.6}$$

Thus, a decrease in S_t corresponds to a loss of competitiveness for domestic economy and, on the contrary, a gain of competitiveness for foreign country.

3.2.2 Households

In each country for $i, j = H, F$ with $i \neq j$, households are distributed in $[0; 1]$. Two kinds of households coexist, namely time-optimizing Ricardian households distributed in $[0; n^R]$ and "hand-to-mouth" non-Ricardian households distributed in $]n^R; 1]$ that do not have access to financial markets and simply consume their disposable income at each period.

Ricardian households

Preferences for consumption and labor are introduced *à la* Jaimovich and Rebelo (2009) allowing for a smooth wealth effect of consumption on labor supply. These preferences can be seen as a generalization of additively separable preferences with the King, Plosser and Rebelo (1988) preferences and the Greenwood Hercowitch and Huffman (1988) preferences as polar cases.

Each Ricardian household l with $l \in [0; n^R]$ maximizes the following utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t U_t^{R,i}(l) = E_0 \sum_{t=0}^{\infty} \beta^t \left(log \tilde{C}_t^{R,i}(l) - \frac{\Delta_t^{R,i}(l) N_t^{R,i}(l)^{1+\phi}}{1+\phi} \right) \tag{3.7}$$

where:

$$\tilde{C}_t^{R,i}(l) = C_t^{R,i}(l) - h\bar{C}_{t-1}^{R,i}(l) \tag{3.8}$$

$$\Delta_t^{R,i}(l) = Z_t^{R,i}(l)/\tilde{C}_t^{R,i}(l) \tag{3.9}$$

$$\text{with} \quad Z_t^{R,i}(l) = (Z_{t-1}^{R,i}(l))^{1-\nu}(C_t^{R,i}(l) - hC_{t-1}^{R,i}(l))^{\nu} \tag{3.10}$$

$\tilde{C}_t^{R,i}$ corresponds to the adjusted consumption with $\bar{C}_{t-1}^{R,i}$ the aggregate past consumption representing a consumption index over the continuum of differentiated households and $C_t^{R,i}$ the consumption before adjustment. Parameter $h \in [0, 1[$ denotes the degree of habit formation for consumption. $N_t^{R,i}$ defines employment and $\phi > 1$ denotes the Frisch elasticity of substitution of labor.[7] Despite we introduce a labor force participation decision (denoted by L in what follows), this is employment that is introduced in the utility function. Since unemployment is positive at the steady-state, this is the labor demand N_t which defines the level of employment in the economy. As a consequence, disutility at work in the utility function is function of N_t. The labor force participation decision is presented later on. $\Delta_t^{R,i}$ introduces the smoothed wealth effect of consumption on labor.

We now express the utility function for a representative Ricardian household in country i assuming that there is a perfect risk sharing within households for the level of consumption in the spirit of Merz (1995). Furthermore, defining aggregate employment for Ricardian households as $N_t^{R,i} = \int_0^{n^R} N_t^{R,i}(l)\, \mathrm{d}l$ allows us to rewrite the optimization program for the representative household as:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(log \tilde{C}_t^{R,i} - \frac{\Delta_t^{R,i} (N_t^{R,i})^{1+\phi}}{1+\phi} \right) \tag{3.11}$$

[7] The Frisch elasticity of labor supply measures the substitution effect of a change in the wage rate on labor supply.

Budget constraint and capital accumulation equation are given by:

$$(1+\tau_t^{c,i})P_t^i C_t^{R,i} + P_t^i I_t^{R,i} + \frac{E_t B_{t+1}^i}{1+R_t} \leq (1-\tau_t^{w,i})W_t^i N_t^{R,i} + B_t^i + R_t^{K,i} K_{t-1}^{R,i} + Tr_t^i \quad (3.12)$$

$$K_t^{R,i} = (1-\delta)K_{t-1}^{R,i} + \left[1 - S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\right] I_t^{R,i} \quad (3.13)$$

with:

$$S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right) = \frac{\kappa}{2}(I_t^{R,i}/I_{t-1}^{R,i} - 1)^2 \quad (3.14)$$

In this economy, as shown by equation (3.12), two taxes are paid by households: VAT $\tau_t^{c,i}$ and labor income tax $\tau_t^{w,i}$. Also, $I_t^{R,i}$ defines private investment, $K_t^{R,i}$ the capital stock, B_t^i the stock of riskless assets held at the period t and W_t^i the nominal wage in country i. Since households loan capital to firms, they are compensated at a rate $R_t^{K,i}$. Moreover, households receive Tr_t^i as social transfers.

Concerning the capital accumulation given by equation (3.13), $\delta \in [0;1[$ denotes the depreciation of private capital. Following Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007), we assume that the cost function related to changes on investment decisions is given by (3.14) where $\kappa > 1$ corresponds to a fixed cost to change in the level of investment.

In each country i, maximizing the utility function of a Ricardian household given by (3.11) subject to budget constraint (3.12) and capital accumulation constraint (3.13) with respect to $C_t^{R,i}$, B_t^i, $I_t^{R,i}$ and $K_t^{R,i}$ yields the following first order conditions where $\mu_t^{R,i}$ and $\Omega_t^{R,i}$ are respectively the Lagrangian multipliers corresponding to the budget constraint and the capital accumulation constraint:

$$\mu_t^{R,i} = \frac{\beta^t U_{C,t}^{R,i}}{P_t^i(1+\tau_t^{c,i})} \quad \text{with} \quad U_{C,t}^{R,i} = \frac{\partial U_t^{R,i}}{\partial C_t^{R,i}} \quad (3.15)$$

$$\mu_t^{R,i} = \frac{\mu_{t-1}^{R,i}}{1+R_{t-1}} \tag{3.16}$$

$$\begin{aligned}\mu_t^{R,i} P_t^i = \Omega_t^{R,i} \left(1 - S\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right) - S'\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\left(\frac{I_t^{R,i}}{I_{t-1}^{R,i}}\right)\right) \\ +\beta E_t \Omega_{t+1}^{R,i} \left(S'\left(\frac{I_{t+1}^{R,i}}{I_t^{R,i}}\right)\left(\frac{I_{t+1}^{R,i}}{I_t^{R,i}}\right)^2\right)\end{aligned} \tag{3.17}$$

$$\Omega_t^{R,i} = \beta E_t[\mu_{t+1}^{R,i} R_{t+1}^{K,i} + \Omega_{t+1}^{R,i}(1-\delta^p)] \tag{3.18}$$

Including (3.16) in (3.15) allows us to obtain the consumption Euler equation:

$$\frac{U_{C,t-1}^{R,i}}{U_{C,t}^{R,i}} = \beta(1+R_{t-1})\frac{P_{t-1}^i(1+\tau_{t-1}^{c,i})}{P_t^i(1+\tau_t^{c,i})} \tag{3.19}$$

Non-Ricardian households

Non-Ricardian households do not optimize their level of consumption over time. They simply consume all their disposable income, composed of their labor revenue and of government transfers, such as:

$$(1+\tau_t^{c,i})P_t^i C_t^{NR,i} = (1-\tau_t^{w,i})W_t^i N_t^{NR,i} + Tr_t^i \tag{3.20}$$

However, we consider that non-Ricardian households decide to participate or not in the labor market in the same manner than Ricardian households. The labor force participation decision is described in the labor market section. In order to define a labor force participation decision for these households, we can already introduce their utility function. Then, similarly to Ricardian households, the utility function for hand-to-mouth households is expressed as:

$$U_t^{NR,i} = log\tilde{C}_t^{NR,i} - \frac{\Delta_t^{NR,i}(N_t^{NR,i})^{1+\phi}}{1+\phi} \tag{3.21}$$

Consumption functions

Consumption functions for the four types of goods produced in the monetary union depend on relative prices and on both elasticities of substitution between tradable and non-tradable goods and between home tradable goods and foreign tradable goods.

In each country i for $i, j = H, F$ with $i \neq j$, demands addressed by households to firms are represented by the following equations:

$$C_t^{i,i} = \lambda\gamma \left(\frac{P_t^{i,i}}{P_t^{T,i}}\right)^{-\zeta} \left(\frac{P_t^{T,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{3.22}$$

$$C_t^{i,j} = (1-\lambda)\gamma \left(\frac{P_t^{i,j}}{P_t^{T,i}}\right)^{-\zeta} \left(\frac{P_t^{T,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{3.23}$$

$$C_t^{NT,i} = (1-\lambda)\gamma \left(\frac{P_t^{NT,i}}{P_t^i}\right)^{-\epsilon} C_t^i \tag{3.24}$$

$C_t^{i,i}$ and $C_t^{i,j}$ respectively define the home consumption of home and foreign tradable goods and $C_t^{NT,i}$ the consumption of non-tradable goods by households in country i.

3.2.3 Firms

In this economy, tradable and non-tradable sectors share the same technology. For each sector, a continuum of firms produce differentiated goods in a monopolistic way and use a Calvo-style price setting mechanism. Moreover, we assume that the nominal wage is similar in both sectors. However, prices can differ across sectors. Besides, we assume that in both sectors firms use the same type of capital. Consequently, the aggregate capital accumulated by home households K_t^i is allocated in both sectors such as $K_t^i = K_t^{T,i} + K_t^{NT,i}$.

The tradable sector

In the tradable sector of each country i for $i, j = H, F$ with $i \neq j$, all firms share the same technology and the production function is given by:

$$Y_t^{T,i} = \xi_t^{A,T,i}(K_t^{T,i})^{\alpha}(N_t^{T,i})^{1-\alpha-\alpha_g}(K_{t-1}^{g,i})^{\alpha_g} \tag{3.25}$$

where $K_t^{T,i}$ is the private capital used in production, $N_t^{T,i}$ the level of labor and $\alpha \in]0;1[$ the share of private capital used in the production process.

$K_{t-1}^{g,i}$ defines public capital accumulated by the government *via* public investment. We suppose that public capital puts a period before becoming really effective. We assume that public capital has the same productivity effect in both sectors. The size of the productivity effect of public capital on the production process is expressed by the parameter α^g.

$\xi_t^{A,T,i}$ is the total factor productivity shock (TFP), common to all firms in the home tradable sector. The TFP exogenous innovation is defined as an AR(1) process:

$$\xi_t^{A,T,i} = (\xi_{t-1}^{A,T,i})^{\rho^{A,i}} exp(\epsilon^{A,T,i}) \tag{3.26}$$

with $\rho^{A,i}$ defining the duration of the productivity shock.

The profit of the representative firm in nominal terms is given by:

$$\Pi_t^{T,i} = P^{T,i}Y_t^{T,i} - (1+\tau_t^{sp,i})W_t^i N_t^{T,i} - R_t^{K,i}K_t^{T,i} \tag{3.27}$$

with $\tau_t^{sp,i}$ denoting the social protection tax paid by firms. We assume that the government does not differentiate the level of taxation between both sectors.

Maximizing the profit function (3.27) with respect to $N_t^{T,i}$ and $K_t^{T,i}$ according to (3.25) yields the following first order conditions for labor and capital:

$$\frac{\partial \Pi_t^{T,i}}{\partial N_t^{T,i}} = 0 \Leftrightarrow \nabla_t^{T,i}(1-\alpha)\xi_t^{A,T,i}(K_t^{T,i})^{\alpha}(N_t^{T,i})^{-\alpha}(K_{t-1}^{g,i})^{\alpha_g} = (1+\tau_t^{sp,i})W_t^i \tag{3.28}$$

$$\frac{\partial \Pi_t^{T,i}}{\partial K_t^{T,i}} = 0 \Leftrightarrow \nabla_t^{T,i} \alpha \xi_t^{A,T,i} (K_t^{T,i})^{\alpha-1} (N_t^{T,i})^{1-\alpha} (K_{t-1}^{g,i})^{\alpha_g} = R_t^{K,i} \tag{3.29}$$

where $\nabla_t^{T,i}$ is the Lagrangian multiplier associated with the function production and equals marginal cost $MC_t^{T,i}$.

By rearranging equations (3.28) and (3.29), we find the demand function for each input, such as:

$$K_t^{T,i} = \frac{\alpha}{1-\alpha}(1+\tau_t^{sp,i}) \frac{W_t^i}{R_t^{K,i}} N_t^{T,i} \tag{3.30}$$

Also from equations (3.28) and (3.29), firms marginal cost $MC_t^{T,i}$ can be expressed as:

$$\nabla_t^{T,i} = MC_t^{T,i} = \frac{((1+\tau_t^{sp,i})W_t^i)^{1-\alpha}(R_t^{K,i})^{\alpha}}{\xi_t^{A,T,i}\alpha^{\alpha}(1-\alpha)^{1-\alpha}(K_{t-1}^{g,i})^{\alpha_g}} \tag{3.31}$$

We can observe that public capital negatively affects the marginal cost of firms. We can thus expect that a public investment shock decreases inflation. Furthermore, assumptions about a common nominal wage and different price dynamics across sectors allow us to introduce different real marginal costs across sectors.

