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**Essais sur le marché du travail en
macroéconomie**

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Introduction Générale

La reconnaissance de Peter Diamond, Dale Mortensen et Christopher Pissarides en tant que récipiendaires du Prix de la Banque de Suède en sciences économiques en mémoire d'Alfred Nobel en 2010 a gravé la vision des modèles d'appariement comme la représentation normative du marché du travail en macroéconomie. Cette vision a permis de remettre en avant un élément central dans la compréhension du chômage et qui avait été négligé par Keynes¹ et ses disciples jusqu'à très récemment : le chômage frictionnel. Alors même que de nouveaux mécanismes du marché du travail purent être étudiés plus en détails, de nouvelles interrogations émergèrent et ce en concomitance avec une crise théorique en macroéconomie.

L'objectif de cette thèse est de contribuer à répondre à trois questions récentes en macroéconomie. Très brièvement, ces questions peuvent être résumées de la manière suivante : i) *quels sont les déterminants de la dynamique des salaires et comment affectent-ils la persistance de l'inflation ?*; ii) *pourquoi la politique budgétaire est-elle plus efficace en période de ralentissement économiques ?*; et enfin iii) *quels sont les effets de débordement d'une réforme structurelle du marché du travail dans un pays spécifique sur ses partenaires commerciaux ?* Ces questions sont liées par le fait que leurs réponses résident dans une analyse approfondie du marché du travail.

Cette introduction générale est organisée de la manière suivante : tout d'abord,

¹ Dans la Théorie Générale, Keynes identifie trois sources au chômage : le chômage volontaire, le chômage frictionnel et le chômage involontaire. Parce que Keynes souhaitait souligner l'importance du chômage involontaire dans le cycle des affaires, il regroupa dans ce qui pourrait être considéré comme un taux de chômage naturel le chômage volontaire et le chômage frictionnel sans chercher à l'étudier plus en détail. Pour plus de détails, voir le chapitre 2.II et le chapitre 2.IV dans Keynes (1936).

une revue de la littérature est présentée de sorte à inscrire ces trois différentes questions dans le débat scientifique actuel en macroéconomie. Par la suite, les différentes contributions de cette thèse à ce débat sont présentées ainsi que la méthodologie utilisée pour répondre à ces questions.

0.1 Révolution et contre-révolution en macroéconomie

Comment évolue, voire progresse, la macroéconomie ? Selon Woodford (1999), grà des révolutions et des évolutions. En effet, la première révolution en macroéconomie est la Théorie Générale de Keynes. On peut aisément dire que, même si l'étude du cycle économique n'a pas commencé en 1936, la macroéconomie en tant que domaine indépendant de l'économie est né avec Keynes. Comme rapporté par De Vroey et Malgrange (2007), les objectifs de Keynes dans sa Théorie Générale peuvent se résumer en quatre points: montrer l'existence d'un chômage involontaire; expliquer pourquoi les rigidités du salaire ne sont pas responsables de ce type de chômage; montrer comment ce chômage involontaire peut être expliqué dans le cadre d'un équilibre général; et enfin montrer pourquoi une faible demande globale est responsable du chômage et comment une politique expansionniste peut aider à éviter ce problème. Si au début de son travail, Keynes souhaitait expliquer le cycle économique, il d renoncer rapidement à ce projet, en raison des limites mathématiques et informatiques de l'époque. Il réussit néanmoins à démontrer l'interconnexion de toutes les principaux agrégats (emploi, taux d'intérêt et prix) à un moment précis.

Si la théorie de Keynes n'est pas de prime abord bien comprise par ses contemporains, la lumière fut faite par trois jeunes économistes, Harrod, Meade et Hicks, qui ont livré leur interprétation de la Théorie Générale. L'interprétation de Hicks (1937) fut la plus convaincante pour la plupart des économistes et donna naissance au modèle IS-LL, plus tard renommé IS-LM pour *Investment-Saving* et *Liquidity preference-Money*. Cependant, Hicks n'a pas seulement donné sa lecture de la théorie générale, il a également inscrit les résultats de Keynes dans un cadre cohérent avec les résultats de la microéconomie. Rejoint par Paul Samuelson et d'autres après la Seconde Guerre Mondiale, ils vont créer une école de pensée

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connue sous le nom de Synthèse Néoclassique. Cette Synthèse réuni ainsi les résultats keynésiens à court terme, de fait avant que le salaire et le prix ne puissent s'ajuster, et les résultats néoclassiques à long terme, après la renégociation du salaire et l'ajustement des prix. La Synthèse Néoclassique a également créé la première rupture entre les disciples de Keynes entre ceux qui l'accepte et ceux qui la rejette, afin de rester aussi proches que possible de l'ouvre originale de Keynes. Ces économistes créeront l'école de pensée dite Post-Keynésienne.

Avec le phénomène de la stagflation des années 70, période o les économies souffrent à la fois d'une faible croissance économique (et donc d'un chômage élevé) et d'un niveau élevé d'inflation, la pensée de Keynes est contestée par un groupe d'économistes qui remettent en cause les implications politiques de cette théorie et qui voient dans la stagflation la confirmation que la théorie de Keynes n'est pas parfaite. Cette école de pensée est connue sous le nom de Monétariste. De faite, la stagflation a posé un problème conséquent à la théorie keynésienne puisque les chocs budgétaires ne sont plus alors capables de stimuler l'activité réelle, même en payant un cot en termes d'inflation. Milton Friedman et les monétaristes l'ont observée et contestent ainsi les implications politiques de la synthèse néoclassique. Cependant, ce n'était pas la première attaque de Friedman contre le modèle keynésien. Par exemple, Friedman s'est opposé à la loi Psychologique Fondamentale de Keynes avec son hypothèse du revenu permanent.² Cependant, la stagflation permettra à Friedman et à ses disciples de contester plus profondément cette théorie. En particulier, le fait que la politique monétaire puisse être utilisée pour réduire le chômage, en payant le prix d'un peu plus d'inflation, est un non-sens pour Phelps (1967) et Friedman (1968). Selon leur point de vue, la courbe de Phillip décrit seulement un compromis entre l'inflation et le chômage à court terme, période au cours de laquelle les consommateurs, ne disposant pas d'informations suffisante sur les prix peuvent être victimes de l'illusion monétaire.³ Cependant, à la longue, cette illusion disparaît et

² La Loi Psychologique Fondamentale stipule *[L]es hommes es hommes tendent à accroître leur consommation à mesure que le revenu croît, mais non d'une quantité aussi grande que l'augmentation du revenu.*

³ Phillips (1958) étudie l'économie britannique de 1861 à 1957 et montre qu'il y a une corrélation négative entre la dynamique des salaires monétaires et le chômage. En supposant que les

les décideurs politiques ne peuvent pas utiliser la politique monétaire pour forcer l'économie à atteindre un taux de chômage inférieur au taux de chômage naturel, pour reprendre la terminologie de Friedman. Dès lors, la monnaie est neutre et ne peut pas affecter la sphère réelle de l'économie. *[La monnaie est une chose trop importante pour être laissée entre les mains des Banques centrales.]*, dira Milton Friedman (2002).

Néanmoins, s'il est certain que l'interventionnisme revendiqué par la Synthèse Néoclassique est alors rejetée, la méthodologie des macro-économistes keynésiens n'est pas encore remise en question par les monétaristes. De ce point de vue, les attaques de Robert Lucas contre la pensée keynésienne sont encore plus virulentes puisque ce dernier conteste à la fois les implications politiques et la méthodologie du modèle IS/LM. Dès lors, la fameuse critique de Lucas devient la deuxième grande révolution en macroéconomie après la Théorie Générale.

Cette critique peut être considérée comme aussi importante que la Théorie Générale en cela qu'elle a annihilé une grande partie des résultats scientifiques trouvés pendant la deuxième partie du 20ème siècle par les macro-économistes. Elle a par ailleurs donné naissance à la Nouvelle École Classique. Selon De Vroey et Malgrange (2007) et Vroey (2012), la critique de Lucas constitue une véritable révolution scientifique à la Kuhn qui peut être définie comme une période durant laquelle le paradigme dominant est remplacé par un nouveau du fait d'une ou plusieurs énigmes empiriques. Ce remplacement va aussi avec une confrontation entre l'ancienne et la jeune génération.⁴ Comme l'a signalé Laffargue et al. (2012), la critique de Lucas peut se résumer en plusieurs points.

L'agent rationnel : Premièrement, Lucas (1976) renforce le concept de rationalité économique. Les agents économiques atteignent leurs objectifs en maximisant les fonctions d'utilité sur un horizon temporel infini. Pour ce faire, Lucas adopte les

entreprises fixent leurs prix en appliquant un taux de marge à leurs cots, on peut facilement montrer en utilisant la courbe de Phillips originelle qu'il existe une relation négative entre inflation et chômage.

⁴ Voir par exemple l'article de Sargent (1977) intitulé *Is Keynesian economics a dead end ?*

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anticipations rationnelles de Muth (1961) et suppose que les agents économiques peuvent utiliser toutes les informations disponibles et, en moyenne, ne font pas faire d'erreurs. Dit différemment, en moyenne, les anticipations sont supposées conformes aux prédictions du modèle. De plus, la nature rationnelle de chaque agent est connue de tous. Cela implique qu'un seul individu sait que tout le monde est rationnel. Le reste de la société sait aussi que cet individu en particulier est rationnel.

En outre, les agents privés évaluent la crédibilité des décideurs et leur propre décision en conséquence. Ainsi, la macroéconomie est passée de la conception d'un agent économique qui commet systématiquement des erreurs avec les anticipations adaptatives à un agent qui connaît parfaitement le véritable modèle de l'économie. On peut voir venir ici une première grande critique contre la Nouvelle Synthèse Néoclassique, mouvement théorique qui accepte la vision macroéconomique de Lucas. Cette critique peut être résumée comme suit : comment les agents économiques peuvent connaître le véritable modèle de l'économie, surtout en temps de crise, alors que les macro-économistes, entre autres, discutent encore de sa nature ? Cependant, selon Woodford (1999), cette représentation des anticipations aura des conséquences énormes en ce qui concerne les recommandations en termes de politiques économiques. En effet, si un responsable politique de la mode fonde sa politique sur le fait que les anticipations des agents privés en matière d'inflation seront différentes que le niveau réel de l'inflation, ce décideur n'obtiendra aucun résultat dès lors que les agents économiques sont supposés connaître la valeur réelle de l'inflation.

La critique du cygne noir : Deuxièmement, l'approche inductiviste de Keynes est remplacée par le falsification, incarné par le *As if* de Milton Friedman. En effet, Keynes et ses disciples ont utilisé leur propre perception pour décrire le fonctionnement de l'économie et pour construire leurs modèles. Si les hypothèses utilisées pour construire le modèle sont vraies, c'est-à-dire si elles reproduisent les faits stylisés, les conclusions de ces modèles sont aussi vrai. Cependant, l'inductivisme méthodologique a été largement critiqué. L'exemple le plus célèbre

de ces critiques est celui du cygne noir. Supposons qu'en Europe, tous les cygnes sont blancs, les éthologues européens peuvent extrapoler, conclure que sur terre, tous les cygnes sont blancs et établir des généralités sur cette espèce sur la simple étude du comportement du cygne blanc. Imaginons maintenant qu'un ou plusieurs éthologues européens voyagent en Australie. Ils découvriront alors des cygnes noirs. Cette découverte rendrait caduque toutes les conclusions précédentes. Cette critique stipule que la perception des macro-économistes et de tout scientifique en général peut être erronée. Lors, le modèle et les conclusions tirées de à ces perceptions erronées seraient également fausses.

Friedman (1953) propose d'inverser la causalité entre empirisme et théorie en macroéconomie. L'importance d'un modèle macroéconomique n'est plus alors sa véracité, mais sa capacité à reproduire l'état de l'économie. Friedman prend l'exemple bien connu et controversé des feuilles autour d'un arbre et cherche à expliquer la densité des feuilles autour de cet arbre. Pour ce faire, Friedman suppose que chaque feuille peut maximiser la quantité de soleil en choisissant sa place sur l'arbre étant donné la place de son voisin. Les feuilles sont censés connaître les lois physiques, être en mesure de discuter et de se déplacer instantanément sur un versant ou sur un autre de l'arbre. Si Friedman assume clairement la nature irréaliste de son hypothèse, il souligne le fait que l'importance n'est pas de savoir si les feuilles sont rationnelles, mais si leur densité sur un arbre est la même que si elles étaient effectivement rationnelles.⁵ Dit différemment, la structure d'un modèle macroéconomique n'a pas à être réaliste, elle doit être en accord avec la théorie de l'équilibre général héritée de la microéconomie et doit reproduire les principaux co-mouvements. Lucas adopte totalement ce point de vue et l'inclut dans sa critique.

Concomitamment avec la critique de Lucas, Kydland et Prescott (1977) remettent en cause les implications politiques de la pensée keynésienne. Dans l'article fondateur *Rules Rather than Discretion: The Inconsistency of Optimal Plans*, Kydland et Prescott supposent que les agents privés sont rationnels et qu'ils con-

⁵ Friedman (1953) écrit page 12 : [D]e ce que nous savons, les feuilles ne délibèrent pas, ne sont pas allées à l'école apprendre les lois piétinantes de la science et des mathématiques propres à leur permettre de calculer la position optimale .

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naissent le véritable objectif des décideurs. Si un décideur annonce une politique qui ne lui permet pas de maximiser cet objectif, les agents privés ne jugeront pas cette politique crédible dans le temps et ne l'incluront dans leurs anticipations. Si cette politique maximise l'objectif du décideur, les agents privés l'incluront dans leur programme.

Pour démontrer leurs propos, Kydland et Prescott prennent l'exemple de la courbe de Phillips. Supposons qu'un gouvernement ait deux objectifs irréconciliables : avoir un faible taux de chômage et avoir une faible inflation. Dans le but de réduire le chômage, ce gouvernement n'a d'autre choix que de sacrifier l'inflation en trompant les anticipations des agents privés. En effet, au début d'une période, les agents privés formeront leurs anticipations concernant le niveau de l'inflation selon la politique annoncée par le décideur. Comme ils sont rationnels, les agents privés connaissent le modèle de l'économie et en particulier la courbe de Phillips. Dans un contexte non stochastique les anticipations des agents privés concernant l'inflation seront réalisées et seront égales au niveau de l'inflation à la fin de la période. Si le gouvernement annonce une cible d'inflation égale à zéro au début de la période, du fait des anticipations des agents privés, elle sera égale à zéro à la fin de la période. Dans ce cas, le chômage sera égal au taux naturel de chômage et les pertes du gouvernement seront dues à ce double objectif.

Cependant, Kydland et Prescott montrent que cette politique est incohérent temporellement. En effet, il est rationnel pour le gouvernement d'essayer de duper les agents privés. Une fois que les agents privés ont formé leurs anticipations en matière d'inflation, selon une cible d'inflation nulle annoncée par le gouvernement, ce dernier peut être tirer profit en laissant croître l'inflation afin de tirer le chômage en de de son taux naturel. Cependant, les agents privés savent que la cible d'inflation n'est pas crédible et anticiperont parfaitement le jeu insidieux du gouvernement. De fait, les agents privés s'attendent à ce que la véritable cible d'inflation soit positive et ajustent leur comportement, notamment en termes de négociation des salaires nominaux et de demande de main-d'œuvre. Finalement, le chômage ne tombera pas en dessous de son taux naturel et le seul résultat de la politique monétaire sera une l'inflation positive.