The non-tradable sector

The non-tradable sector is modeled in a very similar way as the tradable one. Therefore, in the non-tradable sector in each country i for $i, j = H, F$ with $i \neq j$, the production function is:

$$Y_t^{NT,i} = \xi_t^{A,NT,i} (K_t^{NT,i})^{\alpha} (N_t^{NT,i})^{1-\alpha-\alpha_g} (K_{t-1}^{g,i})^{\alpha_g} \tag{3.32}$$

$$\text{with} \quad \xi_t^{A,NT,i} = (\xi_{t-1}^{A,NT,i})^{\rho^{A,i}} exp(\epsilon^{A,NT,i}) \tag{3.33}$$

The profit of the representative firm in nominal terms can be expressed as follows:

$$\Pi_t^{NT,i} = P_t^{NT,i} Y_t^{NT,i} - (1+\tau_t^{sp,i}) W_t^i N_t^{NT,i} - R_t^{K,i} K_t^{NT,i} \tag{3.34}$$

As in the tradable sector, the profit maximization of firm in the non-tradable sector leads to the following optimal input choice and the following marginal cost:

$$K_t^{NT,i} = \frac{\alpha}{1-\alpha}(1+\tau_t^{sp,i})\frac{W_t^i}{R_t^{K,i}}N_t^{NT,i} \tag{3.35}$$

$$MC_t^{NT,i} = \frac{((1+\tau_t^{sp,i})W_t^i)^{1-\alpha}(R_t^{K,i})^{\alpha}}{\xi_t^{A,NT,i}\alpha^{\alpha}(1-\alpha)^{1-\alpha}(K_{t-1}^{g,i})^{\alpha_g}} \tag{3.36}$$

Price setting

In each country i for $i,j = H,F$ with $i \neq j$, firms set their price in each period constrained by a certain degree of rigidity introduced *à la* Calvo (1983). In each period, only a fraction $(1-\theta^p)$ are allowed to reset their price. Firms maximize their price taking into account their mark-up over the marginal cost and constrained by a specific demand function. Then, we present the price setting for the home tradable firms but the process is quite similar in the non-tradable sector and in the foreign economy. Following Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007), the maximization process can be expressed as:

$$\max_{\tilde{P}_t^{T,i}(l)} E_t \sum_{k=0}^{+\infty} \theta^p \frac{\beta \mu_t^{R,i}}{\mu_{t+k}^{R,i}} [\tilde{P}_t^{T,i}(l)(\pi_{k=1}^{T,i}\pi_{t+k-1}^{T,i}) - MC_{t+k}^{T,i}(l)]Y_{t+k}^{T,i}(l) \tag{3.37}$$

$$\text{s.t.} Y_{t+k}^{T,i}(l) = Y_{t+k}^{T,i}G'^{-1}\left(\frac{P_t^{T,i}(l)\pi_{k=1}^{T,i}\pi_{t+k-1}^{T,i}}{P_{t+k}^{T,i}}m_{t+k}\right) \tag{3.38}$$

with $m_t = \int_0^1 G'\left(\frac{Y_t^{T,i}(l)}{Y_t^{T,i}}\right)\frac{Y_t^{T,i}(l)}{Y_t^{T,i}}\,,\mathrm{d}l$ which yields the following FOC:

$$E_t \sum_{k=0}^{\infty} \theta^p \frac{\beta P_t^{T,i}}{P_{t+k}^{T,i}} Y_{t+k}^{T,i}(l)[X_t] = 0 \tag{3.39}$$

where $X_t = \pi^{T,i}_{k=1}\pi^{T,i}_{t+k-1}\tilde{P}^{T,i}_t(l) + ((\tilde{P}^{T,i}_t(l)\pi^{T,i}_{k=1}\pi^{T,i}_{t+k-1} - MC^{T,i}_{t+k}(l))\frac{1}{G'^{-1}(z_{t+k})}\frac{G'(x_{t+k})}{G''(x_{t+k})}$

with $x_t = G'^{-1}(z_t)$ and $z_t = \frac{P^{T,i}_t(l)}{P^{T,i}_t}m_t$.

Finally, the aggregate price index is expressed as:

$$P^{T,i}_t = (1-\theta^p)\tilde{P}^{T,i}_t(l)G'^{-1}\left[\frac{P^{T,i}_t(l)m_t}{P^{T,i}_t}\right] + \theta^p\pi^{T,i}_{k=1}\pi^{T,i}_{t+k-1} P^{T,i}_{t-1}G'^{-1}\left[\frac{\pi^{T,i}_{k=1}\pi^{T,i}_{t+k-1}P^{T,i}_{t-1}m_t}{P^{T,i}_t}\right] \quad (3.40)$$

3.2.4 Labor force participation and wage setting

We assume labor immobility across countries. Within each country, households supply their labor to firm from both tradable and non-tradable sectors. On the demand side, the different types of firms formulate their own labor demand. As mentioned previously, we assume that the nominal wage is common to all firms, independently of the sector. Nevertheless, employment can differ across firms since they do not face the same demand for their specific goods.

The labor market and especially the introduction of the unemployment rate follow closely Gali, Smets and Wouters (2012). In our two-sector model, assuming a similar nominal wage across all firms of a same country allows us to simplify the equilibrium conditions for the labor market. In fact, the real wage for households will be the same regardless of whether they work in tradable sector or in non-tradable sector. Thus, the unemployment rate is defined as the difference between the total labor force participation formulated by households and the aggregate labor demand addressed by firms from both sectors. For the nominal wage setting, we apply the standard Erceg, Henderson and Levin (2000) framework, assuming than each worker is the supplier of a specific kind of work. In this monopolistic framework, workers (or unions representing the workers) set their wage in a Calvo-style price setting. Like in Gali, Smets and Wouters (2012), we relate the wage mark-up included in the wage setting equation to

the unemployment rate.

Labor force participation decision As previously mentioned, both sorts of agents make labor supply decision. We describe the equations relative to Ricardian households but calculations for non-Ricardian households are similar. Following Gali, Smets and Wouters (2012), we assume that a worker l will accept to participate in the labor market if his utility for labor revenue is higher than his disutility for work. In the case of a Ricardian agent, this is expressed as:

$$\left(\frac{1}{C_t^{R,i} - hC_{t-1}^{R,i}}\right)(1-\tau_t^{w,i})\left(\frac{W_t^i(l)}{P_t^i}\right) \geq \Delta_t^{R,i}(L_t^{R,i})^{\phi}(l) \tag{3.41}$$

where $L_t^{R,i}(l)$ denotes the labor supply for a Ricardian worker (l) in the country i.

Re-expressing equation (3.41) and saturating the condition, the aggregate labor force participation is defined by:

$$(1-\tau_t^{w,i})\frac{W_t^i}{P_t^i} = Z_t^{R,i}(L_t^{R,i})^{\phi} \tag{3.42}$$

Definition of the labor force participation is similar in the case of a non-Ricardian household such as we obtain:

$$(1-\tau_t^{w,i})\frac{W_t^i}{P_t^i} = Z_t^{NR,i}(L_t^{NR,i})^{\phi} \tag{3.43}$$

Even if the definitions for the labor force participation are similar across households, both labor force participations can have a different dynamic. Consumption for Ricardian and non-Ricardian households are likely to differ, and accordingly the labor force participation is likely to differ as well because of the effect of consumption on the labor supply decision.

Total labor force participation noted L_t^i is then aggregated such as:

$$L_t^i = L_t^{R,i} + L_t^{NR,i} \tag{3.44}$$

Finally, once we have described total employment and the aggregate labor force participation, unemployment noted U_t^i is simply defined as:

$$U_t^i = L_t^i - N_t^i \tag{3.45}$$

Wage setting We assume that both Ricardian and non-Ricardian households receive the same wage bargained by a representative union. Following Calvo (1983), workers can only reoptimize their nominal wage in each period with a probability $(1 - \theta^w)$, regardless the number of periods since they last reoptimized. In this model, when a worker cannot reoptimize his nominal wage, there is a partial indexation of the nominal wage on past inflation, the degree of indexation being defined by the parameter γ^w. Wage in the period k of a worker who has not reoptimized his wage since the period t is of the form $W_{t+k/t}^i = W_{t+k-1/t}^i (\Pi_{t-1}^{p,i})^{\gamma^w} (\Pi^{p,i})^{1-\gamma^w}$ with $\Pi^{p,i}$ inflation at the steady-state. Since we assume a zero inflation steady-state such as $\Pi^{p,i} = 1$, nominal wages are only indexed on past inflation.

The sequence of isoelastic demand schedules is defined such as:

$$N_{t+k/t}^i = \left(\frac{W_{t+k/t}^i}{W_{t+k}^i} \right)^{-\epsilon^w} N_{t+k}^i \tag{3.46}$$

The first condition for the optimizing process is expressed as:[8]

$$\sum_{k=0}^{\infty} (\beta \theta_w)^k E_t \left[\left(\frac{N_{t+k/t}^i}{C_{t+k}^i} \right) \left(\frac{W_{t+k/t}^{*i}}{P_{t+k}^i} - \frac{\epsilon^w}{\epsilon^w - 1} MRS_{t+k/t}^i \right) \right] = 0 \tag{3.47}$$

with W_t^{*i} the optimal nominal wage, MRS_t^i the marginal rate of substitution between consumption and labor and where $\frac{\epsilon^w}{\epsilon^w - 1}$ corresponds to the wage mark-up desired by the workers.

The last step is to introduce the previous condition in the following law of motion of the aggregate nominal wage that takes into account for the automatic indexation of

[8] A total derivation of this step can be found in Erceg, Henderson and Levin (2010).

the nominal wage on past inflation, that is:

$$W_t^i = [\theta_w (W_{t-1}^i (\Pi_{t-1}^{p,i})^{\gamma_w})^{1-\epsilon^w} + (1-\theta_w)(W_t^{*i})^{1-\epsilon^w}]^{\frac{1}{1-\epsilon^w}} \tag{3.48}$$

Basically, the wage inflation dynamic is based on fluctuations of the effective mark-up in relation to the natural mark-up $\frac{\epsilon^w}{\epsilon^w - 1}$. In this case, the effective markup noted MU_t^i is expressed as:

$$MU_t^i = \frac{W_t^i}{P_t^i} - MRS_t^i \tag{3.49}$$

The marginal rate of substitution between consumption and labor given by MRS_t^i is defined as:

$$MRS_t^i = -\frac{U_{N,t}^i}{U_{C,t}^i} = Z_t^i {N_t^i}^{\phi} \tag{3.50}$$

After simplification, we find that:

$$\frac{W_t^i}{P_t^i} - MRS_t^i = \phi U_t^i \tag{3.51}$$

Thus nominal wages are driven by the unemployment rate. This modelling introduces a micro-foundation of the original Phillips curve, i.e. the link between nominal wages and unemployment.

3.2.5 Aggregate variables and market clearing conditions

In each country i for $i, j = H, F$ with $i \neq j$, we can define aggregate variables and give market clearing conditions.

Total employment noted N_t^i is defined as:

$$N_t^i = N_t^{T,i} + N_t^{NT,i} \tag{3.52}$$

Total consumption given by C_t^i is:

$$C_t^i = C_t^{R,i} + C_t^{NR,i} \tag{3.53}$$

Total demand for goods addressed to tradable firms noted $Y_t^{T,i}$ and to non-tradable firms noted $Y_t^{NT,i}$ are defined as:

$$Y_t^{T,i} = C_t^{T,i} + C_t^{T,j} + C_t^{g,T,i} + I_t^{T,i} + \gamma I_t^{g,i} \tag{3.54}$$

$$Y_t^{NT,i} = C_t^{NT,i} + C_t^{g,NT,i} + (1-\gamma) I_t^i + I_t^{g,i} \tag{3.55}$$

where $C_t^{g,T,i}$ and $C_t^{g,NT,i}$ are public consumption by the home government in both sectors. $I_t^{g,i}$ is public investment. Demand for public goods is assumed to be divided equally between both sectors. Private investment by Ricardian households are split across both production sectors such as:

$$I_t^R = I_t^{T,i} + I_t^{NT,i} \tag{3.56}$$

Total output noted Y_t^i is defined as:

$$Y_t^i = Y_t^{NT,i} + Y_t^{T,i} \tag{3.57}$$

Finally, EMU output noted Y_t^{EMU} is defined as:

$$Y_t^{EMU} = Y_t^H \frac{P_t^H}{P_t^{EMU}} + Y_t^F \frac{P_t^F}{P_t^{EMU}} \tag{3.58}$$

3.2.6 The economic policy

The central bank sets the nominal interest rate R_t following this version of the Taylor rule:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho^r} \left(\frac{Y_t^{EMU}}{\bar{Y}^{EMU}}\right)^{\rho^y} \left(\frac{\Pi_t^{EMU}}{\bar{\Pi}^{EMU}}\right)^{\rho^\pi} \tag{3.59}$$

where the nominal interest rate R_t deviates from its steady-state value $\bar{R}$ by reacting to changes of output and inflation in the whole union from their steady-state value ($\bar{Y}^{EMU}$

and $\bar{\Pi}^{EMU}$).

On the fiscal policy side, we consider fiscal policy in each country i for $i, j = H, F$ with $i \neq j$. We represent the behavior of the different fiscal components as an exogenous process, in order to investigate the cross-border effects of a domestic fiscal policy on the foreign economy. More precisely, we consider six fiscal policy instruments: public consumption, social transfers to households, public investment on the public expenditure side, consumption tax (VAT), labor income tax and social protection tax on the tax side.

The budget constraint in nominal terms of each government in the union is expressed as:

$$\tau_t^{c,i}(P_t^i C_t^i) + (\tau_t^{w,i} + \tau_t^{sp,i})(W_t^i N_t^i) + D_t^i = C_t^{g,T,i} + C_t^{g,NT,i} + I_t^{g,i} + Tr_t^i \tag{3.60}$$

Equation (3.60) shows that the government is allowed to finance an expansionary fiscal policy with a deficit D_t^i. The law of motion of debt is defined such as:

$$B_t^i = (1 + R_t)B_{t-1}^i + D_t^i \tag{3.61}$$

However, we suppose that the government aims at promoting fiscal sustainability. In this sense, we assume that VAT responses to the degradation of debt, following this simple rule:

$$\tau_t^{c,i} = (\tau_{t-1}^{c,i})^{\rho^c}(B_t^i)^{\rho^b} \tag{3.62}$$

We choose VAT because the effects of a VAT cut are similar to those of a rise in transfers to households. Investigating these two fiscal instruments is not really relevant.

As for private capital accumulation, public capital accumulation is defined as follows:

$$K_t^{g,i} = (1 - \delta)K_{t-1}^{g,i} + \left[1 - S\left(\frac{I_t^{g,i}}{I_{t-1}^{g,i}}\right)\right] I_{t-10}^{g,i} \tag{3.63}$$

where $\delta \in [0; 1[$ denotes the depreciation of public capital. We assume that there is a

time-to-build delay for public capital. The length of public capital completion is set to 10 quarters.

Each fiscal variable is defined as an AR(1) process, such as:

$$C_t^{g,T,i} = (C_{t-1}^{g,T,i})^{\rho^g} + \exp(\xi_t^{Cg,T,i}) \tag{3.64}$$

$$C_t^{g,NT,i} = (C_{t-1}^{g,NT,i})^{\rho^g} + \exp(\xi_t^{Cg,NT,i}) \tag{3.65}$$

$$I_t^{g,i} = (I_{t-1}^{g,i})^{\rho^g} + \exp(\xi_t^{Ig,i}) \tag{3.66}$$

$$Tr_t^i = (Tr_{t-1}^i)^{\rho^g} + \exp(\xi_t^{Tr,i}) \tag{3.67}$$

$$\tau_t^{w,i} = (\tau_{t-1}^{w,i})^{\rho^g} - \exp(\xi_t^{\tau^w,i}) \tag{3.68}$$

$$\tau_t^{sp,i} = (\tau_{t-1}^{sp,i})^{\rho^g} - \exp(\xi_t^{\tau^{sp},i}) \tag{3.69}$$

with ρ^g defining the duration of the fiscal shock and the ξ_t the *iid* structural innovations.

3.3 Spillover effects of a domestic fiscal policy

The aim of this analysis is to focus on the spillover effects of a domestic fiscal policy on activity, inflation and also employment in the foreign economy.

3.3.1 Calibration and comments

As in Chapter 1,the structural parameters of the model are set using the posterior means found in Smets, Warne and Wouters (2013). The authors estimate the Gali, Smets and Wouters (2012) model for the Eurozone and our model, despite the extension to two countries and the more detailed fiscal sector, is very close to Gali, Smets and Wouters (2012). Table (3.1) sums up the initial calibration for the model.

The parameters related to the monetary union structure are taken from Rabanal (2009). γ and λ are calibrated from Eurostat data. Moreover, elasticities ϵ and ζ are estimated in Rabanal (2009) for the EMU and we set values according to the obtained posterior means.

For monetary policy parameters, values reported in Table follow also Smets, Warne and Wouters (2013). However, this chapter aims at investigating the impact of active versus passive (or "accommodative") monetary policies on the fiscal spillovers. An easy way to modify the response of the nominal interest rate to changes in output and inflation is to set different values for the parameters ρ^y and ρ^π. In this sense impulse response functions presented later on consider two cases. First, a rather active monetary policy, with $\rho^y = 0.5$ and $\rho^\pi = 1.5$, despite the fact that Taylor rules estimated for the Eurozone indicate a less strong response of the nominal interest rate to inflation and output gap. Second, a passive monetary policy with $\rho^y = 0$ and $\rho^\pi = 1$. In this second case the nominal interest barely reacts and monetary policy can be considered as passive.

As discussed in Leeper, Walker and Yang (2010) for instance, there is little guidance about the value of the public capital elasticity of output. The higher this value, the higher the effects of government investment in productivity in the long run. We set $\alpha^g = 0.05$, a medium value in the literature.[9] For comparison purposes, we suppose the same duration for each fiscal shock with $\rho^g = 0.6$. The parameters for the VAT rule are set following Forni, Monteforte and Sessa (2009), who estimate a rather standard fiscal DSGE model for the Euro Area.

3.3.2 Results

This section summarizes the results concerning the cross-border effects in the foreign country of different kinds of fiscal policy shocks occurring in the domestic economy. In the recent literature, two main transmission channels for an expansionary domestic fiscal policy in a monetary union have been highlighted *i.e* a positive trade effect *via* a rise in imports in the domestic economy and a negative interest rate effect *via* a rise in the interest rate at the union level. The total effect on the foreign activity seems to depend on the relative size of the two transmission channels. This chapter aims at going further by investigating the existence of these channels according to different fiscal

[9] See Straub and Tchakarov (2007) or Stähler and Thomas (2012) among others for the introduction of government investment in new-Keynesian frameworks

Parameter	Value	Definition
Monetary union structure		
γ	0.51	Share of tradable goods
ϵ	0.75	Elasticity of substitution T and NT goods
λ	0.16	Share of home-produced goods in the tradable goods basket
ζ	0.52	Elasticity of subst. between home and foreign tradable goods
s	0.5	Size of the home economy
Households preferences		
n^R	0.3	Share of Ricardian households
h	0.65	Habit formation
ϕ	4,65	Frish elasticity of substitution
ν	0.1	Degree of wealth effect on labor supply
β	0.995	Discount factor
Price and wage setting		
θ_p	0.5	Price rigidity
γ_p	0.5	Indexation of prices on past inflation
θ_w	0.5	Wage rigidity
γ_w	0.16	Indexation of wages on past inflation
Investment and capital		
κ	6	Constant investment cost
δ	0.025	Depreciation of private and public capital
α	0.18	Share of capital in the production function
Monetary and Fiscal policy		
ρ^y	0.19	Output elasticity of the Taylor rule
ρ^π	1.25	Inflation elasticity of the Taylor rule
ρ^r	0.9	Degree of smoothing of the Taylor rule
ρ^g	0.6	Duration of the public expenditure shocks
α^g	0.05	Elasticity of output to public capital
ρ^c	0.96	$AR(1)$ parameter for VAT
ρ^b	0.25	Reaction of VAT to debt

Table 3.1: Initial calibration of the model

instruments. As we explain below, the sign and the size of these transmission channels differ according to the fiscal instruments.

Table (3.3.2) summarizes the signs of the spillover effects according to the different fiscal shocks for foreign GDP, foreign unemployment, foreign inflation and real exchange rate. The following figures summarize the Impulse Response Functions (IRFs) that il-

lustrate the effects for each fiscal policy instrument on the foreign economy. In Table (3.3.2), the signs correspond to the case of an active monetary policy. We will see in this section that the introduction of a passive monetary policy can alter the results.

A first assessment is that spillover effects differ widely according to the fiscal shock. All fiscal instruments produce positive spillover effects on foreign GDP except a rise in government consumption (with the baseline calibration that corresponds to an active monetary policy). Without going into details, Table (3.3.2) indicates that the response of unemployment is not always negatively correlated with the response of output. Also, the different fiscal shocks trigger different effects on foreign inflation and the term of trade, which implies heterogeneous interest rate and trade channels.

	$C_t^{g,H}$	Tr_t^H	$I_t^{g,H}$	$\tau_t^{sp,H}$	$\tau_t^{w,H}$
Y_t^F	-	+	+	+	+
U_t^F	+	-	+/-	-/+	-
Π_t^F	-	+/-	-	-/+	+/-
S_t	-	-	+	+	-/+

Lecture: a symbol $+/-$ for example indicates that the variable increases for a few periods before decreasing.

Table 3.2: Signs of spillover effects according to different domestic fiscal shocks

Effects of a rise in government consumption or social transfers. We first considered alternatively a rise in transfers to households and a rise in government consumption. IRFs are summarized in figures (3.3.2) and (3.3.2). We document first the results in the case of an active monetary policy. The consequences of making passive the response of the nominal interest rate are investigated later on. Despite these fiscal shocks share similar transmission channels, a rise in domestic government consumption triggers a decrease in foreign output while a rise in transfers increases foreign output in the case of an active monetary policy. Transfers to households affect positively private consumption. Since home households consume home goods but also a share of tradable foreign goods, the rise in transfers triggers directly a rise in foreign exports. This positive effect on domestic imports, namely a leakage effect of fiscal expenditure shocks, has been highlighted already in the literature. Secondly, the depreciation of the

real exchange rate adds an upward pressure on foregin exports. Total demand therefore turns towards foreign goods to the detriment of home goods. Thus, the trade channel is the combination of two effects: a rise in imports due to the composition of the household basket of goods and a loss of competitiveness for the home economy. Thirdly, the nominal interest rate increases in response to the rise in inflation at the union level. The rise in real interest rates triggers a negative effect on aggregate demand. According to our calibration and modeling assumptions, a rise in domestic transfers produce a rise in foreign output, with a positive trade channel which prevails over a decrease in private demand induced by a rise in the real interest rate.

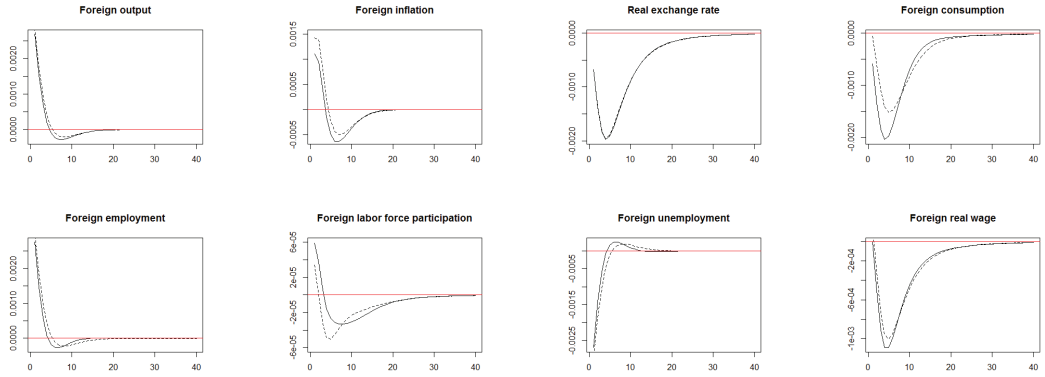


Figure 3.1: Increase in domestic transfers

As a consequence, unemployment decreases significantly since employment in the foreign tradable sector reacts positively to the rise in demand. In the case of a passive monetary policy, the negative effect on private consumption is dampened. Yet, the positive spillover effect on foreign output is enhanced. Let us note that the different calibrations for the response of the nominal interest rate does note influence the term of trade and then the positive effect of higher foreign exports on output.