Pour une grande partie des économistes de l'École de Chicago, dont Kydland and Prescott, les politiques économiques doivent être retirées des mains des gouvernements. Par exemple, en accord avec ces deux auteurs, Nordhaus (1975) montre que le cycle des affaires dans les démocraties peut s'expliquer par le comportement des gouvernements. Dans un monde où les agents privés sont victimes de la *myopie démocratique*, une notion proche des anticipations adaptatives de Friedman, un gouvernement peut être tenté de chercher à duper les électeurs en dégradant la situation macroéconomique durant la première partie de son mandat électoral pour ensuite stimuler l'économie en ayant recourt à une politique expansionniste juste avant les élections afin d'afficher un bilan économique positif. En cela, Nordhaus (1975) partage la vision de Ronald Coase lorsque ce dernier dit : Le type de situations pour lesquelles les économistes ont tendance à considérer que l'action correctrice de l'État se justifie est de fait souvent le résultat de l'action du gouvernement lui-même .⁶ Dès lors, les conclusions de Kydland et Prescott sont simples. Afin d'éviter le problème de l'*incohérence temporelle*, les gouvernements doivent se restreindre eux-mêmes. Tout d'abord, suivant Tinbergen (1952), Kydland et Prescott recommandent qu'une politique économique cible un unique objectif.⁷ Par ailleurs, les gouvernements doivent s'imposer à eux-mêmes une règle et s'y tenir. En particulier, l'optimalité nécessite que la politique monétaire doive être confiée à une autorité indépendante, en dehors du jeu démocratique. Barro et Gordon (1983) confirment cette conclusion en envisageant un jeu répété dans lequel le banquier central peut être puni par les agents privés s'il dévie de la politique annoncée. Une telle indépendance contraint l'autorité monétaire à ne pas dévier de son objectif premier, tel que cela a également été montré par Rogoff (1985).

⁶ Voir Coase (1960), Le problème du coût social, dans *Classic Papers in Natural Resource Economics*, page 28.

⁷ La *règle de Tinbergen* stipule que si l'optimalité est l'objectif à atteindre, un instrument de politique économique ne peut pas servir à plus d'un objectif. Dans l'exemple pris par Kydland et Prescott, la politique monétaire ne peut pas servir à réduire le chômage et à stabiliser les prix.

0.2 *Le cycle des affaire et la Nouvelle Synthèse Néoclassique*

Dans les années 1980, un troisième courant s'élève contre la pensée keynésienne : la théorie des "cycles réels" (Real Business Cycle en anglais, RBC par la suite). Ce courant reprend la volonté de Lucas de démontrer l'inefficacité de la politique monétaire dans un cadre d'anticipations rationnelles. Dans son article fondateur, Lucas (1972) montre que la politique monétaire peut affecter le cycle économique réel en perturbant l'information des producteurs sur les prix. Dans le modèle de Lucas, les prix peuvent fluctuer pour deux raisons différentes : un choc monétaire qui affecte également tous les producteurs et un choc réel qui affecterait un secteur spécifique ou une seule entreprise. Si les producteurs, qui ne peuvent pas observer directement les variations de prix, considèrent que la fluctuation est la même pour toutes les entreprises, il serait préférable pour eux de ne pas ajuster leurs quantités. Dans ce cas, la variation des prix n'aura aucune conséquence pour l'activité réelle. Si les producteurs estiment que la modification des prix ne concerne que leur secteur ou leur entreprise, ils vont modifier leur production (augmenter leur production si les prix augmentent ou diminuer leur production si les prix baissent). Dans les deux cas, les décideurs ne peuvent pas prévoir les résultats d'une variation de la masse monétaire et de fait la politique monétaire est inefficace. Ce modèle sera connu sous le nom de modèle des îles de Lucas.⁸

Dans ces modèles, Lucas jette les bases de ce qui deviendra la norme dans les modèles de la théorie macroéconomique : les agents maximisant leur utilité avec des anticipations rationnelles dans un cadre de marché efficace. Kydland et Prescott (1982) prolongeront ces modèles et, en particulier, expliqueront le cycle des affaires non par un choc de la politique monétaire, mais en raison de la productivité. Un seul agent représentant schizophrène, à la fois employé et employeur, maximise à la fois son utilité et ses profits et les cycles sont dus à la réaction de cet agent rationnel aux chocs réels. De plus, Kydland et Prescott

⁸ En effet, afin d'expliquer pourquoi les producteurs ne peuvent pas directement observer les changements de prix, Lucas (1972, 1973, 1975) reprend la parabole de l'île de Phelps (1969). Chaque producteur individuel est supposé être sur une île isolée. Dès lors, les producteurs connaissent leur propre prix mais ne connaissent pas le prix au niveau l'économie entière. Ainsi, ils ne peuvent pas savoir si les variations des prix concernent leur île où l'ensemble des îles.

utilisent la méthode d'étalonnage pour donner une valeur aux paramètres. Ces valeurs sont trouvées dans la littérature empirique ou sont choisies afin de reproduire les faits stylisés d'une économie au cours d'une période donnée. Une fois les choix de calibrage effectués, le modèle est simulé et des fonctions de réponses impulsionnelles sont dessinées.⁹ Le modèle, et de fait ses recommandations en matière de politiques économiques, n'est accepté que s'il est capable de reproduire la réalité, c'est-à-dire que si les co-mouvements des principales variables d'intérêt reproduisent les faits empiriques. C'est en grand partie le cas pour le modèle de Kydland et Prescott.

Toutefois, les modèles RBC font face à un problème empirique : les chocs monétaires ont des effets temporaires mais réels sur l'activité. Cette question pousse les macroéconomistes à réintroduire des éléments keynesian dans les modèles de RBC pour créer les modèles d'Équilibre Général Dynamique Stochastique (DSGE par la suite). La réunion des éléments classiques et nouveaux keynésiens permet à Goodfriend and King (1997) d'appeler cette nouvelle école de pensée la Nouvelle Synthèse Néoclassique. Comme indiqué par De Vroey et Malgrange (2007), le fait que la politique monétaire ait des effets réels s'explique principalement par la composante keynésienne de la Nouvelle Synthèse: la rigidité des prix et la concurrence imparfaite.

Tout d'abord, la concurrence imparfaite est introduite suivant l'article fondateur de Dixit et Stiglitz (1977). Dans cet article, les auteurs réintroduisent la Concurrence monopoliste de Chamberlin (1933) selon l'approche de Lancaster (1975) : les consommateurs ne sont pas confrontés à des produits identiques mais à des produits ayant des caractéristiques spécifiques. Ainsi, les consommateurs chercheront des produits qui soient aussi proches que possible de leurs préférences. Étant donné que chaque produit n'est qu'un substitut imparfait à un autre, chaque entreprise possède un pouvoir de marché. Ce pouvoir de marché a une grande conséquence : les entreprises ne sont plus *preneuses de prix* mais elles peuvent maximiser leurs profits en fonction de leur niveau de prix. Effec-

⁹ Une fonction de réponse impulsionnelle (IRF par la suite) représente la réponse d'une variable spécifique à l'impulsion exogène d'une autre variable. Les IRF peuvent être comprises comme l'électroencéphalogramme économique après un stimulus.

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tivement, puisque les consommateurs sont prisonniers de leurs préférences, ils ne pourront pas changer leurs habitudes et être intéressé par un autre bien si une entreprise augmente son prix. Cependant, les entreprises ne peuvent pas augmenter sans cesse leur prix. Leur capacité à l'augmenter ou non dépend directement de leur pouvoir de marché. En contrepartie, leur pouvoir de marché du degré de substituabilité des produits de consommation : si les consommateurs peuvent facilement se déplacer d'un produit à un autre, ce qui implique un haut niveau de substituabilité, le pouvoir de marché serait faible et les entreprises seront proches du cadre de la concurrence pure et parfaite. En revanche, si le degré de substituabilité est faible, le pouvoir de marché des entreprises sera élevé et les entreprises seront proches du cadre purement monopolistique.

Deuxièmement, la rigidité des prix joue un rôle central dans les théories et les recommandations politiques keynésiennes. Parmi les différentes manières d'expliquer et de modéliser la rigidité des prix, la rigidité *à la* Calvo est la plus célèbre. Calvo (1983) part du principe que, à chaque période, seule une partie des entreprises présentes dans l'économie peut changer leur prix. Ainsi, les entreprises maximiseront leur profit sur un horizon temporel infini en choisissant leur prix mais en prenant comme donnée la probabilité de pouvoir changer leur prix ou pas. Cela rend les macro-économistes capables d'introduire une rigidité nominale des prix d'une manière très simple. Enfin, la maximisation du profit dans le cadre d'une rigidité des prix *à la* Calvo et de la concurrence monopolistique conduit les entreprises à appliquer un taux de marge à leur cot marginal. Ce taux de marge est fonction de la substituabilité des produits. La nouvelle Synthèse Néoclassique permet ainsi une fois de plus de concilier une approche classique et une approche keynésienne : la Nouvelle École Classique et la Nouvelles École Keynésienne, respectivement. En effet, à court terme, lorsque les entreprises ne sont pas en mesure d'ajuster leur prix à un choc, elles doivent ajuster leur production à la demande. Ainsi, les effets keynésiens prévalent dans ce cas. Autrement, lorsque les entreprises sont en mesure d'ajuster les prix, des conclusions classiques émergent.

Une dernière composante centrale de la Nouvelle Synthèse est la règle de

Taylor. Introduite par Taylor (1993), cette règle explique la dynamique du taux d'intérêt nominal en fonction de l'écart de production et de la différence entre une cible d'inflation et le niveau réel de l'inflation. En matière de politique monétaire, la règle de Taylor implique que les banquiers centraux ont deux objectifs différents : la stabilisation de l'inflation autour d'une cible d'inflation mais aussi le soutien de l'activité réelle. On peut noter que seule la moitié des recommandations de Kydland et Prescott sont modélisées ici. La Banque centrale est indépendante et suit une règle. En revanche, les banquiers centraux ne suivent pas la règle de Tinbergen et utilisent l'outil monétaire pour deux objectifs irréconciliables. Cependant, la règle originelle de Taylor est une relation empirique censée décrire le comportement de la Federal Reserve System américaine. Cela implique que la règle de Taylor est compatible avec le *As If* de Friedman.

Quel est l'impact d'une politique monétaire expansionniste dans les modèles DSGE ? Supposons que le niveau d'inflation soit suffisamment bas et qu'une banque centrale veuille stimuler l'activité réelle en diminuant son taux d'intérêt nominal. Dans ce cas, si l'on suppose que les ménages sont ricardiens,¹⁰ ce qui signifie qu'ils sont rationnels et qu'ils lissent leur consommation sur un horizon infini, une baisse du taux d'intérêt nominal entraîne une augmentation de la consommation et une diminution de l'épargne. Du fait de la rigidité à la Calvo, les entreprises capables de modifier leur prix le feront. Les entreprises qui ne le peuvent pas augmenteront leur production afin de répondre à la demande croissante. Après un certain temps, toutes les entreprises seront en mesure d'ajuster leur prix et la demande va diminuer. Ainsi, à court terme, la politique monétaire a un effet réel sur l'activité. Cependant, à long terme, la seule conséquence de la politique monétaire expansionniste sera une hausse de l'inflation, comme prédit Friedman et ses disciples.

Avec la Nouvelle Synthèse Néoclassique, la macroéconomie semble avoir trouvé une nouvelle paix à travers un nouveau consensus à la fois du point de vue théorique et méthodologique ainsi que de celui des recommandations de politique générale. En effet, la plus grande partie des macro-économistes semble

¹⁰ Cette hypothèse sera discutée plus tard

avoir accepté la critique de Lucas et son approche dynamique de la macroéconomie. Dans le même temps, la même grande partie des macro-économistes a admis que les politiques monétaires sont efficaces à court terme mais inefficaces à long terme. Toutefois, ce consensus sera remis en cause après la crise dite des *subprimes* en 2007.

0.3 La Nouvelle Synthèse Néoclassique remise en cause : vers un nouveau paradigme ?

En raison de la crise financière récente, des voix contre la Nouvelle Synthèse Néoclassique commencent à être entendues. Une question fondamentale est posée à la macroéconomie après l'échec des macro-économistes à prédire la crise et après leur incapacité à aider la Grèce, par exemple, une fois que la crise financière se sera transformée en crise de la dette en Europe. Cette question est la suivante : assistons-nous à une révolution au sens de Kuhn qui forcera les macro-économistes à changer leur paradigme, tout comme la stagflation des années 1970 a balayé la pensée keynésienne ou est-ce juste une crise théorique mineure qui aidera les macro-économistes à s'adapter Leurs modèles ? Il semble que la vérité se trouve quelque part au milieu.

Les critiques proviennent à la fois de la société civile et de la sphère économique. De la société civile, les macro-économistes sont critiqués pour ne pas avoir prédit la crise financière de 2007 et celle de la dette en Europe. En outre, ils ne sont pas en mesure de proposer des réformes claires pour réduire le chômage structurel résultant, en particulier dans des pays comme la Grèce. Les critiques que la Nouvelle Synthèse a à faire face sont principalement liées à la nature irréaliste des modèles DSGE. En particulier, deux éléments sont ciblés : l'agent représentatif et les anticipations rationnelles. Certains autres économistes reprocheront également aux modèles DSGE d'évoluer autour d'un état stationnaire dans un cadre linéarisé. Enfin, le rôle de la monnaie dans ce type de modèles est également attaqué. Détaillons chaque critique, une par une.

En ce qui concerne les anticipations rationnelles, on ne devrait pas peindre

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une image plus sombre de la situation qu'elle ne le mérite. Comme indiqué par Milani (2012), les anticipations rationnelles présentent de nombreux avantages. Parmi eux, le fait qu'en moyenne, les agents ne font pas d'erreurs implique que les anticipations sont confirmées par les résultats des modèles. En revanche, les anticipations adaptatives génèrent des erreurs systématiques de prévision. En outre, les anticipations rationnelles ne sont pas seulement en conformité avec la critique de Lucas, mais sont aussi une façon élégante et simple de modéliser les anticipations des agents.

Cependant, selon Akerlof et al. (2000) et Coibion et Gorodnichenko (2015), les agents ne présentent pas réellement de comportement rationnel. Au cours des expériences et en général, les agents n'atteignent pas l'équilibre rationnel. Les agents réagissent lentement à de nouvelles informations et préfèrent se référer à des notions préconçues, même lorsqu'on leur présente une preuve réfutant leur précon. En conséquence, les agents répètent leurs erreurs. *L'Homo-Œconomicus* semble être un agent avec une rationalité limitée plutôt qu'un agent pleinement rationnel.

De plus, avec des anticipations rationnelles, les modèles RBC et DSGE échouent à reproduire la persistance des principales variables macroéconomiques et en particulier de l'inflation. Néanmoins, les modèles DSGE ont l'avantage d'être très flexibles. Les macro-économistes sont libres d'ajuster et d'adapter leur modèle pour corriger les erreurs qui leur sont présentées. Par exemple, pour corriger la sur-flexibilité du comportement de consommation, certaines habitudes de consommation ont été introduites. Les ménages sont supposés avoir une certaine inclinaison en termes de consommation, ce qui semble être plutôt réaliste. Certains effets de mode peuvent également être introduits puisque, comme le rapporte Milani (2012), les ménages peuvent maximiser leur niveau de consommation en ce qui concerne la déviation de la consommation par rapport à celle de leurs voisins. Ainsi, les résultats contrefaits liés aux anticipations rationnelles peuvent être corrigés en ajoutant un nouveau comportement réaliste dans les modèles DSGE.

En outre, deux méthodes sont expérimentées pour éviter directement les ques-

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tions relatives aux anticipations rationnelles. La première est l'introduction de l'apprentissage adaptatif : les agents sont censés essayer d'ajuster leur comportement par des erreurs structurelles. Une autre fait d'intégrer la rationalité limitée est l'introduction de nouvelles dans les modèles. En règle générale, les agents peuvent recevoir des informations sur un choc futur qui peut concrètement se matérialiser ou non. Si le choc ne se produit pas, les agents doivent ajuster leurs anticipations. Ces ajustements des anticipations peuvent expliquer une partie du cycle économique : les nouvelles impliquent que la récession peut être le résultat d'un ajustement dans les attentes des agents privés à un choc non matérialisé sans faire référence à un choc de productivité négatif. Dans leur article, Beaudry et Portier (2006) montrent qu'un grand facteur de variation des cycles économiques peut être un choc qui n'affecte pas la productivité totale des facteurs à long terme. Ce choc peut être interprété comme une nouvelle qui n'a pas réellement eu lieu.