Public consumption produces similar demand-side effects with one important exception as shown in figure (3.3.2). In the model we assume that the home government only purchases home-produced goods. The automatic rise in domestic imports is therefore missing. However, similarly to the case of government transfers, the inflation pressures

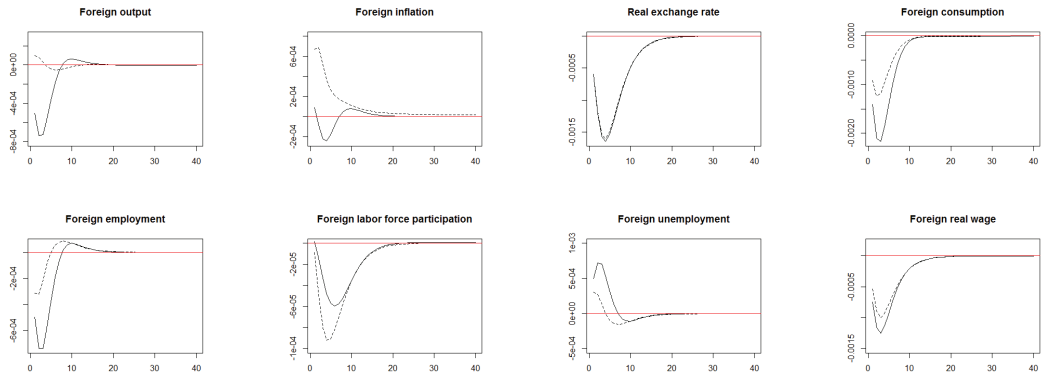


Figure 3.2: Increase in domestic public consumption

in the domestic country trigger a depreciation of the real exchange rate. However, the rise in real interest rates prevails over the positive effect of the real depreciation on the foreign tradable sector. This negative response of foreign output argues for a weak role of the real exchange rate for explaining the sign of the spillover effects of government expenditure shocks, as highlighted in Corsetti, Meier and Müller (2010).[10]

Despite the drop in the real wage and the labor force participation, the decrease in foreign employment triggers an increase in unemployment. The introduction of a passive monetary policy has a sizable impact on the response of foreign output and unemployment. Similarly to the rise in transfers, a government consumption shock puts an upward pressure on prices at the monetary union level. The crowding-out effect of higher real interest rates on private consumption is thus dampened. Quantitatively, the response of foreign output is very slightly positive. Moreover, the response of foreign unemployment is close to 0.

Effects of a rise in government investment. Similarly to government consumption, we assume that public investment goods are built only by home firms. Since we introduce a delay for public capital building, the effects of a rise in government investment are identical to those of government consumption for the first periods. However,

[10]We do not explore the importance of key parameters like the size of each country and the trade elasticities. This is obvious that these parameters greatly influence the size of the trade and interest rate channels.

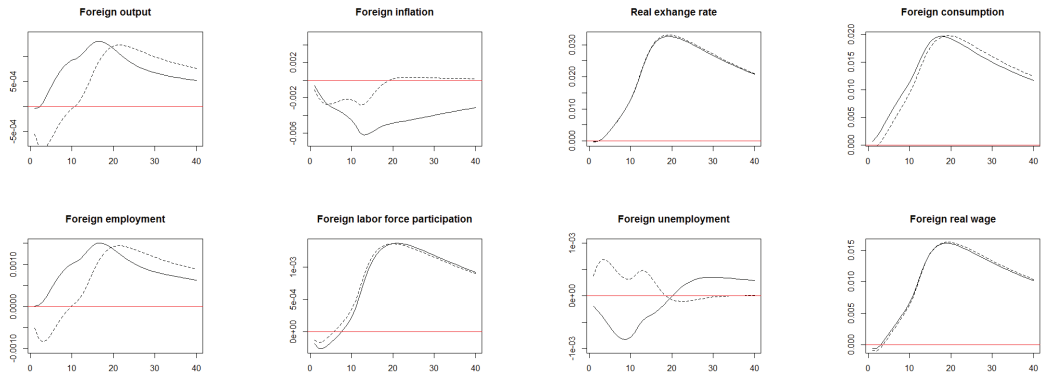


Figure 3.3: Increase in domestic government investment

public investment triggers different effects by rising productivity of home firms. Especially, the accumulation of public capital in the domestic country puts a downward pressure on firms' marginal cost. Figure (3.3) indicates that CPI inflation also decreases in the foreign economy, since foreign households consume one share of domestic goods. As a consequence, in the case of an active monetary policy, real interest rate goes down and private consumption increases in both countries. Interestingly, we can note that the spillovers implied by the deflationary effects of domestic government investment makes the interest rate channel positive. However, home inflation decreases more strongly in the home economy so that the real exchange rate appreciates. Thus, the foreign economy suffers *ceteris paribus* from less exports and a rise in imports. The positive effect of a decrease in real interest rates is predominant. Foreign output increases both in the short and long run since the effects of public capital on prices and interest rates are long-lasting.

Employment rises strongly in the foreign economy in the short run and the level of employment is superior in the long-run. In the case of an active monetary policy, unemployment decreases in the short run but rises after five years. The role of the labor force participation decision is of first importance for explaining the rise of unemployment in the long run. We observe in figure (3.3.2) that the foreign real wage increases significantly and especially in the long run. First, the medium-term decrease in unem-

ployment puts an upward pressure on the nominal wage. Second, the drop in prices in the foreign country generates an automatic rise in the real wage since the nominal wage is weakly indexed on inflation. Thirdly, the marginal productivity of labor in the foreign economy can explain this long-lasting rise in the real wage. As a consequence, and despite a positive wealth effect, labor supply increases significantly in the long run. This strong rise of the real wage and of the labor force triggers a positive response of the unemployment rate in the long run.

The introduction of a less aggressive monetary policy affects rather strongly the results. Interestingly, a more passive response of the nominal interest rate triggers less positive spillovers on foreign output and employment. In the case where fiscal shocks affect negatively prices in the whole monetary union, a passive monetary policy will dampen the output multiplier in both the home and the foreign economies.

Effects of a cut in social protection tax. The social protection tax cut puts a downward pressure on firms' marginal cost so that inflation decreases just after the shock. However, the positive effect on aggregate demand, production and employment tend to rise prices after only a few periods. The cumulative response of inflation (for the first forty periods) is slightly positive so that the real interest rate increases also slightly. In the case of this fiscal shock, the transmission channels for the spillover effects are close to the demand-enhancing fiscal instruments like public consumption or transfers. The slight rise in the real interest rate crowds out private demand and the real exchange rate increases so that the foreign economy benefits from higher exports.

In this case, introducing a more passive monetary policy weakens the crowding-out effect on private demand so that the positive spillover effect on the foreign economy is amplified.

Effects of a cut in labor income tax. A decrease in the labor income tax in the domestic country triggers a rise in private consumption. Similarly to a rise in transfers,

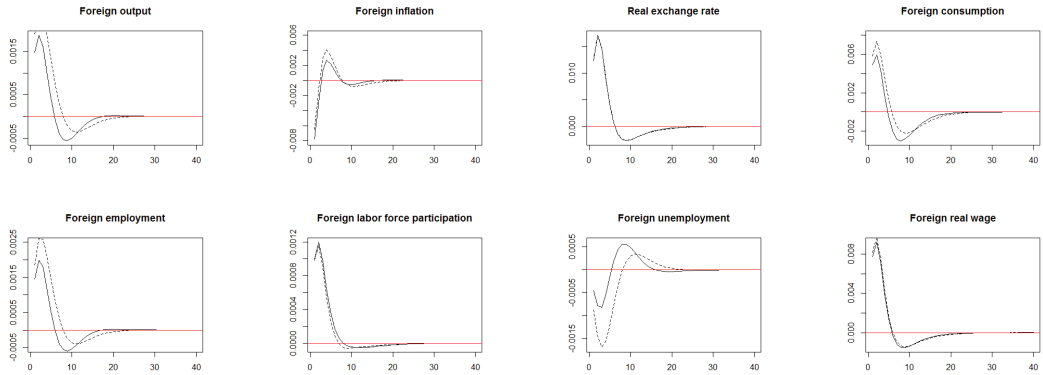


Figure 3.4: Decrease in social protection tax

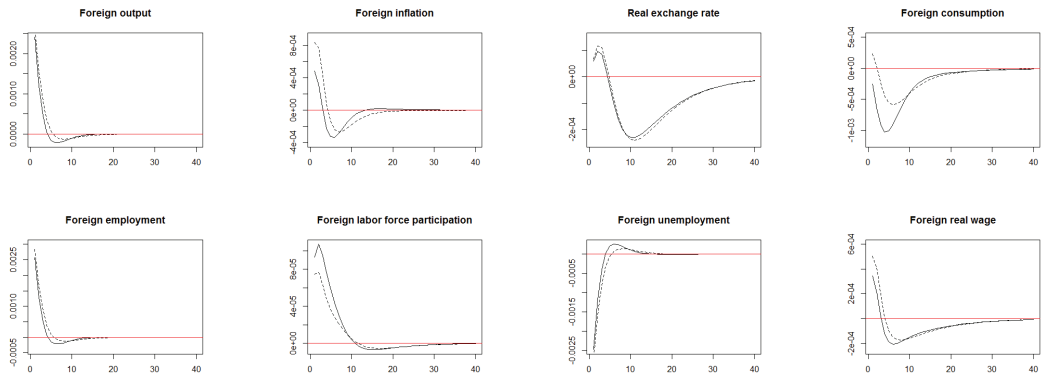


Figure 3.5: Decrease in labor income tax

this positive demand shock produces a rise in production in the home economy but also in the foreign economy. On the domestic labor market, employment increases. The decrease in the labor income tax increases the marginal productivity of labor so that the home labor force participation also increases. However, the positive effect on employment is predominant and home unemployment drops. As a consequence, the home real wage and price increase so that the real interest rate increases. The term of trade decreases producing a rise in foreign exports. Total effect on foreign output is positive. Foreign employment goes up while a mitigate response of the foreign real wage and a negative wealth effect on foreign private consumption trigger a slight rise in the foreign labor force participation. Thus, foreign unemployment declines.

Overall, the fiscal shock produces inflation at the union level so that the real interest rates tends to increase. Similarly to the cases of government consumption and transfers, introducing a more passive behavior for the monetary policy generates a higher response of foreign output, consumption and employment.

3.4 Conclusion

This chapter shows that spillover effects of fiscal policy widely depend on what expenditure component or tax is considered. Based on the classical transmission channels already highlighted in the literature, we show that the different types of expenditure/taxes produce quite different spillovers.

We can summarize our main findings in four major ideas. Firstly, all fiscal instruments produce positive spillovers, except a rise in public consumption. Secondly, the sign of transmission channels can change widely according to the nature of the spending or the tax. In the cases of a rise in public consumption, social transfers and a cut in labor income tax, we observe a rise in real interest rates and a rise in exports for the foreign country. However, government investment and the social protection tax trigger opposite effects. Drop in prices in the domestic economy produces an appreciation of the real exchange rate and a rise in foreign exports. Moreover, the drop in prices at

the union level produces a positive interest rate channel with a decrease in real interest rates in the union. Thirdly, in the case of the active monetary policy, the interest rate channel is stronger than the trade channel in all cases except in the case of transfers to households increase and of a cut in labor income tax. Finally, changing the behavior of the monetary policy entails changes in spillovers of fiscal policy. Since real interest rates tend to increase in the case of government consumption, transfers and a decrease in the labor income tax, introducing a more passive response of the nominal interest rate triggers more positive spillovers on foreign output. Especially, government consumption produces a decrease in foreign output with a more active monetary policy while the spillovers are slightly positive when the interest rate barely reacts to higher prices. Interestingly, a more passive monetary policy is no longer profitable with government investment and the social protection tax. As already mentioned, the transmission channels are reverse for these fiscal shocks, *i.e* a drop in real interest rates and a decrease in foreign exports. Thus, a rather passive monetary policy implies less positive spillovers on foreign output. According to the effects of expenditure or taxes on prices, the behavior of monetary policy influences differently the effects of domestic fiscal shocks on the rest of the union.

Despite the introduction of a labor force participation decision, foreign unemployment moves counter-cyclically, except in the case of a rise in home government investment. For instance, with a decrease in the labor income tax, the labor force participation and employment co-move but the positive effect on foreign employment is predominant so that unemployment drops. Government investment is a special case since, in the case of the active monetary policy, unemployment decreases for the first twenty periods and then increases in the long run. This in the only case where the spillover on output is positive and long-lasting while unemployment increases in the long-run because of a long-run increase in the foreign labor force participation, as highlighted previously.

As a consequence, policy makers in the EMU should give more consideration to these heterogeneities in fiscal policy instruments if they wish to better coordinate fiscal policies in a monetary union like the Euro Area. In the case of the EMU, in which the

Member States had to implement this recovery plan in a coordinated way, the European policy makers should also promote fiscal measures that have positive spillover effects in Member States instruments in order to produce larger fiscal multipliers at the monetary union level.

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Chapter 4

Fiscal transfer schemes in a monetary union: does the nature of transfers matter?[1]

4.1 Introduction

Since recent years, economists have renewed interest for issues related to the stabilization policies implemented in monetary union. Especially, the recent and still ongoing crisis in the Eurozone with as a climax the possible "grexit" points out the necessity to deepen fiscal integration.

After achieving the single market and the implementation of a currency area, some economists argue nowadays that the next step would be to achieve a fiscal union for the Euro Area. The term "fiscal union" can relate to very different elements, such as the sovereign debt pooling, the creation of an economic government for the Eurozone or the implementation of fiscal transfers among member states.

Yet, the recent crisis has revealed the strong economic heterogeneity that exists between the Euro Area members, who have reacted very differently to the crisis episode. Also, despite the strong integration of the Euro Area economies since the creation of the Eurozone, asymmetric shocks still occur. In response to the existence of structural heterogeneities and of asymmetric shocks, many economists argue for the implementa-

[1]This chapter has circulated as the paper Barbier-Gauchard and Betti (2015).

tion of a risk-sharing mechanism through a fiscal transfer scheme. Such a fiscal transfer mechanism is already present in some fiscal unions, especially in the USA, Canada or in Germany. Several papers have attempted to estimate the stabilizing abilities of these insurance mechanisms, most of them for the USA and Canada.[2] If results vary according to the studies, fiscal transfer schemes would reduce the output growth rate differential between members by 20 % on average.

In recent years, different facets of such insurance mechanisms have been investigated in a new-Keynesian framework. In this introduction we briefly review the different aspects of fiscal transfers that have been analyzed in the literature. The main goal of this literature is to document the stabilizing abilities of a fiscal transfer mechanism and, from a normative approach, to investigate the conditions for which a transfer rule can be effective and welfare-enhancing.

Which targets should be included in the transfer rule

Different transfer rules have been suggested in the literature and a crucial question is on which macroeconomic variables should we focus. Despite implementing transfers according to the evolution of output between member states seem logic, we could imagine transfer rules based on unemployment, consumption or deficit. For instance, unemployment is a crucial variable politically and is a good proxy of the business cycle fluctuations while consumption is pro-cyclical and is fundamental since the aim of such transfers is to improve risk-sharing and to enhance welfare.

Beine and Docquier (1997) compare the stabilizing effects of transfer rules based either on output or on unemployment. The main result is that rules based on output are in most cases more effective than rules based on unemployment. The authors show that transfer rules based on unemployment have only limited stabilizing effects on activity and can even have destabilizing effects. Especially, rules in which unemployment are introduced tend to increase the volatility of prices and incomes.

[2]See for instance Sachs and Sala-i-Martin (1992), Von Hagen (1991), Italianer and Pisani-Ferry (1994), Goodhart and Smith (1993), Bayoumi and Masson (1995) or Melitz and Zummer (1999).

Evers (2012) investigates the stabilizing properties of transfer rules in which four variables are included: consumption, labor income, government deficits and GDP. The effectiveness of the rules is measured firstly by computing the welfare implications of each rule and secondly by evaluating the evolution of the level of risk-sharing (cross-correlation of the key macroeconomic variables between member states). Transfer schemes based on difference in consumption and labor income trigger welfare gains while rules depending on differences in output and government deficits produce welfare loss by generating a lower mean consumption. More precisely, the transfer rule based on consumption triggers a welfare gain through a higher mean in consumption while the transfer rules based on labor income produces a welfare gain through a lower volatility of consumption and income. However, the author show that the rule based on government deficit is the most effective for improving risk-sharing between the two economies of the model.

Transfers and financial imperfections

One strand of the literature focuses on the welfare effects of transfer schemes in presence of financial imperfections. Indeed, in the case where financial markets are perfect and allow for a full risk-sharing between agents of the different member states, fiscal transfers will not induce welfare gains and even trigger welfare losses *via* a higher volatility of consumption and income. However, it is unlikely that credit markets can generate a full-risk sharing so that transfers can be welfare-enhancing.

Kim and Kim (2013) investigate the welfare effects of transfers schemes according to the presence or not of financial constraints. The main finding is that in the absence of borrowing constraints for households, the transfers can reduce agents' welfare while the transfers are unambiguously welfare-enhancing when such financial constraints occur. The transfer mechanism is fruitful when the financial markets cannot ensure a full risk-sharing within the monetary union.

Farhi and Wering (2012) focus also on this issue and argue for positive welfare effects of fiscal transfers in presence of financial constraints. The authors go further by showing that even in presence of financial market, private agents' insurance is imperfect so that fiscal transfers can improve welfare and risk-sharing.

D'Imperio (2015) estimates a two-country DSGE model of a monetary union following Kim and Kim (2001) on Euro Area data. The two economies represent the core and the periphery of the Eurozone. The idea behind this distinction between core and periphery is related to the non-optimality of monetary policy in the case of asymmetric shocks. Since the creation of the Eurozone, inflation in the periphery tends to be higher than in the core of the Eurozone. As a consequence, macroeconomic imbalances can arise with higher real interest rates in the core while periphery countries profit from low real interest rates. As a consequence, fiscal transfers would be justified since the monetary policy cannot stabilize activity and prices in member states because of asymmetric shock and structural heterogeneities. D'Imperio (2015) aims at computing what would be the size of an optimal transfer scheme thanks to the estimated model. The main result is that an optimal transfer scheme would trigger transfers between the core and the periphery equal to 70% of the asymmetric shock hitting one of the two economies.

How funds should be used by the recipient economy

Surprisingly, while transfers can be used in very different ways, such as increasing different sorts of expenditure or cutting taxes, the literature generally neglects this point. In most papers, transfers are either used as direct transfers to households, like in Fahri and Werning (2012) or as public consumption (Okano (2010), Kim and Kim (2013) or Evers (2012)) but the link between the use of the transfer and the effectiveness of the scheme is generally neglected. This is surprising since different sorts of spending and different sorts of taxes are available in the governments' tool kit and that the effects of fiscal policy in general very depends on the tools used by the governments. It is even more astonishing that Bajo-Rubio and Diaz-Roban (2003) already pointed out: *"Only Majocchi and Rey (1993) propose that their discretionary mechanism would be financed*

in an ad hoc manner by the countries concerned, and that the amounts to be paid would be conditioned in order to assure its consistency with the Community's objectives. The rest of studies do not examine this issue, although they recognize that the degree of stabilization attained will depend, in part, on how the funds are used".

However, Evers (2006) investigates explicitly the stabilizing properties of transfer schemes according to the nature of the transfers. In a medium-scale DSGE model of a two-country monetary union, transfers between both economies are either transfers within home and foreign households or inter-governmental transfers corresponding simply on a shift of public consumption between both states. One interesting element of this paper is that it focuses on the relative stabilizing properties of both kind of spending according to the nature of the asymmetric shock in the monetary union. In the case of a demand shock introduced as a preference shock for the union-wide consumers towards the tradable goods produced in one economy of the union, Evers (2006) shows that intergovernmental transfers are fully efficient and let the level of welfare similar to the welfare at the steady-state, thanks to a positive shift in demand that compensates the first negative shift in demand induced by the shock. Therefore, public consumption-based transfers can fully stabilize consumption, production and employment in both economies. In the case of a supply shock, Evers (2006) founds that both kinds of transfers are necessary to achieve an efficient insurance. The transfers to households are necessary since the labor income is no longer the same between the two economies because of the inflation differential generated by the productivity shock.

More recently, Zemanek (2009) discusses the fact that the transfers schemes could produce moral hazard problem and notably that such transfers can largely reduce the incentive for the national governments to lead structural reforms. Even if the paper does not focus on the way the funds are used, the author considers public investment as a way to avoid the problem of moral hazard. The point is that transfers based on public consumption reduce the incentive for the governments to lead structural reforms. A solution could be to use the transfers to increase public investment since it has long term effects on productivity and competitiveness. Therefore, Zemanek (2009) argues

for conditional transfers that oblige the governments to invest in productive spending. Such conditions for transfers already exist in Germany. However Zemanek (2009) points out that some Länder have transgressed the rule by using a share of the transfer to purchase goods and services. This point is particularly interesting concerning the use of the transfer. If fiscal unions decide to make a share of the transfers conditional, the central authority has to implement a strong monitoring for the effective use of the transfers at the national and sub-national levels, a monitoring that can be costly.

Aim of the paper

In this paper we follow Evers (2006) since we focus on the stabilizing properties of a fiscal transfer mechanism in a monetary union prone to both asymmetric demand and supply shocks. More precisely, we analyze the effectiveness of the transfers scheme according to the way are used the transfers. We consider a large set of fiscal instruments : public consumption, social transfers to households, public investment, but also three taxes, a VAT, a labor income tax and a social protection tax.

The model represents a monetary union with two symmetric economies. The modeling of each economy follows benchmark medium-scale DSGE models. Especially, we introduce a labor market with a labor force participation decision and unemployment similarly to Gali, Smets and Wouters (2012). We introduce a fiscal union in which coexist national fiscal policies, a central budget and fiscal transfers between both countries. The contribution of this paper is to test the effectiveness of a transfer mechanism to stabilize both output and unemployment according to how the recipient uses the transfer and according to the nature of the shock.

The key point is that a negative demand shock triggers a decrease in output and a rise in unemployment. However, a supply shock generates in the short-run a comovement of output and unemployment. As pointed out in Barnichon (2012) among others, a positive supply shock tends to produce a rise in unemployment in the short-run. A reason is that production rises more strongly than the aggregate demand in the short-

run so that demand for capital and labor fall. We point out in this paper that the different fiscal instruments that can be used in the case of the fiscal transfer mechanism affect differently output and unemployment. Especially, some fiscal instruments are more effective for stabilizing both output and unemployment in both economies in the occurrence of a demand shock while other fiscal instruments are more effective when asymmetric supply shocks hit one economy of the union.

The rest of the paper is organized as follows: the section 4.2 presents the fiscal union, the section 4.3 presents the calibration and the simulations, the section 4.4 exposes the results and the section 4.5 concludes.

4.2 The monetary union framework

4.2.1 The monetary union

For our purposes, we use a two-country DSGE model of a monetary union. Except the fiscal side, the model is similar to the one in Chapter 3. As said previously, we assume a two-country monetary union in which the two economies are perfectly identical. Each economy contains two production sectors, one that produces goods perfectly tradable with the foreign country and one that produces non-tradable goods. The structure of the monetary union follows other DSGE models of a monetary union like Rabanal (2009) for instance.

Each economy includes 6 different kinds of agents. Ricardian optimizing households consume, supply labor, invest in capital and hold riskless bonds while *hand-to mouth* households simply consume their disposable income at each period and supply labor. Intermediate firms produce differentiated goods and final firms package these intermediate goods producing one final homogeneous goods. On the fiscal side coexist two national governments and one central authority as described later on. Finally, the central bank sets the nominal interest rate following a standard Taylor rule.

4.2.2 Introduction of the fiscal union

The fiscal union introduced in this chapter allows for the coexistence of national governments and of a central authority. Different policy scenarios can be introduced thanks to this modeling. For instance, a fully decentralized case in which the two national governments implement fiscal policy without any intervention at the central level. The other polar case is the fully centralized case in which fiscal receipts are levied entirely at the central level and then used in different ways. Finally, with alternative calibrations, we can also implement scenarios where both levels coexist. One will see throughout this section that, for our purposes, we need to use the alternative with both the national and the federal governments.