Une deuxième grande critique du modèle DSGE concerne l'Agent Représentatif. L'agent représentatif est le moyen le plus simple que les macro-économistes ont trouvé pour modéliser les individus. C'est ce que ses détracteurs appellent l'Homo Economicus : un individu purement rationnel qui maximise son utilité sous contrainte budgétaire. La théorie de l'agent représentatif ne laisse aucune place à l'hétérogénéité. De plus, cet héritage de la critique de Lucas implique qu'un comportement individuel au niveau microéconomique peut directement translater au niveau macroéconomique, après agrégation. Cette hypothèse peut être validée, mais seulement selon des hypothèses restrictives. Cependant, il implique que certains faits intéressants sont rejetés de l'étude macroéconomique. Par exemple, comme l'ont signalé Nachane et al. (2016), les macro-économistes ont négligé les interactions et les effets de réseau en raison de l'hypothèse de l'agent représentatif.

Troisièmement, Buitier (2009) montre que la linéarisation dans la résolution des modèles DSGE introduit d'importants problèmes. En particulier, la taille et la sensibilité des chocs n'ont pas d'effet spécifique dans les modèles DSGE linéarisés puisque chaque effet est proportionnel et neutre. En particulier, aucune asymétrie ne résulte d'un choc négatif et d'un choc positif. Dans le même temps, les mod-

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Les modèles DSGE évoluent autour d'un état stationnaire, qui peut être vu comme le nom moderne de l'équilibre en macroéconomie et qui représente l'économie en temps normal. Cependant, par définition, une crise est un phénomène qui ne se produit pas en temps normal et donc pas autour d'un état stationnaire. Cela entraîne deux conséquences : la crise ne peut pas être prédite et les implications politiques ne peuvent pas être parfaitement appréhendées. Fagiolo et Roventini (2012) illustrent parfaitement les conséquences de la politique d'austérité imposée par le FMI et la Commission Européenne aux pays européens pour éviter les problèmes de la dette publique. La nature rationnelle des agents économiques dans les modèles DSGE en période de crise est également contestée. En effet, pour Stiglitz (2011), le fait que les agents économiques connaissent le véritable modèle de l'économie est particulièrement faux en période de crise, quand la panique est la règle et quand la rationalité est hors de propos. Ainsi, les anticipations rationnelles et les agents représentatifs sont parfaitement irréalistes durant une telle période et les modèles DSGE ne sont pas pertinents dans ce cas. Hendry et Mizon (2010) soutiennent également que, pendant une grande crise, les ruptures structurelles peuvent perturber le processus d'apprentissage des agents et créer une non-stationnarité qui empêche finalement l'économie d'atteindre l'équilibre. Le retour à l'état stationnaire n'est pas automatique.

Enfin, comme l'ont signalé Fagiolo et Roventini (2012), il n'y a pas de rôle important pour la monnaie et les banques dans les modèles DSGE. En particulier, dans les modèles DSGE avec de la monnaie, les agents privés ne peuvent pas être en défaut en raison de l'hypothèse de transversalité (ou d'absence de Jeu à la Ponzi).¹¹ Ainsi, il n'y a pas de prime de risque et tous les agents font face au même taux d'intérêt. La monnaie n'est qu'une unité de compte et peut être facilement abandonnée. Comme il n'y a pas de défaut de crédit dans les modèles DSGE, ce type de modèles ne peut ni empêcher ni tenir compte de la crise financière.

¹¹ D'après Charles Ponzi, un jeu à la Ponzi se réfère à une situation où un opérateur paie des intérêts à ses investisseurs grâce à un nouveau capital plutôt que grâce à de nouveaux bénéficiaires. Dans ce jeu, l'opérateur promet des gains attrayants afin d'attirer toujours plus de pigeons. Au début du jeu, l'opérateur utilise son propre capital pour payer les premiers investisseurs. Cependant, en remarquant que les rendements sont réellement très élevés, les investisseurs paient du capital à l'opérateur, sans savoir que c'est ce capital qui servira à payer à la fois leur rendement courant et la commission de l'opérateur.

Personne ne peut nier que toutes ces critiques sont pertinentes. Cependant, s'il est vrai que la crise financière a mis en lumière de véritables problèmes dans la modélisation macroéconomique, il est également vrai que les modèles DSGE sont suffisamment souples pour s'adapter à ces critiques. En cela, la crise financière ne produira pas une révolution à la Kuhn, puisqu'aucun changement de paradigme n'est nécessaire pour répondre à cette crise. En effet, au cours des dernières années, les modèles DSGE ont inclus des composantes de plus en plus réalistes afin d'améliorer leur capacité à répondre à ces critiques. Cette thèse porte sur deux de ces critiques : le manque de persistance, en particulier de persistance de l'inflation, et l'absence d'effets asymétriques liés à l'état du cycle économique. Comme il sera présenté ci-dessous, l'analyse du marché du travail fournit de nombreux éléments de réponse.

0.4 Les Politiques Macroéconomiques et le Marché du Travail

0.4.1 La représentation standard du marché du travail par les modèles d'appariement

Les modèles d'appariement partent du principe qu'une entreprise et un travailleur ne se rencontrent pas instantanément. Si ce point peut être évident pour les non-économistes et tous ceux qui cherchent déjà un emploi ou pour chaque entreprise qui recherche un employé, il a fallu du temps aux macro-économistes pour l'inclure dans leur analyse. Comme nous l'avons dit précédemment, la notion de chômage frictionnel était connue de Keynes et de ses disciples mais laissée dans la notion globale de chômage naturel. Le chômage frictionnel n'a pas été considéré comme une notion clé capable d'expliquer la dynamique des principales variables du marché du travail.

Cette représentation du marché du travail est maintenant parfaitement bien inscrite dans la littérature macroéconomique. Si un seul article présentant le modèle d'appariement devait être retenu, cela serait indéniablement l'article fondateur de Mortensen et Pissarides (1994). Cependant, cet article est la conclusion d'un travail plus vaste commencé avec Phelps (1970) et Mortensen (1970) qui ont

été les premiers à considérer le marché du travail comme la réunion de différents flux. Par la suite, Diamond (1982a, b), Mortensen (1982) et Pissarides (1979, 1985) donneront au modèle d'appariement son squelette.

D'un point de vue théorique, les modèles d'appariement soulignent l'importance des frictions de recherche pour expliquer la dynamique du chômage. En particulier, le chômage n'est plus considéré comme une simple variable résultant d'un déséquilibre dans cette économie. Les salaires sont maintenant négociés afin de maximiser les surplus des entreprises et des travailleurs liés à l'emploi dans un cadre de négociation efficace à la Nash (1950). À partir de maintenant, ils ne dépendent pas seulement de la productivité marginale du travail, comme dans un marché du travail walrasien, mais aussi de l'étanchéité du marché du travail, du taux marginal de substitution des travailleurs entre l'offre de travail et les loisirs. Les conditions de création et de destruction d'emplois sont clairement expliquées et dérivées grâce aux paramètres structurels de l'économie. Les coûts d'affichage des emplois vacants et la productivité de réservation deviennent les variables clés de cette dynamique.

D'un point de vue empirique, plusieurs faits stylisés ont été mis en évidence. La taille et l'évolution des variables clés deviennent la préoccupation des économistes. Par exemple, comme souligné par Blanchard et Diamond (1989, 1990) et confirmé par Bleakley et al. (1999), les flux emploi-chômage et chômage augmentent pendant les récessions. À leur tour, les flux emploi active et population active diminuent pendant les récessions. Une autre caractéristique du marché du travail est soulignée par Hall (2006) et Shimer (2012). Ces auteurs montrent que la probabilité de trouver un emploi est fortement pro-cyclique tandis que le taux de séparation est assez constant dans le temps. Yashiv (2006) n'est pas d'accord avec Hall (2006) et Shimer (2012) sur ce point et estime que le taux de séparation est très volatile. Enfin, il apparaît que les taux d'embauche et de destruction d'emplois ont la même amplitude. Ainsi, les taux de recherche d'emploi et de séparation semblent être des variables clés pour expliquer les cycles économiques.

Merz (1995) et Andolfatto (1996) sont parmi les premiers auteurs à introduire

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le modèle d'appariement dans un modèle d'équilibre général. Ils montrent qu'une telle introduction améliore la capacité du modèle RBC standard à reproduire des preuves empiriques. Par exemple, le fait que la productivité entraîne l'emploi, que les heures travaillées sont plus volatiles que les salaires et que l'emploi et le chômage sont des variables persistantes sont maintenant reproduits par les modèles RBC.

Cependant, les modèles d'appariement soulèvent également certaines questions. Par exemple, Shimer (2003) rapporte que le modèle d'appariement standard ne peut représenter qu'une faible fraction des fluctuations du cycle des affaires, en particulier en ce qui concerne le chômage et les postes vacants. L'auteur explique la faible volatilité des deux variables en théorie, notamment parce que les salaires sont trop souples dans ces modèles. La dynamique salariale et son caractère souple dans les modèles théoriques, en particulier, comme il sera développé plus précisément plus loin dans les chapitres 2 et 3, est une question centrale dans les modèles macroéconomiques qui vise à étudier la mise en œuvre des politiques économiques.

0.4.2 Des politiques économiques

Quel est le but des politiques économiques ? Cette question est très controversée. La réponse peut simplement être d'améliorer le bien-être commun, mais quelqu'un pourrait ajouter dans le cas où le marché ne peut pas l'atteindre par lui-même et quelqu'un d'autre pourrait répondre ce qui est presque toujours le cas. Pour éviter ces questions idéologiques et fournir une réponse scientifique, la meilleure façon est de se référer à l'ouvrage fondamental de Richard Musgrave, un économiste américain qui est bien connu pour sa définition des fonctions du gouvernement. Musgrave (1959) considère un ménage public composé de trois branches différentes : l'Allocation, la Distribution et les Branches de Stabilisation. Chaque branche a un objectif spécifique à atteindre. Les deux objectifs principaux de la branche Allocation sont d'allouer des ressources pour satisfaire ce que Musgrave a appelé les besoins publics ainsi que les besoins tutélaire. Selon Musgrave (1959), suivi par Colm et Musgrave (1960), en raison des externalités, les marchés privés pourraient ne pas satisfaire les préférences individuelles. Dans

ce cas, des ressources publiques doivent être allouées pour satisfaire ces besoins négligés. Les besoins privés et publics sont, selon ces auteurs, entièrement identiques, sauf en ce qui concerne leurs origines. Les besoins tutélares sont, selon la vision de Musgrave, des services publics qui ne sont pas particulièrement demandés par des individus mais qui sont jugés essentiels par la société dans son ensemble comme l'éducation ou les services médicaux. La branche Distribution a pour objectif de réaffecter des ressources entre ménages à revenus faibles et à revenus élevés. Cette branche répond aux questions de justice sociale et son principal outil est le système fiscal.

Dans la typologie de Musgrave, la dernière branche est la plus liée aux modèles DSGE. En effet, la branche Stabilisation s'intéresse davantage à la réalisation du plein emploi et à la stabilisation de l'inflation, en utilisant les dépenses publiques, la gestion de la dette et la stimulation des revenus, dans une vision keynésienne de la macroéconomie.

0.4.3 De l'efficacité de la politique budgétaire

Si les modèles DSGE et la Nouvelle Synthèse Néoclassique ont embrassé l'idée que la politique monétaire est efficace, c'est-à-dire capable d'atteindre l'objectif de stabilisation, la capacité de la politique budgétaire doit encore être démontrée ou du moins ré-illustrée. En 2002, lors du 13e Congrès mondial de l'Association économique internationale, Robert Solow a demandé : La politique fiscale est-elle possible? Est-elle souhaitable?. Si R. Solow avait conclu sa conférence en montrant l'efficacité des stabilisateurs automatiques, nous sommes loin de l'interventionnisme keynésien de la première synthèse néoclassique.¹²

Pourquoi la macroéconomie remet-elle en question l'efficacité de la politique budgétaire? Tout d'abord, comme on l'a déjà mentionné, les travaux de Kydland et Prescott (1977) ont mis en cause de façon spectaculaire la mise au point fine et la mise en œuvre de la politique budgétaire keynésienne en général. S'il avait été

¹² Les stabilisateurs automatiques sont des outils économiques qui ont pour effet de compenser les fluctuations du cycle économique sans intervention directe des gouvernements. Toutefois, le rôle principal des stabilisateurs automatiques n'est pas de modérer les fluctuations du cycle économique.

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possible d'imaginer un décideur politique monétaire indépendant qui applique une règle avec un objectif unique, du fait que la politique budgétaire influence les trois niveaux de la typologie du Musgrave et en particulier parce que la politique budgétaire répond aux préoccupations de justice sociale, il semblerait inconcevable dans les systèmes démocratiques de détourner cet outil économique du jugement des citoyens. Ajoutons à ce premier argument ceux de l'École de Chicago. Avant les travaux de Nordhaus (1975) et de Rogoff et Sibert (1988), cités plus haut, Buchanan et Tullock (1962) expliquaient comment un gouvernement est un agent économique standard, avec sa propre fonction objective à maximiser et surtout comment ses objectifs ne sont pas nécessairement en accord avec le bien-être social. Lors, seule la politique budgétaire peut être l'outil de ce gouvernement rationnel et égoïste, puisque la politique monétaire est guidée par des décideurs indépendants qui n'ont qu'une stabilité objective de l'inflation. Enfin, un dernier argument rapporté par Robert Solow affirme que les effets de la politique budgétaire sont longs à se faire sentir.

Par conséquent, une politique budgétaire expansionniste visant à stimuler l'économie après une crise pourrait être effective durant une période de croissance. Cette situation représenterait un gaspillage de ressources publiques et pourrait être contre-productive puisque, par exemple, une inflation excessive pourrait se produire. Par conséquent, la deuxième partie du raisonnement de Robert Solow est que, même si la politique budgétaire est efficace, est-il possible de mettre en œuvre une politique fiscale rationnelle, qui n'est pas soumise à des tentations démocratiques et qui sera opérationnelle dans le temps ?

Deuxièmement, après la critique de Lucas, les doutes sont jetés sur l'efficacité de la politique budgétaire. Dans son article fondateur, Barro (1974) démontre une intuition émise par David Ricardo dans son Essai sur le système de financement il y a un siècle. Cette réinterprétation du travail de David Ricardo donne naissance à l'équivalence ricardienne.¹³ Cette équivalence indique que les différentes façons que possède un gouvernement pour financer sa politique budgétaire produisent le même effet sur la demande globale. En effet, supposons qu'un gouvernement

¹³ Voir Ricardo (1846).

puisse financer de nouveaux biens publics soit grâce à une augmentation des impôts courants, soit par la dette, voire par la création monétaire. Supposons également que les ménages sont rationnels et qu'une solidarité intergénérationnelle existe. Dans ce cadre, si un gouvernement finance sa politique fiscale en émettant de nouvelles obligations, les agents privés s'attendent à ce que la politique budgétaire expansionniste actuelle doive être financée à l'avenir par une augmentation des impôts. Par ailleurs, les agents privés réduiront leur consommation actuelle afin d'acheter les nouvelles obligations et afin de pouvoir payer les impôts futurs. De même, si le gouvernement finance sa politique budgétaire grâce à la création monétaire, les agents privés s'attendent à une hausse de l'inflation, ce qui les poussera à augmenter leur épargne afin d'éviter la détérioration des actifs futurs. Dans les deux cas, les agents privés se comporteront de la même façon que si le gouvernement finit sa politique fiscale en augmentant les impôts courants : ils réduisaient leur consommation actuelle pour payer les impôts. La dette et la création monétaire ne sont pas considérées par les agents rationnels comme une création de richesse nette mais seulement comme des impôts futurs. Aiyagari et al. (1992), Baxter et King (1993), Christiano et Eichenbaum (1992) et Fatt Mihov (2001), entre autres, analysent dans le cadre des modèles RBC avec des ménages ricardiens l'effet de la politique budgétaire et concluent à son inefficacité.

La question de Robert Solow est double et les deux parties de cette question nécessitent une réponse. Premièrement, les gouvernements peuvent-ils utiliser la politique budgétaire ? La réponse est donnée par Robert Solow lui-même et est affirmative : en utilisant des stabilisateurs automatiques. Cette solution est en fait conforme à Kydland et Prescott (1977) puisqu'elle implique que les gouvernements adoptent une politique budgétaire structurelle et la laissent agir sans intervention discrétionnaire. Les impôts et l'assurance chômage sont les stabilisateurs automatiques les plus connus. En effet, une fois que le gouvernement choisit de protéger les travailleurs grâce aux allocations de chômage, ce gouvernement n'a plus à agir : en cas de crise, le nombre de chômeurs augmente entraînant une augmentation automatique des dépenses publiques. De facto, en soutenant la consommation privée pendant la récession, les prestations de chômage compensent la dynamique du cycle économique et peuvent être considérées comme

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un stimulus keynésien automatique. De plus, lorsque les revenus sont élevés, les obligations fiscales augmentent et améliorent ainsi les finances publiques. Réciproquement, lorsque les revenus sont faibles, les passifs d'impôt diminuent et les finances publiques se détériorent.

Deuxièmement, un gouvernement devrait-il utiliser un outil fiscal pour empêcher la société de subir des fluctuations macroéconomiques ? Le fait que selon l'équivalence ricardienne la politique budgétaire ne produit pas du tout la richesse est discutable à la fois d'un point de vue empirique et d'un point de vue théorique. Premièrement, d'un point de vue théorique, l'équivalence ricardienne nécessite des hypothèses controversées. Akerlof (2007) énumère certaines d'entre elles, accentuant certains aspects sociologiques. En effet, l'équivalence ricardienne implique que i) les individus évoluent dans un horizon temporel infini plutôt que dans un horizon temporel fini; ii) il existe un lien altruiste parfait entre les générations dans cet horizon infini; iii) il n'y a pas de famille sans enfants; iv) il n'y a pas d'effet d'éviction des dépenses publiques sur le secteur privé puisque l'augmentation des dépenses publiques déclenche une baisse de la consommation privée et n'a alors aucune conséquence sur le taux d'intérêt; v) il n'y a pas de propriété étrangère de la dette intérieure; vi) les agents privés et publics empruntent sur le marché des capitaux au même taux; vii) enfin, le marché des capitaux est parfait et il n'existe pas de contraintes d'emprunt intergénérationnelles.

Ces critiques sont assez fortes pour supposer au moins que les ménages ricardiens (c'est-à-dire les ménages qui adoptent le comportement ricardien) ne représentent pas tous les ménages d'une économie. De plus, dans le cadre des modèles RBC, Baxter et King (1993) montrent qu'une augmentation de la consommation publique entraîne *in fine* une augmentation de la production globale. Même si un certain phénomène ricardien est présent dans ce type de modèles, dans la littérature issue de la Nouvelle École Classique et dans à court terme, la politique budgétaire est efficace. En effet, après l'augmentation des dépenses publiques, les ménages ricardiens s'attendent à une augmentation des impôts futurs. En réaction, les ménages ricardiens réduisent leur consommation et augmentent leur offre de main-d'œuvre. Cet effet de richesse négatif est compensé

par la réduction du salaire réel induite par l'augmentation antérieure de l'offre de main-d'œuvre. Parce que le marché du travail suit une logique néoclassique dans ce type de modèles, cette baisse des cots de main-d'œuvre se traduira directement par une augmentation de la production des entreprises. Selon la loi de Say, l'offre crée ses propres exigences et la production globale augmente. Avec les modèles DSGE o des rigidités réelles sont introduites, les résultats keynésiens sont accentués. Ainsi, d'un point de vue théorique, il semble que la question n'est plus si la politique budgétaire est efficace, mais plutôt à quel point elle est.

De la taille du multiplicateur budgétaire

Même si cette question est d'une importance primordiale pour la politique économique et après près d'un siècle de macroéconomie moderne, elle reste une question sans réponse. D'un point de vue empirique, Ramey (2012) rapporte qu'une grande partie de la littérature conclut à un multiplicateur budgétaire allant de 0,5 à 1,5. Ce résultat a déjà de sérieuses implications en termes de mise en oeuvre des politiques économiques puisque l'implication d'un gouvernement ne serait pas la même si le multiplicateur budgétaire était égal à 0,5 plutôt qu'à 1,5.

La théorie fournit plusieurs interprétations pour expliquer ce fait empirique. Par exemple, le fait que les modèles DSGE incluent ou non des ménages non-ricardiens affectera la taille des multiplicateurs budgétaires. En effet, si l'on suppose qu'une part de la population d'une économie n'a pas accès au marché financier, si l'on introduit des ménages non-ricardiens, la taille des multiplicateurs budgétaires augmente. Par exemple, Coenen et Straub (2005) construisent un modèle DSGE avec des ménages ricardiens et non ricardiens et utilisent la méthode bayésienne pour estimer leur modèle pour la zone euro. Les auteurs concluent que les ménages non-ricardiens sont minoritaires en Europe mais qu'ils influencent grandement l'économie et en particulier la politique budgétaire.

Toutefois, l'importance de la présence de ménages non-ricardiens ou, à l'aide du terme approprié, de ménages dits *de la main à la bouche* n'a rien à voir avec les questions de multiplicateurs budgétaires, mais vient de la nécessité pour les macro-économistes de corriger une conséquence fallacieuse de la présence de

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consommateurs ricardiens dans les modèles DSGE. En effet, dans les modèles DSGE de base, une augmentation de la consommation publique conduit à une diminution de la consommation privée. Cependant, une grande partie de la littérature empirique conclut au contraire. Par exemple, Blanchard et Perotti (2002) et Fatt Mihov (2001) utilisent un VAR Structurel pour identifier les chocs exogènes liés aux dépenses publiques. Leurs résultats sont quadruples : premièrement, ils montrent qu'un choc positif sur les dépenses publiques entraîne une augmentation persistante de cette variable; Deuxièmement, cette augmentation donne une réponse positive dans la production; Troisièmement, tous deux trouvent un multiplicateur fiscal positif; Enfin, Blanchard et Perotti (2002) constatent que les dépenses publiques absorbent considérablement les investissements privés. Tous ces résultats sont confirmés par Gal al. (2007). En outre, ces derniers constatent que l'augmentation des dépenses publiques déclenche une augmentation des heures travaillées et du salaire réel ainsi qu'une augmentation persistante du déficit.¹⁴ Enfin, Perotti (2005) généralise cette étude pour plusieurs pays de l'OCDE et conclut à des effets positifs d'une augmentation des dépenses publiques sur la consommation privée et sur la production.

Afin de concilier les données empiriques décrites ci-dessus, une solution soutenue par Mankiw (2000) est l'introduction des ménages dits *de la main à la bouche*. L'expression de la main à la bouche peut à tort être comprise comme une modélisation moderne des ménages ayant *le plus faible niveau richesse liquide*, en utilisant l'expression de Greg Kaplan dans l'article de Hotchkiss (2014). En fait, elle embrasse deux réalités différentes. D'une part, ce que Kaplan et al. (2014) appellent les ménages pauvres *de la main à la bouche* est la représentation traditionnelle des ménages *de la main à la bouche* qu'une grande partie des macro-économistes peut avoir: il y a des ménages qui n'ont pas accès au marché financier et qui, même s'ils ont l'intention, ne peut pas lisser leur consommation pour faire face à des fluctuations de revenu. Ce type de ménages représenterait seulement dix

¹⁴ La réponse du salaire réel à un choc aux dépenses publiques reste controversée. Par exemple, Ramey et Shapiro (1998) étudient les conséquences d'une augmentation des dépenses militaires. Ils montrent qu'il entraîne une baisse de la consommation privée et des salaires alors que le salaire réel reste constant. Edelberg et al. (1999) suivent la méthodologie de Ramey et Shapiro (1998) et concluent à une diminution du salaire réel après une augmentation des dépenses publiques.

pour cent de la population américaine et ne serait pas en mesure d'expliquer la majeure partie des faits empiriques. D'autre part, il existe une deuxième catégorie, les ménages *de la main à la bouche* aisés, qui représenteraient la plus grande partie des ménages *de la main à la bouche*. En effet, il existe une composition de portefeuille optimale qui a un montant positif de richesse illiquide, comme les comptes d'épargne logement ou de retraite. Dans cette situation, les ménages riches *de la main à la bouche* ont plus intérêt à détenir ces investissements à long terme et à subir à court terme les pertes liées aux fluctuations de revenu plutôt que d'utiliser le marché financier pour lisser leur consommation en raison, par exemple, des coûts de transaction.

De plus, il faut tenir compte du fait que la nature de l'intervention gouvernementale influe sur la taille du multiplicateur fiscal. En effet, comme l'indiquent Beetsma et Giuliadori (2010), une augmentation de la consommation publique ou de l'investissement public n'aura pas d'impact sur l'économie dans la même proportion puisque celle-ci agira positivement sur la productivité du travail et du capital et stimulera la demande globale.

L'impact du cycle des affaires sur le multiplicateur budgétaire

Comme cela sera examiné plus loin dans le chapitre 3 de cette thèse, le cycle économique influence l'ampleur des effets de la politique budgétaire sur l'économie. En effet, Auerbach et Gorodnichenko (2012) montrent que, pour l'économie américaine, le multiplicateur budgétaire est plus important en période de ralentissement économique qu'en temps normal. Ce résultat est également confirmé pour l'économie française par Creel et al. (2011). Une fois de plus, cela aura de grandes conséquences sur le plan des politiques budgétaires : une meilleure connaissance de ce phénomène aurait permis aux décideurs européens de mieux évaluer l'impact des politiques d'austérité appliquées après le début de la crise de la dette européenne. Par exemple, Blanchard et Leigh (2013) font état de la différence entre la croissance réelle cumulée du PIB réel sur 2010 et 2011 et les prévisions des Perspectives Économiques Mondiales du FMI pour la même période pour l'Union européenne. Les auteurs montrent que pour chaque point de pourcentage de consolidation budgétaire, la différence entre les prévisions du FMI et

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la réalité augmente d'environ 1 point de pourcentage en moyenne. Une raison pour expliquer cette différence est que les économistes du FMI n'ont pas pris en compte le fait que ces économies étaient en période de crise, et donc avec un multiplicateur fiscal plus important. Ainsi, les conséquences négatives de la politique d'austérité ont été multipliées tandis que les positifs ont été dissimulés.

Jusqu'à récemment, les modèles DSGE n'étaient pas en mesure de prendre en compte la position de l'économie sur le cycle économique. Cette limite est directement liée à la critique de la linéarisation. En effet, la linéarisation empêche les modèles DSGE standard de refléter les différences entre un choc qui survient pendant le ralentissement économique et un choc qui survient pendant la reprise économique. Pour régler cette question, les progrès doivent être réalisés dans deux directions différentes. Tout d'abord, d'un point de vue purement technique, l'approximation de Taylor de second ordre a été adoptée. Cette approximation permet de linéariser des équations mais en incluant des éléments non linéaires. Dès lors, différentes stratégies sont introduites pour refléter les différents états de l'économie. Une des stratégies les plus intuitives est introduite par Michailat (2014). Ici, l'auteur introduit les différents états de l'économie en supposant que pendant le ralentissement économique, le niveau du salaire réel à l'état stationnaire est élevé alors qu'il est faible pendant la reprise économique.¹⁵ Il est assez intuitif que le marché du travail a un rôle primordial dans cette approche.

Deuxièmement, la théorie macroéconomique doit expliquer cette asymétrie entre le ralentissement économique et la reprise économique. Encore une fois, le marché du travail jouera un rôle crucial. Comme l'ont exposé Hairault et al. (2010), le modèle d'appariement est un cadre parfait pour étudier les effets non linéaires puisque sa structure intègre des éléments qui ne réagissent pas de la même manière en période de crise et en période de croissance économique. Pour prouver ce point, les auteurs étudient les conséquences d'un choc positif sur le taux de recherche d'emploi. Ils supposent que les ralentissements économiques

¹⁵ La cyclicalité des salaires réels n'a pas trouvé de consensus dans la littérature. Dans son modèle, Michailat (2014) constate qu'il existe une relation positive entre le chômage et le salaire réel. Puisque le chômage est clairement contra-cyclique, l'auteur montre d'un point de vue théorique que le salaire réel est aussi contra-cyclique.

sont représentés par un taux de chômage élevé, et donc un grand bassin de demandeurs d'emploi, tandis que les retournements économiques sont représentés par un faible niveau de chômage et donc un petit bassin de demandeurs d'emploi.

Dans ce contexte, les auteurs montrent qu'un choc positif sur le taux de recherche d'emploi aura un impact plus important en période de ralentissement économique que pendant la reprise économique. En effet, étant donné que le bassin de chercheurs d'emploi est faible en période de croissance économique, le choc positif concernera moins de travailleurs et produira alors moins de créations d'emplois que d'habitude. En contrepartie, pendant les périodes de récession économique, étant donné que le bassin de demandeurs d'emploi est important, un choc positif sur le taux de recherche d'emploi produira plus de créations d'emplois qu'en temps normal.

Michaillat (2014) étudie un choc positif sur l'emploi public et trouve des résultats similaires. En période de ralentissement économique, un choc positif sur l'emploi public entraîne un effet d'éviction sur l'emploi privé. Cet effet d'éviction est plus faible que l'augmentation de l'emploi public, ce qui entraîne une augmentation de l'emploi total, de sorte que, même si le multiplicateur fiscal est inférieur à un, il demeure positif. Lorsque le salaire réel est élevé, le bassin de demandeurs d'emploi est également important et l'effet d'éviction sur l'emploi privé est faible. En contrepartie, lorsque le salaire réel est bas, le bassin est également faible et l'effet d'éviction a des conséquences plus profondes. Ainsi, comme dans Hairault et al. (2010), le multiplicateur fiscal est plus important en période de ralentissement économique que pendant la reprise économique. Reste une question : ces effets restent-ils les mêmes dans le cadre d'un équilibre général ? Les réponses à cette question seront données au chapitre 4.

Les effets de débordement budgétaires

Une dernière question importante sur la politique fiscale est son efficacité dans un cadre d'économie ouverte. Le modèle standard de Mundell (1963) et de Fleming (1962) indique que dans un cadre de taux de change fixe, la politique budgétaire est pleinement efficace tandis que dans un taux de change flexible, la politique

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budgétaire est évincée par le taux de change et est donc inefficace. Ainsi, une simple politique budgétaire peut représenter un comportement non-coopératif. En effet, comme le rapporte Buti et Noord (2004), un gouvernement qui augmente ses dépenses publiques en achetant des biens et des services nationaux permet une appréciation du taux de change commun et exporte l'effet d'éviction externe sur les autres membres de la zone euro. En outre, afin de maintenir le marché monétaire équilibré, une politique monétaire restrictive doit être imposée à l'ensemble de la zone.¹⁶ Toutes ces considérations soulignent la nécessité de la coordination des membres d'un espace économique commun.