National governments

The budget constraint of the home economy can be expressed as, in nominal terms:

$$(1-\tau^{c,EMU})[(P_t^H C_t^H)\tau_t^{c,H}] + (1-\tau^{l,EMU})[(W_t^H N_t^H)(\tau_t^{w,H}+\tau_t^{sp,H})] + T_t^H = C_t^{g,H} + I_t^{g,H} + Tr_t^H \quad (4.1)$$

and similarly for the foreign economy:

$$(1-\tau^{c,EMU})[(P_t^F C_t^F)\tau_t^{c,F}] + (1-\tau^{l,EMU})[(W_t^F N_t^F)(\tau_t^{w,F}+\tau_t^{sp,F})] + T_t^F = C_t^{g,F} + I_t^{g,F} + Tr_t^F \quad (4.2)$$

The variables with a superscript "H" defines variables in the home economy, those with a superscript "F" the foreign country and finally variables with a superscript "EMU" concern the union as a whole. For the budget constraint of the home country (and similarly for the foreign country), P_t^H defines the consumer price index for the domestic households, C_t^H consumption in the home economy, W_t^H is the nominal wage and N_t^H represents employment. In equation (4.1) are present the six fiscal instruments available

to the home government: public consumption $C_t^{g,H}$,[3] public investment $I_t^{g,H}$ and social transfers to households Tr_t^H, and the three taxes, namely the VAT, the labor income tax and the social protection tax, respectively $\tau_t^{c,H} \in [0;1]$, $\tau_t^{w,H} \in [0;1]$ and $\tau_t^{sp,H} \in [0;1]$

$\tau^{c,EMU} \in [0;1]$ and $\tau^{l,EMU} \in [0;1]$ define the degree of centralization of the tax system. If $\tau^{c,EMU} = \tau^{l,EMU} = 1$, the whole tax receipts are gathered at the central level. At the opposite if $\tau^{c,EMU} = \tau^{l,EMU} = 0$, the fiscal policy is fully decentralized. In the case where $0 < \tau^{c,EMU} < 1$ and $0 < \tau^{l,EMU} < 1$, both levels coexist. When the central government gathers at least one share of the fiscal receipts, it redistributes this public money to the two national governments according to simple rules presented later on in this section. T_t^H and T_t^F represents the funds they receive or pay coming from the central government respectively in the home and the foreign economy.

The central government

The central government collects at least a share of the national fiscal receipts and therefore has the following budget constraint:

$$\tau^{c,EMU}\left[(P_t^H C_t^H)\tau_t^{c,H} + (P_t^F C_t^F)\tau_t^{c,F}\right] + \tau^{l,EMU}[(W_t^H N_t^H)(\tau_t^{w,H} + \tau_t^{sp,H}) + (W_t^F N_t^F)(\tau_t^{w,F} + \tau_t^{sp,F}))] + D_t^{EMU} = T_t^{EMU} \quad (4.3)$$

where T_t^{EMU} defines the total budget of the central authority. We assume than the central government can also create a deficit D_t^{EMU}, so that the debt dynamic of the central government is defined as:

$$B_t^{EMU} = (1 + R_t)B_{t-1}^{EMU} + D_t^{EMU} \quad (4.4)$$

where $(1 + R_t)B_{t-1}^{EMU}$ corresponds to the stock of debt at the previous period plus the interest payment.

[3] We assume in this chapter that public consumption is equally produced by the tradable and the non-tradable sector.

The central government determines its fiscal policy in two steps. Firstly, it decides the size of the budget T_t^{EMU} according to the following rule:

$$\frac{T_t^{EMU}}{\bar{T}^{EMU}} = \left(\frac{Y_t^{EMU}}{\bar{Y}^{EMU}}\right)^{-\alpha^{y,EMU}} \left(\frac{U_t^{EMU}}{\bar{U}^{EMU}}\right)^{\alpha^{u,EMU}} \left(\frac{D_t^{EMU}}{\bar{D}^{EMU}}\right)^{\alpha^{d,EMU}} \tag{4.5}$$

with $\alpha^{y,EMU}, \alpha^{u,EMU}, \alpha^{d,EMU} \in [0;1[$ which can differ from the parameters included in the national simple rules.

Secondly, central government allocates the transfers to both economies according to the output and unemployment differentials such as:

$$T_t^H = \frac{T_t^{EMU}}{2} - Tr_t^{EMU} \tag{4.6}$$

and

$$T_t^F = \frac{T_t^{EMU}}{2} + Tr_t^{EMU} \tag{4.7}$$

Equations (4.6) and (4.7) indicate that the transfer scheme is balanced each period and finally the transfer is determined such as:

$$\frac{Tr_t^{EMU}}{\bar{Tr}^{EMU}} = \left(\frac{Y_t^H}{Y_t^F}\right)^{\alpha^{y,tr}} \left(\frac{U_t^H}{U_t^F}\right)^{\alpha^{u,tr}} \tag{4.8}$$

with $\alpha^{y,tr}, \alpha^{u,tr} \in [0;1[$.

This paper aims at investigating in what extent the ways the recipient economy uses the transfer affects the stabilizing properties of the fiscal transfer scheme. In the following simulations, the scenario is as follows. We assume that the central government collects the half of the national fiscal receipts by setting $\tau^{c,EMU} = 0.5$ and $\tau^{l,EMU} = 0.5$. In the different simulations the negative asymmetric shock (in turn a demand and a supply shock) hits the domestic economic so that the latter has a stronger degradation of output than the foreign economy. Then, for comparison purposes we assume for all the simulations than the foreign economy uses public consumption following the shock and the transfers, so that the only fiscal instrument that is not constant in the equation

(4.2) is public consumption, such as:

$$(1-\tau^{c,EMU})[(P_t^F C_t^F)\tau^{c,F}] + (1-\tau^{l,EMU})[(W_t^F N_t^F)(\tau^{w,F}+\tau^{sp,F})] + T_t^F = C_t^{g,F} + I^{g,F} + Tr^F \quad (4.9)$$

We simulate the model for each fiscal instrument used in the domestic economy. For instance, in the case where the domestic government uses the federal funds by decreasing the VAT, equation (4.1) becomes:

$$(1-\tau^{c,EMU})[(P_t^H C_t^H)\tau_t^{c,H}] + (1-\tau^{l,EMU})[(W_t^H N_t^H)(\tau^{w,H}+\tau^{sp,H})] + T_t^H = C^{g,H} + I^{g,H} + Tr^H \quad (4.10)$$

4.3 Calibration of the model and description of the simulations

The values chosen for the parameters are similar to those used in Chapter 3 (see Table (3.1)). We use posterior means form Smets, Warne and Wouters (2013) who estimated the Gali-Smets-Wouters model for the Eurozone as a single economy. Parameters related to the monetary union structure are extracted from Rabanal (2009) who estimated a standard two-country model of a monetary union with Euro-Area data.

For our purposes, we set $\tau^{c,EMU} = \tau^{l,EMU} = 0.5$. This calibration corresponds to an intermediary case in which the central government collects the half of the national fiscal receipts. It enables us to test the following scenario: the central government collects national fiscal receipts and then redistribute to the two economies according to the transfer rule (4.8). As said previously, we assume that the transfer is always used through public consumption in the foreign economy while we simulate the model for each fiscal instrument in turn in the home economy.

In equation (4.5), we assume that $\alpha^{y,EMU} = \alpha^{u,EMU} = 0.4$ and that $\alpha^{d,EMU} = 0.2$. Thus, the central government aims at stabilizing both output and unemployment but

also takes into account the dynamic of the deficit. Finally, we set $\alpha^{y,tr} = \alpha^{u,tr} = 0.5$ so that the decision about transfer is based equally on the output and on the unemployment differentials.

4.4 Stabilizing properties of the different transfers schemes

4.4.1 Response of the economy in the case of a negative supply shock in the home economy

	$C_t^{g,H}$	Tr_t^H	$\tau_t^{c,H}$	$\tau_t^{w,H}$	$\tau_t^{sp,H}$
Output differential	0.0063	0.012	0.0078	0.00026	0.0004
Inflation differential	0.002	0.0037	0.0064	0.00095	0.0012
Unemployment differential	0.0023	0.0026	0.004	0.0021	0.0021
Real exchange rate	0.0068	0.013	0.0084	0.032	0.0047

Table 4.1: Standard deviations in the case of a 1% supply shock.

In this first case, the domestic economy faces a negative supply shock. The rise in firms' marginal cost triggers an increase in prices and output declines. However, as it has been pointed out in Chapter 1, this is likely that a productivity shock produces in the short run a positive correlation between output and unemployment.[4] As shown in Figures (4.1), (4.2) and (4.3), home output declines but home unemployment decreases.

Following the negative supply shock, foreign output falls but to a lesser extent than in the home economy. The consumer price index increases also in the foreign economy and unemployment increases following the reduction in output.

Tables (4.1) displays standard deviations of output, inflation, the real exchange rate and unemployment differentials between both countries when a supply shock occurs. A first observation is that a decrease in the labor income tax and in the social protection tax following the fiscal transfer triggers the lowest volatility of the differential between

[4]See Barnichon (2012) for a detailed discussion about the short-run effects of productivity shocks on unemployment.

both economies. At the opposite, the demand-enhancing fiscal instruments (a drop in VAT, a rise in government consumption and in transfers to households) trigger a lower stabilization in the case of the supply shock. The drop in the labor income tax and in the social protection tax generates a better stabilization of home output but also the spillover effects on foreign output are significantly positive, as shown in Chapter 3. Public consumption, VAT and transfers also reduce the output differential but to a lesser extent. One can notice that transfers reduce less the difference in output between the two economies than public consumption. As shown in Chapter 3, a rise in transfers to households in one member state triggers a strong leakage effect since home households will consume more home goods but also more foreign goods since one share of goods are perfectly tradable in the monetary union. Thus, a rise in transfers to households in the home economy generates a positive spillover effect on the foreign economy so that the output differential between the two economies is more volatile than in the case of a rise in public consumption following the fiscal transfer.

As said previously, the negative productivity shock puts an upward pressure on home and foreign prices. However, the rise in prices is more important in the home economy. One interesting observation is that when the fiscal transfer is used for rising public consumption and transfers to households or for decreasing VAT, it triggers additional upward pressures on prices in the domestic economy. These demand-enhancing instrument thus increase the volatility of home inflation so that the inflation differential between the two economies is greater than without any fiscal intervention. At the opposite, a drop in the social protection tax in the home economy triggers a decrease in inflation in the short-run and a slightly positive response of prices in the long run. Also, as shown in the Chapter 3, a drop in the labor income tax generate weak pressures on home inflation and decreases slightly foreign prices. As a consequence, these two taxes are more effective for stabilizing inflation between member states, as indicated in Table (4.1) and Figures (4.1), (4.2) and (4.3).

When a negative supply shock occurs in the home economy, it tends to reduce unemployment. As a consequence, the implementation of a fiscal policy in order to boost

output will tend to enhance this drop in unemployment in the home economy. In this case, a labor income tax cut is the most effective fiscal tool to stabilize unemployment in the home economy since it produces a rise in output but a mitigate effect on home unemployment. More precisely, and as discussed already in Chapter 3, a labor income tax cut in the home economy boosts output and employment but also the labor force participation since marginal utility of labor for the households increases. Thus, as shown in Figures (4.1), (4.2) and (4.3), the labor income tax cut stabilizes unemployment more than the other fiscal instruments.