La coordination de la politique budgétaire est une question bien connue, surtout en Europe. Avec la création du marché unique et de l'Union économique et monétaire, l'interdépendance entre chaque économie européenne a été amplifiée. Dès lors, les décisions budgétaires d'un gouvernement particulier se répandent sur les autres pays européens. Si le *Pacte de Stabilité et de Croissance* avec sa *Procédure de Déficit Excessif* visait à organiser les différentes politiques budgétaires et si la crise financière obligea l'Union européenne à renforcer sa coordination avec la création de nouvelles institutions telles que le *Mécanisme Européen de Stabilité*, cela est loin d'être parfait.

Une question majeure à laquelle il faut répondre est la suivante: par quels canaux la politique budgétaire d'un pays A peut-elle affecter un pays B ? Deux canaux principaux peuvent être identifiés dans la littérature : les canaux commerciaux et financiers. Tout d'abord, le canal commercial a été le prisme avec lequel les effets de débordement ont été étudiés pendant longtemps. Suivant Weyerstrass et al. (2006), il peut être décomposé en sous-canaux de la manière suivante : i) le *canal du revenu* qui est le canal traditionnel exposé par Mundell (1963) et Fleming (1962). Le mécanisme de transmission est assez simple : si le revenu dans un pays donné augmente, le niveau des exportations dans ce pays augmentera également et stimulera les importations de ses partenaires commerciaux; ii) le *canal des prix* affecte la compétitivité des prix des différentes économies;

¹⁶ Cette conséquence doit être mise en perspective pour quelqu'un qui se concentre sur l'Union européenne puisqu'elle ne tient que dans le cas d'une petite zone qui ne peut pas influencer le reste du monde. Ce n'est pas le cas de la zone euro qui peut peser sur les taux d'intérêt mondiaux.

iii) le taux d'intérêt et le taux de change; iv) le *canal du déficit jumeau*. Dans un monde keynésien et ouvert très simple, on peut facilement montrer qu'il existe un lien direct entre le solde budgétaire de l'État et la balance commerciale. Ainsi, *ceteris paribus*, si un gouvernement décide d'augmenter son déficit pour financer un plan de relance, il aura des conséquences comme une baisse de la balance commerciale et donc une stimulation des exportations de ses partenaires commerciaux. Bluedorn et Leigh (2011) estiment qu'une baisse de 1% du PIB dans les dépenses publiques entraîne une augmentation de 0,6% du compte courant, ce qui tend à prouver l'existence d'un tel phénomène ; v) enfin le *canal de la réforme structurelle* : toutes les réformes qui affectent la concurrence, la croissance de la productivité, le chômage, etc. ont des conséquences sur l'offre. En retour, cela affectera les exportations et les importations de partenaires commerciaux.

Il existe une myriade d'études qui visent à documenter l'existence du canal commercial. Parmi eux, Beetsma et al. (2006) et Bénassy-Quéré et Cimadomo (2012) concluent qu'une relance budgétaire positive en Allemagne entraîne une augmentation de la production européenne. Beetsma et al. (2006) estiment qu'une augmentation d'environ 1% des dépenses publiques allemandes augmente de 0,12% dans le reste de l'Europe tandis qu'une baisse des impôts ne produit qu'un effet de débordement positif de 0,03% sur le revenu européenne. Auerbach et Gorodnichenko (2012) élargissent l'étude et documentent les retombées fiscales entre les pays de l'OCDE. Ils confirment l'existence de tels effets de débordement par le canal commercial. Si la voie du commerce a été principalement utilisée pour expliquer les retombées budgétaires entre les pays, la crise de la dette souveraine a mis en évidence un canal financier. L'effet de la dette publique sur le secteur privé est connu : Roeger et In 't Veld (2013) indiquent qu'il existe un comouvement entre la dette souveraine et la dette non financière des entreprises dans un pays vulnérable. Le principal canal qui explique cette corrélation est la faiblesse du secteur bancaire qui peut souffrir des difficultés du gouvernement et qui se répercute sur les prêts privés. De plus, Corsetti et al. (2013) utilisent un modèle DSGE pour étudier les conséquences d'une réduction des dépenses publiques pour un gouvernement qui a émis un niveau d'endettement public élevé. Ils montrent qu'il existe des effets non linéaires sur le niveau d'endettement.

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Au-dessus d'un niveau de 90% du ratio de la dette sur le PIB, l'effet négatif des réductions des dépenses publiques est compensé par les effets positifs de la baisse de la dette souveraine.

Cependant, le canal de transmission entre ces économies faibles et les plus fortes doit encore être relevé. Principalement, ce canal indique l'existence de retombées négatives par l'impact de la prime de risque d'un seul État membre sur l'une des autres membres. L'intuition derrière est assez simple : dans une union, en raison de l'existence de relations commerciales entre les membres, si un État se heurte à des difficultés face à ses dettes, des doutes peuvent être jetés sur la capacité des autres membres à faire face à leurs propres dettes puisqu'une solidarité budgétaire entre les États pourrait exister. Caporale et Girardi (2013) estiment un modèle VAR Global pour la zone euro et montrent que les rendements de la dette publique dépendent grandement de l'émetteur et semblent valider l'existence de canaux financiers.¹⁷ En effet, lorsque des États sains comme l'Allemagne émettent de nouveaux emprunts publics, les rendements de la dette publique mondiale semblent chuter dans la zone euro. Au contraire, lorsque les États en difficulté émettent de nouvelles obligations, la prime de risque augmente pour l'ensemble de la zone euro. Roeger et In 't Veld (2013) construisent un modèle DSGE à deux pays avec un secteur bancaire pour analyser la relation entre la dette souveraine et la performance économique dans une union monétaire. Ils montrent qu'une augmentation de la dette du secteur public affecte négativement la demande privée, car cela conduit à une augmentation des coûts d'emprunt du secteur privé non seulement dans le pays endetté mais aussi dans les autres pays de l'union.

Ces problèmes de débordement soulèvent la question de la coordination de la politique budgétaire et plus particulièrement celle du manque de coordination dans l'Union européenne. Ce manque de coordination introduit des comportements stratégiques entre les États européens qui peuvent réduire l'excédent global de l'ensemble de la région, exercer parfois des pressions à la baisse sur les normes sociales et du travail et enfin encourager l'euroscépticisme. Un grand

¹⁷ La méthodologie du GVAR sera présentée plus loin

nombre d'exemples non coopératifs peuvent être trouvés dans la littérature. Cameron (2012) montre par exemple que la réponse des gouvernements européens à la crise de 2007 a été rien de moins que disparate. Par exemple, le gouvernement italien a augmenté ses dépenses de 3% du PIB en 2008 et a financé cette augmentation par une augmentation des impôts d'un montant identique. Même si Haavelmo (1945) nous a appris qu'une augmentation des dépenses publiques financée par une augmentation des impôts dans la même proportion a toujours un effet multiplicateur positif, le plan de relance italien n'avait rien à voir avec celui du Luxembourg ni de la Finlande et de l'Allemagne, qui représentent une dégradation du déficit public de 3,9%, de 3,2% et de 3,2%, respectivement. Des raisons internes peuvent avoir forcé l'Italie à ne pas stimuler davantage son économie. Cependant, une meilleure coordination entre les pays européens devrait définitivement diviser le fardeau de manière plus efficace.

Enfin, la littérature très récente se concentre sur le canal des réformes structurelles et en particulier sur l'impact des réformes du marché du travail dans un seul État membre sur l'activité des autres membres. Après les réformes Hartz en Allemagne, après la loi italienne sur l'emploi¹⁸ et la loi franse El Khomri, il est clair que l'Union européenne est engagée dans une profonde réforme structurelle et non coordonnée de ses marchés du travail.

Si la conséquence des réformes de Hartz pour l'Allemagne est bien connue, les répercussions de ces réformes sur le reste des États membres ne sont pas claires à la fois d'un point de vue théorique et empirique.¹⁹

Comme rapporté par Bouvard et al. (2013) et Amable et Fran (2014), au début des années 2000, l'Allemagne était préoccupée par deux grands enjeux qui seront la cible principale des réformes Hartz : un taux de chômage élevé et une population vieillissante qui exercent une pression à la baisse la population active. Afin

¹⁸ La réforme du marché du travail italien est une combinaison de plusieurs lois. Parmi ceux-ci, on peut citer la Loi n. 78 du 16 mai 2014, dite Décret Poletti, la Loi de Budget n. 190/2014, la loi de délégation n. 183/2014, etc.

¹⁹ Cette thèse se focalise sur le cas allemand pour la simple raison que les cas italien et français sont trop récents pour être analysés de manière satisfaisante.

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de réduire le chômage et d'encourager les travailleurs à réintégrer le marché du travail, le Parlement allemand a adopté quatre paquets différents.²⁰ Premièrement, Hartz I (janvier 2003) a créé le fameux Personal-Service-Agentur et supprime la durée de 2 ans pour les emplois temporaires. Deuxièmement, Hartz II (avril 2003) a aidé les chômeurs à créer leur propre entreprise et a généralisé les des emplois subventionnés, appelés mini et midi.²¹ Troisièmement, Hartz III (janvier 2004) a réformé l'Agence fédérale pour l'emploi, un service public de l'emploi, sur le marché du travail allemand. En outre, la période utilisée pour calculer les prestations de chômage et la durée du droit aux allocations ont été réduites. Enfin, Hartz IV (janvier 2005) a regrouper deux aides différentes : l'aide au chômage (Arbeitslosenhilfe), qui était une subvention liée au revenu pour les chômeurs qui ne sont plus éligibles aux prestations, et l'aide sociale (Arbeitslosengeld II), sont fusionnés. Plus précisément, l'aide au chômage a disparu alors que l'aide sociale a été renforcée et soumise à une recherche active d'emploi. Selon Arent et Nagl (2013), avant Hartz IV, l'aide au chômage était de l'ordre de 53% du salaire net des travailleurs. Avec Hartz IV, l'aide sociale est devenue une subvention non rentable et soumise à des conditions de ressources qui ne peut aller au-delà de 345€.²²

Du point de vue de l'emploi, les réformes de Hartz ont été concluantes pour l'Allemagne : entre 2004 et 2011, le taux de participation a augmenté de 4,6% alors même que la population en âge de travailler a baissé de 1,3%. Ce premier fait s'explique principalement par une augmentation des participations des personnes âgées (plus 16,2 points de pourcentage) et des femmes (plus 6,0 points de pourcentage). Le taux d'emploi passe de 64,9% en 2004 à 72,4% en 2012, ce qui s'explique principalement par les emplois temporaires puisqu'ils ont été multipliés par 2,7 entre 2003 et 2011, tandis que l'emploi à temps plein a augmenté de 2,4% entre 2004 et 2011 et l'emploi à temps partiel a augmenté de 33% sur

²⁰ Voir Ebbinghaus et Eichhorst (2006) pour plus de détails juridiques concernant les réformes Hartz.

²¹ Les emplois subventionnés sont des emplois à bas salaire et à faible niveau d'heures travaillées. Les mini-emplois offrent un plafond de salaire de 400€ tandis que les midi-emplois offrent un plafond de salaire de 800€ en 2003.

²² Les paiements sous condition de ressources impliquent que si un membre d'un ménage a un revenu ou un actif financier suffisamment élevé, le paiement du ménage peut être annulé.

la même période. Enfin, Jacobi et Kluve (2006), Klinger et Rothe (2010) et Hertweck et Sigrist (2012) montrent que Hartz III a notamment accru l'efficacité de l'appariement et réduit en même temps le niveau de chômage structurel en Allemagne. Cependant, tout n'était pas parfait : cette chute du chômage et cette augmentation de la participation au marché du travail se sont accompagnées d'une augmentation de la pauvreté et des inégalités. Le taux de pauvreté des travailleurs est passé de 4,8% en 2004 à 7,5% en 2006, accentuant ainsi le phénomène des travailleurs pauvres en Allemagne. Cependant, comme le rapportent Bouvard et al. (2013), les chômeurs ont été la partie de la population la plus touchée. Le taux de pauvreté de la population des chômeurs est passé de 41% en 2004 à 68% en 2010. Ce fait est une conséquence directe des réformes Hartz. En effet, la réduction des prestations de chômage a encouragé une partie des travailleurs à accepter un emploi temporaire et à temps partiel. Cependant, la situation est devenue précaire pour les travailleurs qui ne purent pas trouver un emploi, comme les chômeurs de longue durée qui ne purent être réintroduits facilement sur le marché du travail.

D'un point de vue théorique, Dao (2013) démontre dans un modèle DSGE à deux pays, calibré pour l'Allemagne et le reste de l'Union européenne (RoE par la suite) que les réformes de Hartz ont eu des retombées positives sur le RoE. En effet, l'auteur montre que la baisse des coûts de main-d'œuvre a entraîné une augmentation de la production allemande qui a stimulé la demande allemande pour les exportations du RoE. En fin de compte, la production pour le RoE aurait été augmentée par les réformes de Hartz. Ce résultat semble être confirmé par Gadatsch et al. (2015) : les auteurs ont utilisé un modèle DSGE à deux pays avec un marché du travail frictionnel et ont simulé des politiques budgétaire et du marché du travail pour reproduire les réformes Hartz. Ils montrent que les réformes Hartz ont effectivement augmenté la production, la consommation et l'emploi allemands, mais ont peu affecté la balance commerciale et le compte courant allemand. Afin d'expliquer l'excédent persistant de compte courant de l'Allemagne, les auteurs proposent d'étudier le taux d'épargne plus élevé observé dans le pays.

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L'impact du taux d'épargne sur le compte courant allemand est validé par Kollmann et al. (2014). Dans un modèle de DSGE estimé, les auteurs montrent que la balance commerciale allemande est affectée par trois éléments : le taux d'épargne allemand, la demande du RoE pour les produits allemands et les réformes Hartz. Si ceux-ci ne peuvent pas expliquer par eux-mêmes l'excédent de compte courant allemand, selon cette étude empirique ils font partie du processus. Cependant, selon Gadatsch et al. (2015), les réformes de Hartz ont eu un impact positif sur le PIB de 0,2% environ en 2015. Les auteurs expliquent cet impact positif comme suit : la baisse du chômage allemand a été positive pour la demande allemande adressée aux produits du RoE. Cette étude admet également que l'Allemagne en a bénéficié plus que le reste de la zone euro puisque le PIB allemand a augmenté d'environ 2%. De même, les termes de l'échange allemand ont légèrement augmenté.

Cependant, la littérature ne conclut pas sur l'impact de la diminution de l'assurance-chômage sur la compétitivité prix allemande, alors qu'il a été un argument majeur dans les critiques de la réforme allemande du marché du travail. Certaines réponses tenteront d'être introduites dans le chapitre 4 de la présente dissertation.

De la persistance de l'inflation et de l'efficacité de la politique monétaire

Au début de la macroéconomie, l'efficacité des politiques budgétaire et monétaire dépendait de la capacité des entreprises à ajuster leur prix aux variations économiques. Keynes a supposé que les prix sont totalement rigides de sorte que les entreprises doivent ajuster leurs quantités produites au choc économique. Les gouvernements peuvent alors utiliser les outils budgétaires et monétaires pour organiser des politiques contra-cycliques. Dans la théorie néoclassique, les prix se déplacent librement et permettent au marché de rester à l'équilibre, peu importe les chocs qui peuvent frapper une économie. Dans ce monde, les politiques économiques sont totalement inefficaces, mais aussi inutiles puisque la situation du plein emploi est toujours atteinte. Ces deux points de vue différents sont connus et sont trop simples pour être pleinement satisfaisants. Au moins, cette opposition a la vertu de souligner la nécessité de comprendre la formation des prix et la dynamique des prix à la fois pour la théorie macroéconomique et les mises

en œuvre des politiques. Le débat n'est plus de savoir si les prix sont rigides ou non. Les études microéconomiques et macroéconomiques ont conclu que les prix, et plus précisément l'inflation, sont persistants. Fuhrer (2010) fournit une définition éclairante de la persistance de l'inflation: Une variable économique est considérée comme persistante si, toutes choses égales par ailleurs, elle montre une tendance à rester proche d'o elle a été récemment. Ainsi, la vérité était entre les visions keynésienne et classique: les prix ne sont pas rigides puisqu'ils évoluent même à court terme, mais les prix ne s'adaptent pas automatiquement aux chocs économiques. De nos jours, la littérature se concentre sur deux questions principales relatives à l'évolution du niveau des prix, à savoir l'inflation : dans quelle mesure l'inflation est persistante et surtout pourquoi l'inflation est persistante. Cette thèse se concentrera sur ce dernier point.

La nouvelle synthèse néoclassique a la vertu de fournir un cadre suffisamment large pour incorporer les différentes explications de la persistance de l'inflation. Ces différentes interprétations de la persistance de l'inflation peuvent être classées grâce à une simple définition des sources de persistance de l'inflation. En utilisant le modèle triangulaire de Gordon (1982), l'inflation s'explique par trois sources différentes: son propre retard, une mesure de l'activité réelle telle que le chômage ou l'écart de production et les changements d'offre. Cette définition standard de l'inflation fournit les deux principales sources de persistance de l'inflation: la persistance intrinsèque et héritée. La persistance intrinsèque explique la persistance de l'inflation grâce aux frictions qui peuvent survenir lors du processus de fixation des prix. La persistance héritée explique la persistance de l'inflation à travers la mesure de l'activité réelle. De ce point de vue, deux branches de la littérature vont dans une direction différente sans nécessairement être en contradiction.

La courbe de Phillips accéléré de Friedman (1968) et Phelps (1967) a souligné l'importance des attentes pour expliquer la dynamique de l'inflation. Selon leur représentation, l'inflation dépend de l'écart de production et de son propre retard. Dans ce monde, les agents économiques forment des anticipations à travers des anticipations adaptatives. Ainsi, ce retard d'inflation est à l'origine de la persistance de l'inflation et est entièrement intrinsèque. Cependant, depuis les antic-

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ipations rationnelles de Muth (1961) et Lucas (1972), la plupart des économistes rejettent les anticipations adaptatives. De fait, expliquer l'inertie de l'inflation grâce à son propre retard est devenu inadapté. Par ailleurs, comme les prix deviennent théoriquement de fait une variable purement prospective, ils deviennent flexibles et ne correspondent plus aux faits stylisés.

Taylor (1980), Calvo (1983) et Rotemberg (1982), entre autres, proposent d'introduire des contrats nominaux échelonnés afin de concilier les anticipations rationnelles et l'inertie de l'inflation. Dans ces modèles, la négociation des contrats dépend directement de la valeur des contrats négociés au cours des périodes précédentes. Dans ce monde, l'inflation dépend de l'écart de production ou des cots marginaux, selon les caractéristiques des différents modèles et des anticipations rationnelles sur l'inflation future. Si ces contrats permettent aux modèles d'équilibre général d'augmenter leur rigidité des prix, Ball (1994) montre qu'ils ont des conséquences factuelles: une politique de désinflation peut entraîner une augmentation de la production. De plus, Fuhrer et Moore (1995) montrent empiriquement que le degré de persistance de l'inflation dans ces modèles est bien inférieur à l'inertie réelle de l'inflation américaine post-guerre. En conséquence, la persistance de l'inflation est trop faible et la désinflation cote trop peu cher. Comme le rapporte Fuhrer (2010), le problème est le suivant : puisque le retard dans le triangle de Gordon a disparu, l'inflation peut sauter instantanément suite à un choc exogène. Dès lors, la persistance de l'inflation dépend directement de la persistance héritée de l'écart de production ou des cots marginaux. S'il n'y a pas de persistance dans la mesure de l'activité réelle, c'est-à-dire pas de rigidité réelle, alors l'inflation sera flexible.

À ce stade, il semble que la définition de l'inflation qui s'accorde le plus avec les faits empiriques est une forme hybride qui combine les anticipations prospectives et rétrospectives. Cette forme est introduite par Gali et Gertler (1999). Cependant, cette solution est plutôt un compromis entre la théorie et les évidences empiriques plutôt qu'une véritable explication de la dynamique de l'inflation. Les banquiers centraux doivent clairement identifier ce qui motive la dynamique de l'inflation et dans quelle mesure. Plusieurs raisons seront données pour expliquer théoriquement l'introduction d'un tel retard inflationniste dans la nouvelle

courbe de Phillips keynésienne. L'un des articles les plus célèbres est Christiano et al. (2005). Dans cet article, les auteurs supposent que les entreprises évoluent dans un monde à la Calvo où les prix sont réévalués au hasard. Il en résulte que les entreprises sont parfois incapables d'ajuster leur prix au cycle économique pour certaines périodes. Dans cette période, les auteurs supposent que les prix sont indexés sur les prix passés. Cette hypothèse donne naissance à une Nouvelle Courbe de Phillips Keynésienne (NKPC par la suite) hybride. Toutefois, comme l'a indiqué Woodford (2007), cette hypothèse est purement théorique puisqu'il n'existe aucune preuve microéconomique d'une telle indexation. Une autre interprétation pour l'incorporation de termes d'inflation retardés dans la courbe de Phillips est qu'elle peut être un proxy pour la rationalité limitée. Par exemple, Erceg et Levin (2003), Collard et al. (2004) et Milani (2005) proposent d'expliquer la persistance intrinsèque grâce à l'apprentissage et à la formation des anticipations. Ces modèles estimés sont tout à fait concluants puisque le niveau de persistance de l'inflation est conforme aux preuves empiriques. Finalement, une critique plus générale concerne toute cette branche de la littérature qui vient de Cogley et Sbordone (2005). Les auteurs cherchent à estimer une équation d'inflation censée représenter une dynamique d'inflation à long terme. Pour ce faire, Cogley et Sbordone (2005) intègrent des écarts logarithmiques par rapport aux valeurs d'équilibre de différentes variables telles que la production, le cot marginal et l'inflation anticipée, mais aussi un terme d'inflation retardée. Tout d'abord, les auteurs montrent qu'il existe une tendance de l'inflation qui évolue lentement avec le temps. Deuxièmement, ils montrent qu'une fois cette tendance prise en compte, il n'est pas nécessaire d'inclure des termes d'inflation retardés pour reproduire la persistance de l'inflation. Cependant, ce résultat est qualifié de controversé par Fuhrer (2010): l'auteur rapporte qu'une étude réalisée par Barnes et al. (2009) conclut exactement le contraire.

Une autre approche pour expliquer la persistance de l'inflation consiste à se concentrer sur la persistance héritée et donc à se concentrer sur la mesure de l'activité réelle dans le triangle de Gordon. Dans les modèles nouveaux-keynésiens, comme nous l'avons déjà mentionné, les entreprises évoluent à la fois dans le monde de Calvo et dans un cadre de concurrence monopoliste. Dans cet en-

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vironnement, les entreprises maximisent leurs profits en fixant leur prix et en ajoutant un taux de marge à leur cot marginal. Ce taux de marge dépend de leur pouvoir de marché et donc de la substituabilité individuelle des produits. En retour, la dynamique de l'inflation dépend directement des cots marginaux des entreprises. Ainsi, comprendre la dynamique de l'inflation signifie comprendre les cots marginaux déterminants. En cela, les institutions du marché du travail et le salaire réel jouent un rôle crucial.

Hall (2005) est l'un des premiers auteurs qui ont étudié l'interaction entre le marché du travail frictionnel et la persistance de l'inflation. L'auteur propose d'incorporer une norme sociale rétrograde pour introduire la rigidité nominale des salaires dans un modèle néo-keynésien. Cette hypothèse semble aller dans la bonne direction puisque Gali et al. (2001), Edge et al. (2003) et Christiano et al. (2005), entre autres, confirment empiriquement que la rigidité des salaires a une grande influence sur la dynamique de la production et de l'inflation dans les économies européenne et américaine.

Cependant, ce type de modèles doit faire face à une critique importante: dans un cadre de négociation efficace, la rigidité des salaires n'a aucune conséquence directe sur la persistance de l'inflation. En effet, dans un cadre de négociation efficace de Nash, les entreprises et les travailleurs négocient à la fois le salaire et les heures travaillées. En conséquence, le niveau optimal d'heures travaillées est atteint une fois que les cots marginaux des entreprises sont égaux au taux marginal de substitution des travailleurs entre le travail et les loisirs. S'il s'agit d'un résultat microéconomique standard, dans ce cadre, la rigidité des salaires n'a pas d'impact direct sur les cots marginaux, puis sur la dynamique de l'inflation. Pour éviter ce problème, Trigari (2006) introduit une autre fa pour les entreprises et les travailleurs de négocier les heures travaillées dans les modèles DSGE. Introduit pour la première fois par Leontief (1946), la négociation du droit de gérer suppose que les entreprises et les travailleurs négocient ensemble le salaire réel afin de maximiser leur surplus conjoint, tout comme dans la négociation efficace. La différence survient lorsque le salaire réel est fixé. En effet, à ce stade, les entreprises optent pour le niveau des heures travaillées qui maximisent leur profit,

sans tenir compte de l'excédent des travailleurs. Enfin, l'optimalité exige que les cots marginaux soient égaux aux salaires réels. L'intuition derrière cette condition optimale est que les entreprises n'ont aucune information sur le taux marginal de substitutions des travailleurs et doivent considérer le salaire réel comme un proxy.

Cette relation entre le cot marginal et le salaire réel est connue sous le nom de *canal du salaire*. Pour explorer ce canal, Christoffel et Linzert (2010) proposent d'introduire la rigidité salariale de Hall (2005). Il en résulte que puisque les salaires sont rigides, le cot marginal et l'inflation réagissent moins aux chocs monétaires. Ce type de modèles génère un degré de persistance de l'inflation qui est en ligne avec les preuves empiriques.

Plusieurs critiques sont adressées à ce type de modèles. Premièrement, comme l'ont indiqué Sveen et Weinke (2007) et Thomas (2011), deux sous-ensembles d'entreprises, à savoir les détaillants et les producteurs, sont supposés pour séparer les décisions de création d'emplois à celles de la détermination des prix. Les auteurs soutiennent que cette hypothèse rend impossible l'étude de l'impact des frictions de recherche sur le processus de fixation des prix même s'il existe des liens entre la décision d'ajustement de la main-d'œuvre et la fixation des prix. Cette séparation théorique entre les entreprises d'embauche et les producteurs serait responsable de la neutralité des frictions de recherche dans un cadre de négociation efficace. Une autre option est présentée par Ravenna et Walsh (2008). Les deux auteurs assouplissent l'hypothèse selon laquelle le recrutement d'un travailleur prend du temps, comme c'est le cas dans les modèles standard nouveaux-keynésiens, et qu'une fois le rapport entre une entreprise et un travailleur, celui-ci devient instantanément productif. Dit différemment, le nouveau travailleur embauché n'a pas besoin de formation ou de période d'adaptation. Puisque l'emploi peut réagir plus rapidement, les entreprises adaptent leur production en utilisant la marge d'emploi étendue plutôt que la marge intensive. Puis, dans un cadre de négociation efficace, puisque la réponse des heures travaillées aux chocs externes est faible, la réaction des cots marginaux sera faible et la persistance de l'inflation augmentera.

Krause et Lubik (2010) introduisent de la recherche-en-emploi dans les mod-

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èles DSGE et en étudient les implications pour la dynamique de l'inflation. La recherche-en-emploi introduit la possibilité pour les travailleurs de trouver un emploi qui offre un meilleur salaire que le travail qu'ils détiennent actuellement. Généralement, les économistes intègrent la recherche-en-emploi d'une manière très simple. Ils considèrent deux secteurs dans l'économie : un bon secteur qui offre des salaires élevés et un mauvais qui offre des bas salaires. Les travailleurs qui ont un mauvais travail cherchent un meilleur emploi, même s'ils sont déjà employés. Les travailleurs qui ont en bon travail ne peuvent pas améliorer leur situation et ensuite se contenter de leur emploi réel. Ainsi, de bons emplois peuvent être comblés grâce à des chômeurs ou des travailleurs déjà en emploi, tandis que les mauvais emplois ne peuvent être comblés que grâce aux chômeurs. En conséquence, le cot marginal réel dans l'ensemble de l'économie est la somme des cots marginaux du secteur défavorisé et du secteur de la santé qui dépendent du rendement des heures travaillées dans les deux secteurs. La réponse des cots marginaux réels à un choc externe dépendra alors de la réponse de chaque secteur. Krause et Lubik (2010) montrent que cette réponse est plus faible que dans les nouveaux modèles keynésiens standard et déclenchera une réactivité à l'inflation plus faible.

Enfin, Christoffel et al. (2009a) comparent toutes ces différentes hypothèses. Ils construisent un cadre commun (fondamentalement basé sur le modèle de Trigari (2006) avec une négociation efficace à la Nash et aucune rigidité de salaire) et introduisent une par une les différentes hypothèses présentées plus tôt. Les auteurs montrent que les modèles qui intègrent le canal du salaire et les rigidités des salaires réels sont les plus susceptibles de reproduire le degré de persistance de l'inflation dans le cadre nouveau keynésien. Cependant, si ces modèles ont la vertu de montrer la voie, ils s'arrêtent au milieu de la route. Ces modèles imposent une rigidité exogène sur le salaire réel sans préciser leurs origines. Une étude plus approfondie des institutions du marché du travail pourrait permettre aux macro-économistes d'identifier clairement ces rigidités. Les institutions du marché du travail peuvent être définies comme la législation sur la protection de l'emploi (EPL par la suite), les prestations de chômage, le salaire minimum et la négociation collective. Si l'impact de la négociation salariale sur la

dynamique de l'inflation a déjà été étudié, la relation entre l'inflation et le reste des institutions reste incertaine. En particulier, l'impact des cots de licenciement sur la dynamique des salaires, et donc sur la persistance de l'inflation, a été négligé. Thomas (2006) montre qu'il existe une relation négative entre les cots de lancement et les fluctuations des cycles économiques. Tandis que Thomas (2006) l'explique par l'impact des cots de licenciement sur la destruction d'emplois, Macit (2010) montre que les cots de licenciement affectent la dynamique des salaires et ont des conséquences directes sur la persistance de l'inflation. L'introduction des cots de licenciement dans un modèle DSGE avec un marché du travail frictionnel pourrait accroître la rigidité des salaires de manière endogène et ensuite la persistance de l'inflation. Cependant, Macit (2010) néglige deux éléments principaux : d'abord, il oublie d'inclure le canal des salaires, ce qui a pour conséquence de limiter l'impact des cots de licenciement sur la dynamique de l'inflation ; deuxièmement, il cont les cots de licenciement comme une taxe forfaitaire pour les entreprises, négligeant ainsi l'étude de l'indemnité de licenciement.²³

0.4.4 Valeur ajoutée à la littérature

La revue de la littérature antérieure vise à mettre en évidence les questions théoriques et empiriques actuelles qui sont posées aux macro-économistes. L'objectif de cette thèse est de contribuer à répondre à ces questions. Dans la première partie de cette dissertation, les effets de la EPL sur la dynamique des salaires et de l'inflation sont étudiés (premier et deuxième chapitres). La deuxième partie de la thèse vise à expliquer les différences de multiplicateurs budgétaires en fonction du cycle économique grâce au marché du travail (troisième chapitre). Enfin, la dernière partie de la thèse est consacrée aux effets de débordement des réformes du marché du travail allemand sur les autres pays européens dans une perspective empirique.