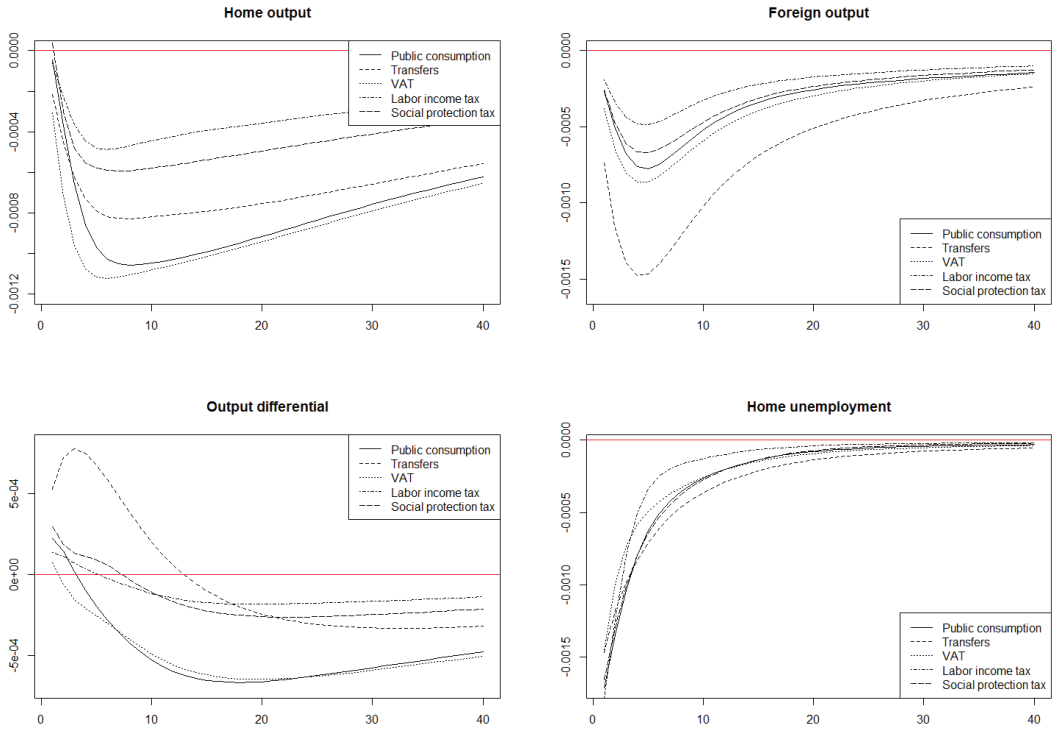

Figure 4.1: Response to a negative supply shock in the home economy I

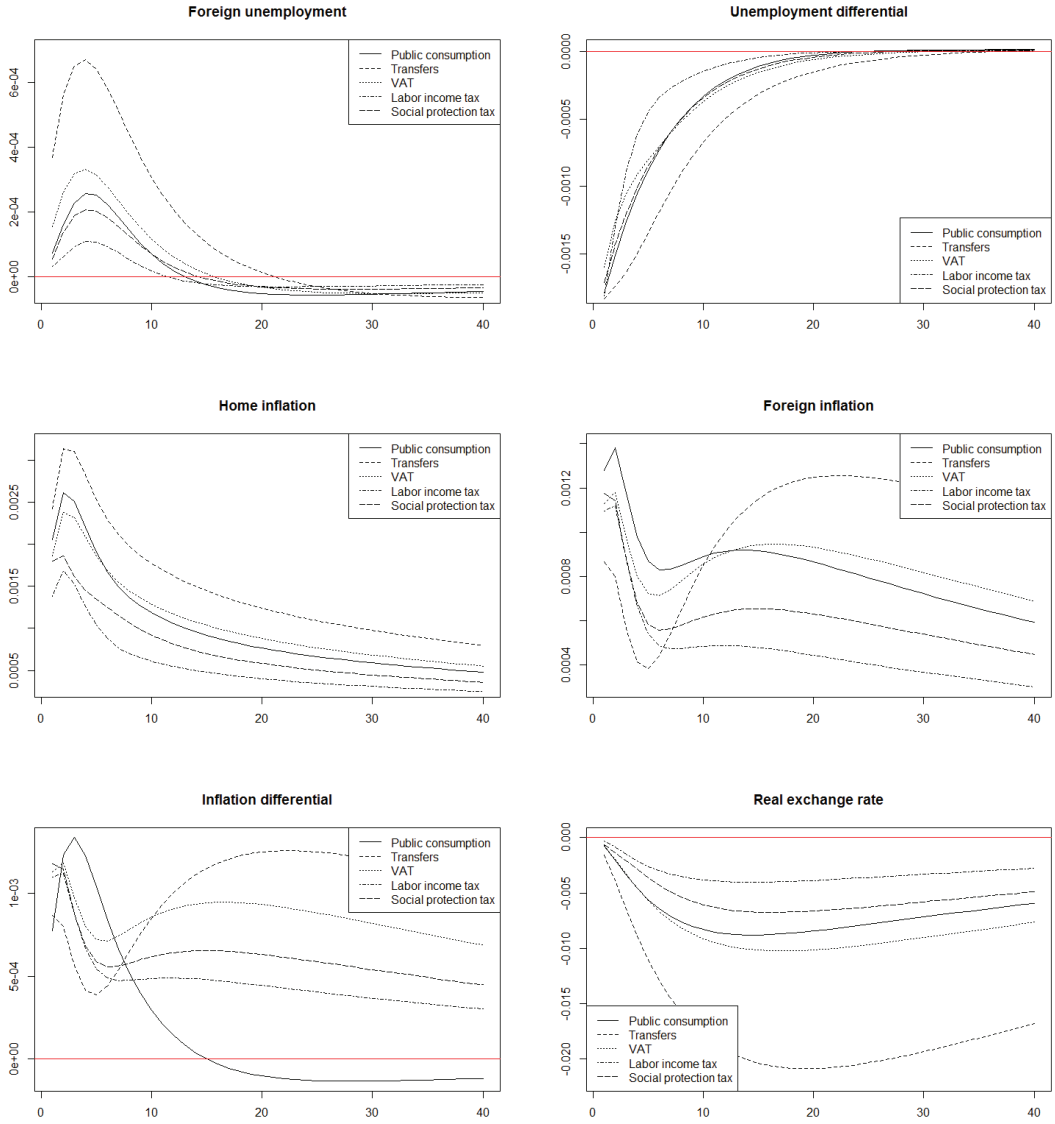

Figure 4.2: Response to a negative supply shock in the home economy II

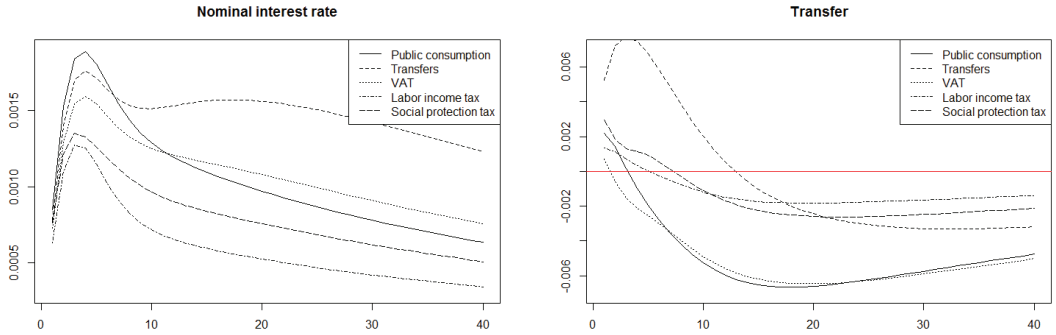

Figure 4.3: Response to a negative supply shock in the home economy III

4.4.2 Response of the economy in the case of a negative demand shock in the home economy

	$C_t^{g,H}$	Tr_t^H	$\tau_t^{c,H}$	$\tau_t^{w,H}$	$\tau_t^{sp,H}$
Output differential	0.00048	0.0012	0.001	0.0008	0.001
Inflation differential	0.00024	0.0007	0.0004	0.0013	0.0023
Unemployment differential	0.00042	0.0013	0.001	0.003	0.0011
Real exchange rate	0.00066	0.002	0.001	0.0034	0.0042

Table 4.2: Standard deviations in the case of a 1% demand shock.

In the case of a negative preference shock for the domestic households, home output falls. In contrary to the effects of a supply shock, a negative demand shock triggers a fall in prices and a rise in unemployment in the home economy, as shown in Figures (4.4) and (4.5). Since home households consume a significant share of foreign goods, the drop in consumption in the home economy impacts also negatively the demand for goods in the foreign economy so that output and prices fall in the foreign economy.

In Table (4.2) are reported the standard deviations in the case of an asymmetric demand shock. The main result is that when a negative demand shock occurs, the demand-enhancing fiscal instruments, namely public consumption, transfers to households and VAT are more effective to stabilize macroeconomic differentials between economies than the labor income tax and the social protection tax, in opposition with the case of a sup-

ply shock.

Similarly to the previous case, transfers to households and a VAT cut are less effective to reduce output differential than public consumption since the shift in demand produced by the transfer is limited by a leakage effect in favor of the purchase of foreign goods.

Since in the case of a demand shock output and inflation are positively correlated, the demand-enhancing fiscal instruments are now effective for reducing inflation differential between both economies. Also, the degradation of output is followed by a rise in unemployment in both economies but to a lesser extent in the foreign economy. As a consequence, transfers based on public consumption stabilize in this case the most effectively home unemployment and the unemployment differential between both economies.

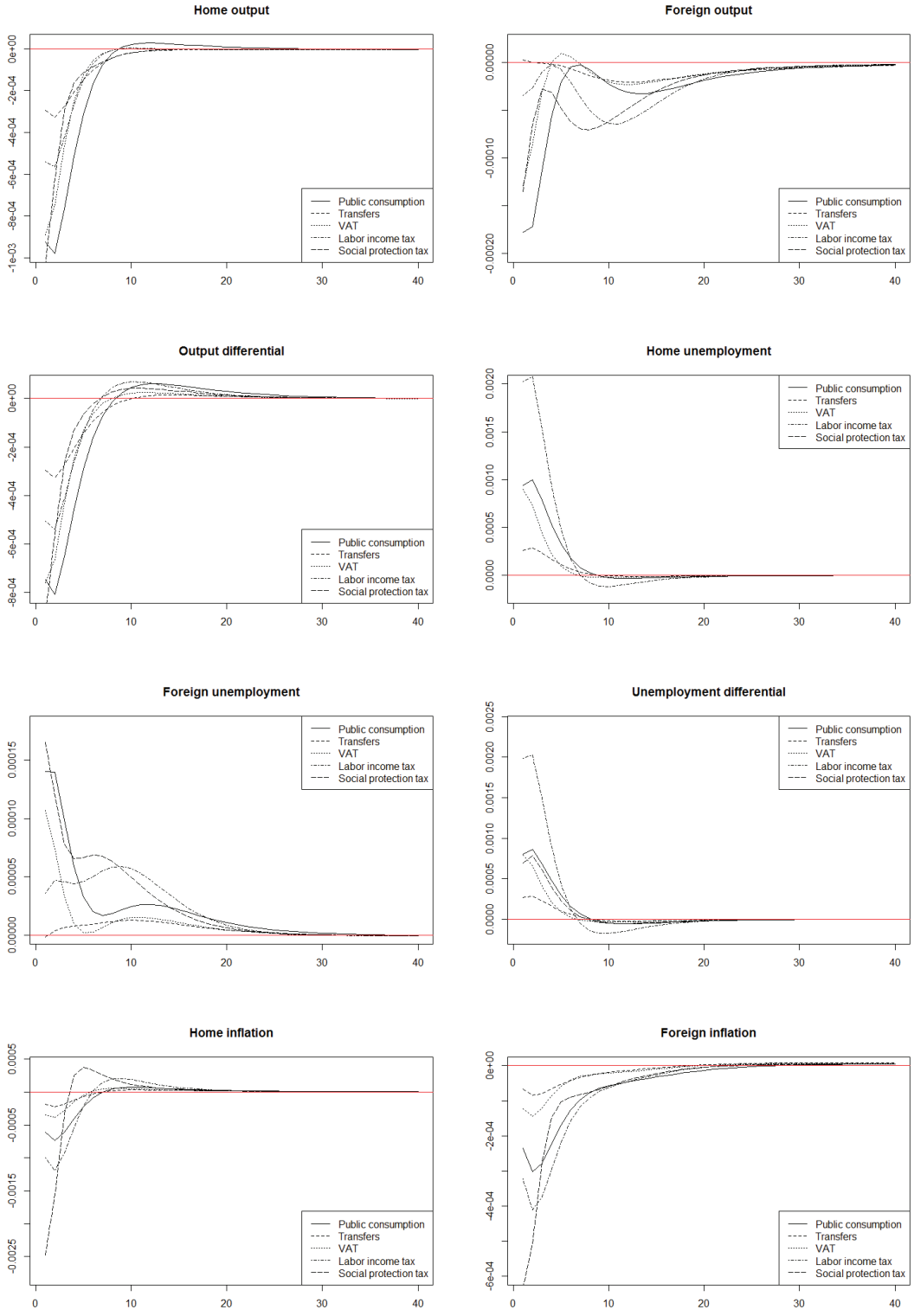

Figure 4.4: Response to a negative demand shock in the home economy I

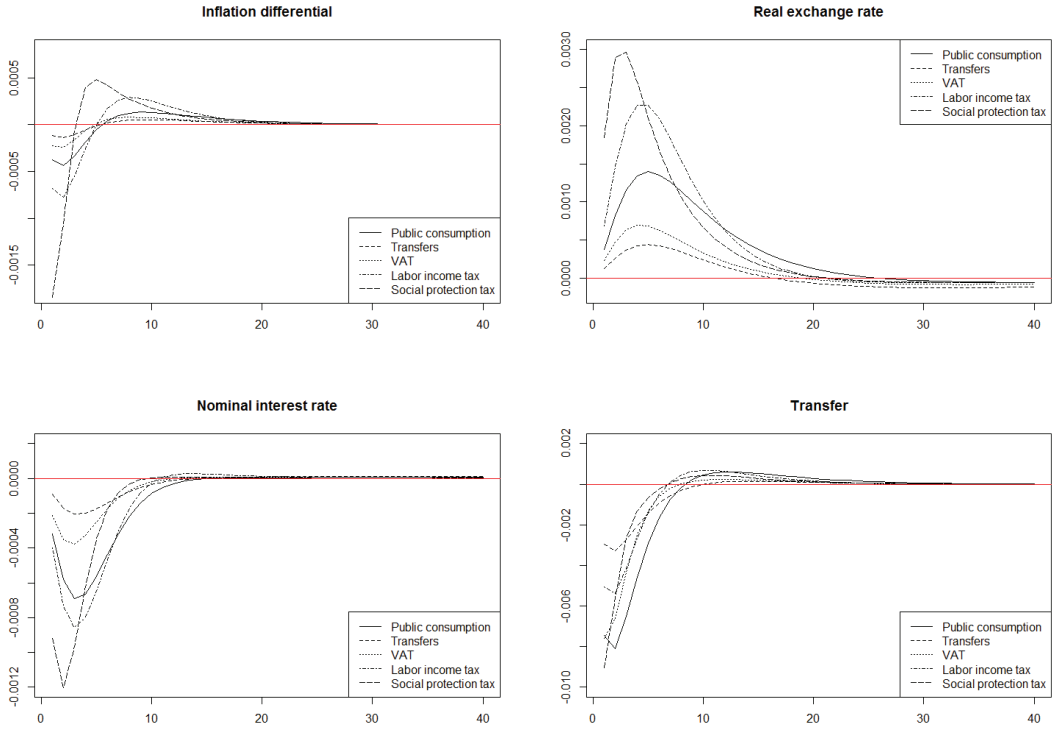

Figure 4.5: Response to a negative demand shock in the home economy II

4.5 Conclusion

The main result of this chapter is that the stabilizing properties of fiscal transfer schemes strongly depend on the way the recipient economy uses the funds form the transfer. Public consumption, transfers and the VAT are more effective to stabilize macroeconomic differential in a monetary union when asymmetric demand shocks occur while the labor income tax and the social protection tax are more effective in the case of an asymmetric supply shock.

Also, transfers to households and a VAT cut do not seem to be very effective even in the case of a demand shock since these fiscal instruments trigger a large leakage effect so that the output differential is less reduced than in the case of public consumption.

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Chapter 5

General conclusion

Main findings of this PhD thesis

Overall, this thesis attempts to contribute to the broad literature concerning the short-run effects of fiscal policy on economic activity. Studying the macroeconomic effects of fiscal policy requires to consider its different and numerous facets. The work provided in this thesis takes into account some important aspects of fiscal policy. I attempt to show that the effects of fiscal policy greatly depend on the way the government intervenes, through different sorts of expenditure and taxes. Also, I argue, in line with a large body of papers, that investigating the effects of fiscal policy shocks on the labor market is relevant, since effects on output and unemployment can differ strongly. Also, one part is dedicated to the analysis of fiscal policy in a monetary union, with a focus on spillover effects of fiscal policy and on the stabilizing properties of fiscal transfer schemes within a monetary union.

I would like to conclude this thesis by stepping back on the existing literature on fiscal policy in the broad sense. Where do we stand? Which lessons can give the academic profession to policy makers? First, a fundamental question is the effectiveness of fiscal policy to stabilize macroeconomic activity over the business cycle. As discussed throughout the thesis, the value of the output fiscal multiplier varies strongly among studies. However, from a theoretical point of view, we can reasonably think that neo-

classical and Keynesian effects coexist. Moreover, even if the size of the multiplier is uncertain, a reasonable position is to think that the multiplier is significantly positive so that fiscal expansions and contractions affect the real economy. In this sense, this statement argues in favor of the intervention of the governments, alongside monetary policy, in terms of macroeconomic stabilization policies. Especially, since the conventional tools of monetary policy are currently limited in the Eurozone, it would justify the implementation of expansionary fiscal policies, or at least, less restrictive fiscal policies. The current situation in the Eurozone is somehow unprecedented. In recent years, European institutions have faced a complicated trade-off. With high debt levels, a rising uncertainty about the solvability of Euro-Area economies and the risk of contagion of financial stress from some Euro-Area economies to the rest of the union have led to the implementation of austerity plans in order to reassure the financial markets. Alongside these national plans, the creation of the European Stability Mechanism has allowed to prevent some economies and especially Greece to go bankrupt. In return for liquidities, European institutions impose large fiscal consolidations and structural reforms. The success of such a policy is closely related to the size of the fiscal multipliers. If we consider that the value of the multiplier is low or even close to 0, the implementation of austerity plans would be fruitful. By reassuring the private sector (financial markets, investors) with a low cost on output growth, these plans could have a positive effect on the economic activity. On the contrary, if the effects of fiscal policy are large, these plans could be harmful, with large negative effects on output and a low effect on deficits and debts. Especially, an important message that has been delivered by economists is that the effects of fiscal policy depend on numerous elements. Two of these elements have been highlighted throughout the thesis: the position of the economy over the business cycle and the behavior of the monetary authority. This is likely that the fiscal multiplier has been large in recent years according to these elements since most of economies have faced a strong economic downturn and since central banks interest rates are close to 0.

Recent contributions on fiscal policy in monetary unions also deliver clear messages to policy makers, especially for the Eurozone. It has been shown with clarity that coordinated fiscal policies trigger larger effects on the real economy than non-coordinated

ones. Also, one strand of this literature argues for a deeper fiscal integration in the Eurozone, through reflections on fiscal unions. This statement is far from being new and was already present in the seminal works on optimal currency areas of Mundell or McKinnon among others. Also, the MacDougall report in 1977 was already pointing out the necessity for the future Eurozone to carry out fiscal integration alongside the achievement of monetary integration and of the single market. If economists urge the European policy makers to strengthen the fiscal framework in the Eurozone, it would be wrong to affirm that nothing has been accomplished over the recent years. The creation of the permanent European Stability Mechanism, the discussions about debt pooling across member states or the recent and coordinated European Commission's Investment Plan for Europe are signs of the will to reform the way is implemented fiscal policy in the Eurozone. In this sense, both academics and policy makers seem to take an important interest in the financial aspects of fiscal policy in monetary unions.

Research project

I will describe briefly the future research projects which are in the continuity of this thesis. First, in line with Chapter 3, I and my supervisors Amélie Barbier-Gauchard and Giuseppe Diana would like to estimate the spillover effects of fiscal policy on Euro-area data. Similarly to the theoretical exercise in Chapter 3, the focus would be on the spillover effects of fiscal policy according to the fiscal instrument used. From a methodological point of view, we would use a Global Vector Autoregression Model[1]. This modeling is relevant for that purpose since it enables to take into account the international linkages between countries and especially the strength of the trade between economies, which is central for estimating the cross-border effects of fiscal policy. Also, this methodology is well suited to counterfactual exercises. In this sense, and always in line with Chapter 3, we could provide empirical evidences of the spillover effects of fiscal policy in the case of a passive monetary policy (for instance a ZLB episode). In line with this research project, Hebous and Zimmermann (2013) and Ricci-Risquete

[1]See Pesaran, Schuermann and Weiner (2004), Pesaran and Smith (2006) or Dees, di Mauro, Smith and Pesaran (2007) for seminal articles that describe the GVAR methodology. Chudik and Pesaran (2014) offer a comprehensive survey on recent contributions and extensions in the GVAR literature.

and Ramajo-Hernández (2015) also investigate the spillover effects of fiscal policy with a GVAR model. Both papers point out that spillover effects and multipliers are larger when fiscal policies are coordinated in a monetary union. Our contribution would be to estimate spillover effects for a large set of fiscal instruments and to work on different policy scenarios. As already said, we project to deal with ZLB episodes but also to test the impact on economic fluctuations of different fiscal scenarios, and especially the introduction of a fiscal transfer mechanism.

One potential problem is the availability of some time series for the different sorts of expenditure and taxes for the Eurozone members. For some countries, the ESA 95 quarterly time series only start from the nineties and even later in some cases. That makes the length of the data set rather short. We suggest two ways to compromise with this issue. First, we could only estimate the effects of fiscal policy for countries which have the longer samples for the fiscal data (Netherlands, France, Italie and Germany). Especially, these countries are among the larger economies of the Eurozone. Second, we could extend the available ESA 95 series with cash account data gathered by the governments and other insitutions.[2]

For now, Chapter 2 has been published as a working paper co-written with Thomas Coudert entitled "How can the labor market account for the effectiveness of fiscal policy over the business cycle?". We would like to extend this work by focusing on additional aspects. First, we would like to extend the model by introducing an endogenous labor force participation decision.[3] It has been shown in this thesis that the recent literature related to the effects of fiscal policy on unemployment has focused on the important role that can play changes in labor supply. We believe it would be interesting to look at the response of the labor supply according to different steady-state unemployment values and to assess if this additional channel distorts or not our result.

[2]Paredes, Pedregal and Pérez (2009) already used cash account national fiscal data for creating a fiscal data set for the Eurozone.

[3]Ravn (2005) introduces a labor force participation decision in a search and matching model for the labor market. Campolmi, Faia and Winkler (2011) and Brückner and Pappa (2012), who investigate the effects of fiscal policy on the labor market, introduce also a labor force participation decision following Ravn (2005)

Also, in the model of Chapter 2, the bargaining power of the workers is assumed to be exogenous and constant. However, this is likely that this parameter varies over the business cycle: it would be lower during times of economic downturn and higher during expansions. This parameter drives the response of the real wage through the efficient Nash bargaining and the dynamic of the real wage is central in the mechanism we highlight throughout the paper. In this sense, we would like to investigate the impact of a lower bargaining power during high-unemployment periods on the output fiscal multiplier. We can do it simply by simulating the model with different values for this parameter. One more ambitious project would be to endogenize this parameter in a job search and matching model.

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Fiscal Policy and the Labor Market in the Euro Area : Multiplier, Spillover Effects and Fiscal Federalism

Résumé

Cette thèse contribue aux travaux récents sur les effets de la politique budgétaire à court terme sur l'économie. Plus précisément, sont étudiés dans cette thèse trois principaux aspects de la politique budgétaire à court terme. Premièrement, un des messages principaux consiste à dire que l'impact de la politique budgétaire sur l'économie dépend fortement de l'instrument fiscal utilisé. Augmenter les transferts aux ménages, augmenter l'investissement public ou diminuer les côtisations patronales sur les salaires produisent des effets fort différents sur les variables macroéconomiques clefs et notamment sur le niveau d'activité. Deuxièmement, au délà des effets sur l'activité économique, une large partie de cette thèse analyse l'impact de chocs budgétaires sur le marché du travail. Un des pricipaux résultats est qu'il paraît délicat de traduire des multiplicateurs sur l'activité en multiplicateurs sur le chômage, notamment à cause de la réponse de l'offre de travail. Troisièmement, nous savons que de multiples facteurs influencent la taille du multiplicateur budgétaire. Deux de ces éléments sont abordés dans cette thèse : la position de l'économie sur le cycle économique et la réponse de la politique monétaire. Les deux premiers chapitres de la thèse analysent ces différents aspects dans un cadre d'économie fermée. Les deux derniers chapitres traitent de la politique budgétaire en union monétaire en analysant les effets de débordement entre Etats membres ainsi que les capacités stabilisatrices de mécanismes de transferts budgétaires entre Etats membres afin d'amortir les chocs conjoncturels.

Mots clefs : Politique budgétaire, marché du travail, union monétaire, effets de débordements , transferts fiscaux, modèles nouveaux Keynésiens, modèles de séries temporelles

Résumé en anglais

This thesis aims at contributing to the recent studies which investigate the short-run effects of fiscal policy on economic activity. More precisely, three main aspects of fiscal policy in the short run are analyzed. First, one major message is that the impact of fiscal policy on the economy depends strongly on the fiscal instrument used by the government. Rising transfers to households, increasing public investment or cutting social protection tax trigger very different effects on key macroeconomic variables and especially on output. Second, one large part of this thesis is dedicated to the analysis of the effects of fiscal policy shocks on the labor market. One main result is that we cannot determine unemployment fiscal multipliers according to the value of the output fiscal multiplier, especially because of the response of the labor force participation to fiscal policy shocks. Third, this is well-known that many elements influence the size of the output fiscal multiplier. Two of these elements are considered throughout this thesis: the position of the economy over the business cycle and the behavior of the monetary policy. The two first chapters of this thesis analyze these different aspects in some closed economy models. The two last chapters extend this study at the case of a monetary union by investigating the spillover effects of fiscal policy between member states but also the stabilizing properties of fiscal transfer mechanisms between member states in order to soften cyclical shocks.

Keywords: Fiscal policy, labor market, monetary union, spillover effects, fiscal transfers, new-Keynesian model, time series model