Le chapitre 2 examine l'impact des cots de licenciement sur le salaire réel et sur la persistance de l'inflation. Un modèle DSGE nouveau-keynésien est réalisé suivant Trigari (2006). À la suite de Macit (2010), des cots de licenciement

²³ L'indemnité de licenciement est un élément de la EPL. Outre les indemnités de licenciement, la EPL comprend les différentes législations relatives à la notification préalable et les raisons valables pour la mise à pied des travailleurs, le fonctionnement des agences de travail temporaire et les contrats à durée déterminée.

forfaitaires sont introduits dans un marché du travail fictif. Le salaire réel est négocié selon la négociation de type *droit-à-gérer* afin d'incorporer le canal du salaire dans le modèle de Macit et de lier directement la dynamique de salaire à la Courbe de Phillips Nouvelle Keynésienne. Afin de comparer mes résultats aux études précédentes, l'économie est soumise uniquement aux chocs monétaires. Comme premier résultat, je montre que les coûts de licenciement affectent le salaire réel de deux façons différentes. Premièrement, les coûts de licenciement obligent les analystes à distinguer les travailleurs déjà en emploi des nouveaux travailleurs. En effet, étant donné qu'une période d'essai existe dans la plupart des pays de l'OCDE, les travailleurs qui ont récemment trouvé un emploi ne peuvent pas jouir de la EPL. Ainsi, l'impact des coûts de licenciement sur leur salaire ne sera pas le même que sur les travailleurs de longue date. Je montre que les coûts de licenciement affectent négativement les nouveaux travailleurs. Cependant, la manière dont les coûts de licenciement ont une incidence sur les travailleurs de longue date est tout à fait ambiguë dans ce modèle, la longueur attachée aux coûts de tir en salaire réel est composée de deux éléments. Le premier élément dépend négativement de la variation du profit après une augmentation du salaire réel alors que le deuxième élément dépend positivement de l'utilité des travailleurs après une augmentation du salaire réel. Ici, deux visions des coûts de tir sont présentes. D'une part, la première interprétation considère que les travailleurs doivent être mieux protégés lorsque le profit des entreprises diminue, car le risque d'être mis à pied est plus grand. En contrepartie, pendant la reprise économique, les travailleurs peuvent être moins protégés puisque ce risque est plus faible. D'autre part, on peut considérer que les travailleurs doivent être plus protégés quand ils ont plus à perdre, c'est-à-dire quand l'utilité gagnée à partir de leur salaire est plus grande. À la fin, cette nouvelle dynamique réduit la réactivité des salaires réels aux chocs monétaires. Deuxièmement, les conséquences des coûts forfaitaires de tir sur la persistance de l'inflation sont faibles. Ce résultat s'explique par le fait que la dynamique à la racine des nouvelles rigidités n'est qu'un sous-ensemble de la dynamique des salaires.

Le chapitre 3 examine plus en détail le rôle des coûts de licenciement sur la dynamique des salaires. Le modèle DSGE utilisé dans ce chapitre est une con-

tinuation du modèle utilisé au chapitre 2. Cependant, un nouvel élément est introduit: l'indemnité de licenciement. Cet élément de la EPL a été écarté en raison de la critique de Lazare (1990). Cette critique précise que les effets des indemnités de licenciement sont réglés au cours de la négociation salariale. En effet, dans un cadre de négociation salariale efficace, les travailleurs préfèrent annuler l'effet de l'indemnité de licenciement, c'est-à-dire d'accepter une réduction de leur salaire égale au niveau de l'indemnité de licenciement obligatoire afin de protéger leur emploi. Si ce résultat est controversé, il a conduit la théorie macroéconomique à rejeter l'analyse des indemnités de licenciement. Cependant, cette étude est intéressante à maints égards : comme l'ont rapporté Garibaldi et Violante (2002, 2005), les indemnités de licenciement sont quantitativement significatives et qualitativement différentes des cots de licenciement forfaitaire. En effet, les indemnités de licenciement présentent une caractéristique particulière par rapport aux cots de licenciement forfaitaire : elles constituent un nouveau revenu unique pour les travailleurs licenciés, soit un transfert des entreprises vers les travailleurs. De plus, le niveau des indemnités de licenciement peut être négocié entre les entreprises et les travailleurs, comme l'a signalé Fella (2007).²⁴

Dans ce chapitre, j'introduis par étapes les indemnités de licenciement dans un modèle DSGE afin d'identifier clairement la caractéristique qui affecte le plus la persistance de l'inflation. À titre de référence, j'utilise le modèle de Trigari (2006) avec une négociation salariale efficace. Premièrement, je présente des indemnités de licenciement forfaitaires pour étudier l'effet du transfert de revenu sur les cots marginaux des entreprises. Deuxièmement, je suis Garibaldi et Violante (2005) et je permets aux entreprises et aux travailleurs de négocier le montant des indemnités de licenciement afin de maximiser leur séparation. Enfin, je réintroduise le canal des salaires en introduisant la négociation de type droit-à-gérer. Je montre que le transfert des entreprises vers les travailleurs en cas de licenciement n'a pas d'impact considérable sur la persistance de l'inflation. Cependant, les négociations visant à fixer le niveau des indemnités de licenciement réintroduisent le mécanisme de Lazare (1990) : les travailleurs acceptent de payer une partie de leur indemnité de départ pour partager le fardeau de la EPL avec les en-

²⁴ L'auteur indique qu'en 1990, 51% des syndicats ont négocié des indemnités de départ non conventionnelles pour les travailleurs non manuels et 42% pour les travailleurs manuels.

treprises. Ce comportement est interprété comme un système de contribution qui est mis en œuvre librement entre les entreprises et les travailleurs. Si un mécanisme à la Lazear est présent dans mon modèle, notre conclusion diverge car je montre que, dans un cadre de négociation de type droit à gérer, les indemnités de licenciement introduisent une rigidité endogène des salaires réels et permettent au modèle nouveau-keynésien de reproduire la persistance de l'inflation. Finalement, si l'indemnité de départ introduit un système de contribution, celui-ci doit être mis en évidence par le canal de salaire présent grâce au droit-à-gérer. Lorsque les deux éléments sont fusionnés, le modèle donne une persistance de l'inflation plus grande que le modèle de Trigari (2006) et en concordance avec les évidences empiriques.

Le chapitre 4 porte sur l'efficacité de la politique budgétaire en fonction du cycle économique. Peu d'articles cherchent à expliquer pourquoi les multiplicateurs budgétaires sont plus importants en période de ralentissement économique que pendant la reprise économique, parmi eux, Sims et Wolff (2013) et Michailat (2014). Ce chapitre fait partie de cette littérature. Afin de mettre en évidence un nouveau canal de transmission, j'utilise un modèle DSGE à grande échelle avec un marché du travail frictionnel à deux secteurs : un secteur public et un secteur privé. Des politiques d'austérité sont simulées grâce à des réductions des salaires du secteur public et des postes vacants afin d'étudier les plans d'austérité mis en œuvre dans l'Union européenne au cours de la crise de la dette publique. Une attention particulière est accordée à la réaction de la production et de la dette publique aux chocs budgétaires. Afin de prendre pleinement en compte le phénomène de non-linéarité résultant des différents états de l'économie, je résous le modèle en utilisant des approximations de Taylor de second ordre. Enfin, par souci de réalisme, j'introduis des ménages ricardiens et non-ricardiens. Le ralentissement économique est modélisé grâce à un taux de chômage plus élevé à l'équilibre. Il en résulte que le bassin de demandeurs d'emploi est plus grand au cours de la récession économique, tout comme dans Michailat (2014). En revanche, ce bassin est plus petit au cours de la reprise économique.

Dans ce cadre, les réductions des salaires du secteur public et des postes va-

cants génèrent une plus grande réponse à l'emploi pendant la récession économique. Contrairement à Michailat (2014), j'étudie l'impact de la réponse du marché du travail sur la production et la dette publique. La réponse du marché du travail se répercute sur le marché des biens et services grâce à la réponse du salaire réel. En effet, la plus grande réponse dans l'emploi se traduit par une augmentation plus forte du salaire réel (grâce à une plus grande réponse de la productivité marginale totale du travail). Il crée des pressions inflationnistes plus importantes qui déclenchent en retour une augmentation plus importante du taux d'intérêt nominal. Enfin, la réponse du taux d'intérêt nominal crée un effet d'éviction plus important sur les consommations des ménages ricardiens. En conséquence, le multiplicateur fiscal est plus important en période de ralentissement économique et les effets négatifs à court terme de la politique d'austérité sont amplifiés : la production diminue tandis que la dette publique augmente davantage à court terme pendant le ralentissement économique. Ces résultats ne sont pas en contradiction avec les résultats exposés dans les études précédentes. En effet, ils sont basés sur les résultats de Michailat (2014) et sont complémentaires au canal de Sims et Wolf (2013).

Enfin, le chapitre 5 examine les répercussions des réformes budgétaires et du marché du travail en Allemagne, appelées réformes Hartz, sur le reste de la zone euro. Dans ce chapitre, nous étudions en particulier les effets de Hartz IV et de la taxe sociale sur la valeur ajoutée (réduction des cotisations de sécurité sociale et hausse de la TVA) sur l'Allemagne et le reste de la zone euro. Pour ce faire, 8 économies de la zone euro (Autriche, Belgique, Finlande, France, Allemagne, Italie, Pays-Bas et Espagne) qui représentent environ 90% du PIB de la zone euro sont étudiés, de 1992 à 2011 à Q4, dans un modèle GVAR. L'approche GVAR permet d'évaluer l'interdépendance internationale. Il permet de considérer l'Allemagne et le reste de la zone euro comme deux groupes parfaitement séparés, en ignorant les problèmes d'identification. De plus, il permet de mettre en lumière des relations de long et de court terme qui sont compatibles avec la théorie macroéconomique. En tant que variables individuelles, je me concentre sur la production, l'inflation, le compte courant, le taux de change réel, la TVA, les cotisations sociales, les prestations de chômage et le taux d'intérêt

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nominal. D'une part, je montre que les variables domestiques, en particulier l'inflation, sont fortement influencées par leur homologue européenne à court terme.²⁵ D'autre part, les analyses dynamiques du modèle affichent trois résultats principaux. Tout d'abord, la baisse des prestations de chômage a une incidence négative sur la production allemande. Ce résultat est nouveau en ce sens que les modèles théoriques qui mettent l'accent sur cette politique ont étudié les réformes de Hartz dans leur ensemble et concluent à un impact positif global. Ici, je montre que si Hartz IV encourage les travailleurs à chercher plus activement un emploi, cela réduirait le revenu réel, puis la consommation et l'activité allemandes. La TVA sociale a eu un impact plus ambigu sur la production allemande puisque la baisse de la cotisation sociale stimule l'activité allemande tandis que la hausse de la TVA la réduit. La principale conséquence de la TVA sociale a été d'améliorer grandement le compte courant allemand. Deuxièmement, dans le modèle, l'Allemagne apparaît comme une force motrice dans la zone euro puisque toute politique qui augmente la production allemande tend à augmenter par conséquent le reste de la zone euro un. Ainsi, la diminution de la contribution sociale a positivement déversé sur le reste de la zone euro, alors que l'augmentation de la TVA et la réduction des prestations de chômage ont eu une incidence négative sur sa production. Enfin, le modèle montre que, contrairement à la littérature théorique, la dévaluation fiscale qui représente ces réformes du marché du travail et de la fiscalité peut être au moins partiellement responsable de la forte augmentation du compte courant allemand. Cette augmentation du compte courant allemand s'est réalisée au prix de la dégradation des partenaires commerciaux allemands, même si la politique différente ne les affectait pas de manière homogène.

²⁵ Les auteurs ne sont pas d'accord sur l'influence contemporaine des prix étrangers sur les prix nationaux. Par exemple, dans une littérature GVAR, Dees et al. (2007) montrent que dans la zone euro, les prix individuels sont faiblement affectés par leur contrepartie européenne, tandis que Ricci-Risquete et Ramajo-Hernez (2015) montrent le contraire.

Chapter 1 | General Introduction

The recognition of Peter Diamond, Dale Mortensen and Christopher Pissarides as recipients of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel in 2010 engraved the vision of search and matching models as the standard representation of the labor market in macroeconomics. This vision has allowed for a new conception of the labor market and brought back on the front scene something neglected by Keynes¹ and his successors until recently as a key variable that can explain unemployment: frictional unemployment. As labor market mechanisms were deeper analyzed, many more issues arose simultaneously with a theoretical crisis in macroeconomics.

The aim of this dissertation is to contribute to answer three recent issues in macroeconomics. In a very simple way, these issues can be summed up as follows: i) *what are the determinants of wage dynamics and how do they affect inflation persistence?*; ii) *why is fiscal policy more efficient during economic downturns than during economic upturns?*; and finally iii) *what are the spillover effects of a structural reform of labor market in a specific country on its trading partners?* These questions are all linked by the fact that their answers lie in a deep analyze of the search and matching labor market.

This general introduction is organized as follows: I review the specific liter-

¹ In the General Theory, Keynes identified three sources of unemployment: voluntary unemployment, frictional unemployment and involuntary unemployment. Because Keynes wanted to highlight the importance of involuntary unemployment in the business cycle, he regrouped in what one can call the natural rate of unemployment both voluntary and frictional unemployment without studying more deeply frictional unemployment. For more details, see chapter 2.II and chapter 2.IV in Keynes (1936).

ature and engrave these three different issues in the recent scientific debate in macroeconomics. Then, I present the different contribution of this dissertation and the different methodologies I used to answer these questions.

1.1 Revolution and counter-revolution in macroeconomics

How does macroeconomics evolve, even progress? According to Woodford (1999), thanks to "revolution and evolution". Indeed, the first revolution in macroeconomics is Keynes' General Theory. One can easily say that, even if the study of the business cycle did not start in 1936, macroeconomics as an independent economic field was born with Keynes. As reported by De Vroey and Malgrange (2007), the objectives of Keynes in his General Theory can be summed up in four points: to show the existence of involuntary unemployment; to explain why wage rigidities are not responsible for that kind of unemployment; to show how this involuntary unemployment can be explained in a general equilibrium framework; and finally to show why a weak aggregate demand is responsible for involuntary unemployment and how an expansionary policy can help to avoid this issue. If at the beginning of his work, Keynes wanted to explain business cycle, he had to renounce quickly to this project, because of mathematical and informatics limits. Instead, he showed the interconnection of every main variable (employment, interest rate and price) at a specific moment.

If Keynes' theory was not well understood at first by his contemporaries, light was made by three young economists, Harrod, Meade and Hicks, who gave their interpretation of the General Theory. Hicks's (1937) interpretation was the most convincing one for the great part of economists. This interpretation gave birth to the IS-LL model, lately renamed IS-LM for Investment-Saving and Liquidity preference-Money supply. However, Hicks did not only give his reading of the General Theory, but he also inscribed Keynes' results into a conceptual framework in coherence with microeconomics results. Joined by Paul Samuelson among others after World War 2, they will create a school of thought known as the *Neoclassical Synthesis*. The Neoclassical Synthesis brought together the Keynesian

1.1 Revolution and counter-revolution in macroeconomics

short run results, mainly before wage and price can adjust, and the Neoclassical long run results, after the renegotiation of wage and the adjustment of price. The Synthesis also created the first break among Keynes disciples between the ones who accepted this synthesis and the ones who rejected it in order to stay as close as possible to the Keynes' original work. These economists will create the school of thought named *Post-Keynesian economics*.

With the 70's stagflation, a period in which economies suffer from both a weak economic growth (and high unemployment) and high level of inflation, Keynes' thought has been challenged by a group of economists that contested Keynesian policy implications and that found in stagflation the confirmation that Keynes' theory was not perfect. This school of thought is known as Monetarists. Stagflation posed a great problem to the Keynesian theory since fiscal shocks were unable to stimulate real activity even by paying a cost in terms of inflation. Milton Friedman and the Monetarists observed it and contested the political implications of the Neoclassical Synthesis. However, this was not the Friedman's first attack against the Keynesian model. For instance, Friedman opposed to Keynes' Fundamental psychological law² his Permanent income hypothesis. However, the stagflation will allow Friedman and his disciples to contest more deeply Keynes' theory. In particular, the fact that monetary policy can be used to reduce unemployment, by paying the price of a little bit more of inflation, is a non-sense for Phelps (1967) and Friedman (1968). To their point of view, the Phillip's curve³ describes only a trade-off between inflation and unemployment in the short run, period during which consumers do not have great information about price and can be a victim of money illusion. However, in the long run, this illusion disappears and policy makers cannot use the monetary policy to force the economy to reach a level of unemployment below the natural rate of unemployment, to use Friedman's glossary. Then, money is neutral and cannot affect the real sphere of

² The Fundamental psychological law stipulates : "[M]en are disposed, as a rule and on average, to increase their consumption as their income increases, but not by as much as the increase in their income".

³ Phillips (1958) studies the Britain economy from 1861 to 1957 and shows that there is a negative correlation between money wage dynamics and unemployment. By assuming that firms set their prices using a markup rule, one can easily show using the original Phillips curve that there is a negative relationship between inflation and unemployment.

an economy. "[M]oney is too important to be left to the Central Bankers", Milton Friedman said.⁴

Nonetheless, if it is certain that the interventionism implied by the neoclassical synthesis is then rejected, the methodology of the Keynesian macroeconomists was not yet questioned by Monetarists. In that point of view, the attacks of Robert Lucas on the Keynesian thought were even harder since Robert Lucas contested both the political implications and the methodology of the IS/LM model. Then, the well-known *Lucas critique* became the second great revolution in macroeconomics after the *General Theory*.

This critique can be considered as important as the *General Theory* in that it forced macroeconomists to obliterate a great part of the scientific results found during the second part of 20th century. It gave birth to the *New classical* thought. According to De Vroey and Malgrange (2007) and Vroey (2012), the Lucas critique constitutes a true scientific revolution *à la* Kuhn. A scientific revolution *à la* Kuhn is a period during which the dominant paradigm is replaced by a new one because of one or several empirical puzzles. This replacement goes also with confrontations between the old and the young generation.⁵ As reported by Lafargue et al. (2012), the Lucas critique can be summed up in several points.

The Rational Agent: First, Lucas (1976) reinforces the concept of rationality in economics. Economic agents reach their objectives by maximizing utility functions on an infinite horizon. To do so, Lucas adopts Muth's (1961) rational expectation and assumes that economic agents can use all the available information and do not make mistakes, in average. Said differently, in average, the agents' expectations are assumed to be in conformity with the prediction of the model. Moreover, the rational nature of every single agent is known by everyone. It implies that a single individual knows that everyone else is rational. The rest of the society also knows that this individual in particular is rational.

⁴ Friedman (2002), *Capitalism and Freedom*, pp 219, University of Chicago Press Economics Books, University of Chicago Press

⁵ See for example Sargent's (1977) article entitled "Is Keynesian economics a dead end?"

Furthermore, private agents evaluate the credibility of policy makers and make their own decision accordingly. Thus, macroeconomics moved from the conception of an economic agent who systematically makes mistakes with "adaptive expectations" to an agent who perfectly knows the true model of economics. One can see coming up here a first great criticism against the New Neoclassical Synthesis, that is the theoretical movement that accepts the macroeconomic vision of Lucas. This criticism can be summed up as follows: how could economic agents know the true model of economics, especially in time of crisis, whereas macroeconomists, among others, are still discussing its nature? However, according to Woodford (1999), this representation of expectation will have huge consequences for economic policies recommendations. Indeed, if an old fashion policy maker bases his policy on the fact that private agents' inflation expectations will be different than the true level of inflation, this policy maker will obtain no result from his policy as long as economic agents are supposed to know the true value of inflation.

The black swan criticism: Second, the Keynes' inductivist approach is replaced by falsificationism, embodied by the Milton Friedman's "As if". Indeed, Keynes and his disciples used their own perception to describe economic functioning and to build their models. If the hypotheses used to build the model are true, which means if they replicate the stylized facts, then the conclusions of these models are also true. However, inductivism has been criticized in detail. One of the most famous examples of these critiques is the *black swan* instance. Supposing that in Europe, all swans are white, European ethologists can extrapolate. They would conclude that on earth, all swans are white and draw generalities on that species from the study of white swan behavior. Let us now imagine that one or several European ethologists travel to Australia. They would discover black swans. This discovery would obliterate all the previous conclusions. This critique tells that the perception of macroeconomists, and every scientist, can be wrong. Then, the model and its conclusions made thanks to these false perceptions would be wrong as well.

Friedman (1953) proposes to reverse the causality between empiricism and theory in macroeconomics. The importance of a macroeconomic model is not its truthful nature but its capacity to reproduce the state of economics. Friedman takes the equally well-known and the more controversial example of *the leaves around a tree*. He wants to explain the density of the leaves around a tree. In order to do so, Friedman assumes that each single leaf can maximize the amount of sun received by choosing its place on the tree given the place of its neighbor. Leaves are supposed to know physical laws, be able to argue and move instantaneously on a face or on another. If Friedman clearly assumes the unrealistic nature of his hypothesis, he stresses the point that the importance is not to know if leaves are rational but if their density on a tree is the same *as if* they were.⁶ Said differently, the structure of a macroeconomic model does not have to be realistic, it must be in agreement with the general equilibrium theory inherited from microeconomics and it must replicate the main co-movements. Lucas totally adopts Friedman's point of view and includes it in his criticism.

Macro-econometric models criticism: Finally, the last part of the critique focuses on the structural nature of the estimated parameters in macro-econometric models. With Keynesian macro-econometrics, structural models are simple sets of equations that rely explained variables to several explanatory variables. The estimated parameters are considered to be structural and invariable. Lucas judges it wrong: these parameters are not exogenous, they contain elements of economic policy such as fiscal and interest rate. These parameters must evolve with the implementation of economic policies. For Lucas, the only structural parameters are the one describing the agents' program of optimization.

In line with Lucas critique, Kydland and Prescott (1977) question the political implications of the Keynesian thought. In the seminal article *Rules Rather than Discretion: The Inconsistency of Optimal Plans*, Kydland and Prescott assume that

⁶ Friedman (1953) says page 12: "[S]o far as we know, leaves do not "deliberate" or consciously "seek," have not been to school and learned the relevant laws of science or the mathematics required to calculate the "optimum" position".

private agents are rational and that they know the true objective of policy makers. If a policy maker announces a policy that does not allow him or her to maximize this objective, private agents will not judge it credible over time and will not include it into their expectations. If this policy maximizes the policy maker's objective, private agents will include it into their program.

To demonstrate their words, Kydland and Prescott take over the example of the Phillips curve. Let us assume that a government has two irreconcilable objectives: to have low unemployment and to have low inflation. In order to reduce unemployment, this government has no other choices but to sacrifice inflation by deceiving private agents' expectations. Indeed, at the beginning of a period, private agents will form their expectations in terms of inflation according to policy maker announcement. Since they are rational, private agents know the true model of the economy and in particular they know the Phillips curve. In a non-stochastic universe, the private agents' inflation expectations will be realized and be equal to the level of inflation at the end of the period. If the government announces an inflation target equal to zero at the beginning of the period, because of the private agents expectation, it will be equal to zero at the end of the period. In this case, unemployment will be equal to the natural rate of unemployment and the government losses will be due to its double objectives.

However, Kydland and Prescott show that this policy is inconsistent over time. Indeed, it is rational for the government to try to dupe private agents. Once private agents have made their expectation according to zero inflation target announced by the government, the latter can be better off letting inflation rise to decrease unemployment below its natural rate. However, private agents know that the inflation target is not credible and will perfectly expect the insidious game of the government. Private agents expect that the true government inflation target is positive and adjust their behavior, in particular in terms of nominal wage and labor demand. Finally, unemployment will not fall below its natural rate and, as unique result, inflation will be positive.

For a great part of economists belonging to the Chicago school including Kyd-

land and Prescott (1977), economic policies must be taken out from governments. For instance, in line with both authors, Nordhaus (1975) shows that business cycle in democracies can be explained by the governments behaviors. In a world where private agents are the victim of *democratic myopia*, a notion quite close to the Friedman's adaptive expectations,⁷ a government can be tempted to dupe electors by degrading macroeconomic situation during its electoral accountability in order to stimulate the economy using expansionary policies just before elections and to present great economic results. Just as Kydland and Prescott (1977), the optimum is never achieved in this situation. In that, Nordhaus (1975) shares the same vision with Ronald Coase who said: "*The kind of situation which economists are prone to consider as requiring corrective Government action is, in fact, often the result of Government action*".⁸ Thereafter, Kydland and Prescott conclusions are simple. In order to avoid the so-called problem of *time inconsistency*, governments have to restrain themselves. First, in line with Tinbergen (1952), Kydland and Prescott recommend that a specific policy targets a specific objective.⁹ Second, governments have to impose themselves a policy rule and stick to it. In particular, optimality requires that monetary policy has to be left into the hands of an independent authority, outside of the democratic game. Barro and Gordon (1983) confirm this conclusion by assuming a repeated game where the monetary policy maker can be punished by private agents if he or she deviates from the announced policy. With an independent authority, the policy maker is better off not deviating from his or her first objective, as it has been shown in Rogoff (1985).

1.2 The Real Business Cycle and the New Neoclassical Synthesis

In the 1980's, a third attack wave arises against Keynesian thought: the "real business cycle" (RBC thereafter) theory. It starts with Lucas' will to demonstrate the

⁷ See Rogoff and Sibert (1988) for an article with rational private agent. The conclusions are quite the same than in Nordhaus (1975).

⁸ See Coase (1960), "The problem of social cost," in "Classic Papers in Natural Resource Economics", page 28.

⁹ The *Tinbergen rule* stipulates that if optimality is aimed to be reached, a policy instrument cannot serve more than for one objective. In Kydland and Prescott's example, the monetary policy cannot be used to reduce unemployment and to stabilize prices.

monetary policy inefficiency into a rational expectation framework. In his seminal article, Lucas (1972) shows that monetary policy can affect real business cycle by disrupting producers' information about prices. In Lucas' model, prices can fluctuate for two different reasons: a monetary shock that affects all producers in a same amplitude and a real shock that would affect a specific sector or a single firm. If producers, that cannot observe directly price variations, consider that the fluctuation is the same for all firms, they would be better off adjusting their quantity. In this case, the change in prices will have no consequences for real activity. If producers consider that the prices change concerns only their sector or their firm, they will modify their production (increasing their production if prices increase or decreasing their production if prices fall). In both cases, policy makers cannot predict the results of a variation in money supply and monetary policy becomes ineffective. This model will be known as the *Lucas island model*.¹⁰

In these models, Lucas lays the foundations for what will become standard models in macroeconomic theory: utility maximizing agents with rational expectations in an efficient market framework. Kydland and Prescott (1982) will extend these models and, in particular, will explain business fluctuations not because of monetary policy shock but because of productivity ones. A single schizophrenic representative agent, both an employee and an employer, maximizes both his or her utility and profits and cycles are due to the reaction of this rational agent to real shocks. Moreover, Kydland and Prescott use the calibration method, which will also become a standard in macroeconomic theory, to give a value to structural parameters. These values are found in the empirical literature or are chosen in order to replicate stylized facts of an economy during a specific period. Once calibration choices are made, the model is simulated and impulse response functions are drawn.¹¹ The model is approved and its policy recommendations

¹⁰ Indeed, in order to explain why producers cannot directly observe prices changes, Lucas (1972, 1973, 1975) takes over Phelps's (1969) island parable. Each single producer is assumed to be on an isolated island. Therefore, producers know their own price but they do not know the economy-wide price level. Thus, they do not know if price variations concern only their island or every single island.

¹¹ An impulse response function (IRF thereafter) represents the response of a specific variable to an exogenous impulse in another variable. IRF can be seen as the economy electroencephalogram after a stimulus.

accepted only if it allows to replicate the reality, that is if the co-movement of the principal variables of interest fits the empirical facts. It is mainly the case for the Kydland and Prescott's model.

However, RBC models face an empirical issue: monetary shocks have temporary but real effects on activity. This issue pushes macroeconomists to reintroduce Keynesian component into RBC models to create the so-called Dynamic Stochastic General Equilibrium models (DSGE thereafter). The meeting of New classical elements and New Keynesian ones allows Goodfriend and King (1997) to call this new school of thought the *New Neoclassical Synthesis*. As reported by De Vroey and Malgrange (2007), the fact that monetary policy has real effects can be mainly explained by the Keynesian component of the New Synthesis: price rigidity and imperfect competition.

First, imperfect competition is introduced following the seminal article of Dixit and Stiglitz (1977). In this article, the authors re-introduce the Chamberlin's (1933) Monopolistic competition using the approach of Lancaster (1975): consumers do not face identical products but products with specific characteristics. Thus, consumers will look for products that are as close as possible to their preferences. Since each specific product is produced only by a single firm and since a product is only an imperfect substitute to another, each firm owns a market power. This market power has a great consequence: firms are no longer price takers but they can maximize their profit according to their price level. Indeed, since consumers are prisoners of their preferences, they will not be able to change their habits and be interested by another good if a firm increases its price. However, firms cannot endlessly increase their price. Their ability to increase it or not depends directly on their market power. In return, their market power depends on the level of consumer products substitutability: if consumers can easily move from one product to another, which implies a high level of substitutability, firms' market power would be low and firms would be close to the perfect competition framework. In return, if the degree of substitutability is low, firms' market power would be high and firms would be close to the pure monopolistically framework.

Second, price rigidity has a central role in Keynesian theories and policy recommendations. Among the different manners to explain and model price rigidity, the rigidity *à la* Calvo is the most famous one. Calvo (1983) assumes that, at each period, only a share of firms present in the economy can change their price. Thus, firms will maximize their profit on an infinite horizon choosing their price but taking as given the probability to be able to change their price or not. This makes macroeconomists able to introduce nominal rigidity in a very simple manner. Finally, profit maximization in a Calvo price rigidity and monopolistic competition framework leads firms to apply a mark-up to their marginal cost. This mark-up is a function of products substitutability. The New Neoclassical Synthesis allows once again to reconcile a Classical approach and a Keynesian one: New Classical and New Keynesian schools, respectively. Indeed, in the short run, when firms are not able to adjust their price to a shock, they have to adjust their production to the demand. Thus, Keynesian effects prevail in that case. Otherwise, when firms are able to adjust prices, Classical conclusions arise.

A last central component of the New Synthesis is the Taylor rule. Introduced by the seminal article of Taylor (1993), this rule explains the dynamic of nominal interest rate as a function of the output gap and the difference between an inflation target and the actual level of inflation. In terms of monetary policy, the Taylor rule implies that Central Bankers have two different objectives: the stabilization of inflation around an inflation target but also the support of real activity. One can note that only half of the Kydland and Prescott's recommendations are modeled here. Central Bank is independent and follows a rule. Indeed, Central Bankers do not follow Tinbergen's rule and use monetary tool for two irreconcilable objectives. However, the original Taylor rule is an empirical relationship supposed to describe Federal Reserve System behavior. It implies that the Taylor rule is consistent with Friedman's *As if*.

What is the impact of an expansionary monetary policy in this DSGE model? Let us suppose that the level of inflation is low enough and that a Central Bank wants to stimulate real activity decreasing its nominal interest rate. In this case, if someone assumes that households are Ricardian, which means that they are

rational and that they smooth their consumption on an infinite horizon,¹² a decrease in nominal interest rate yields an increase in consumption and a decrease in saving. Following Calvo's rigidity, firms that are able to change their price will increase it. Firms that cannot will increase their production in order to answer the increasing demand. After a while, all firms will be able to adjust their price and the demand will decrease. Thus, in a short run perspective, monetary policy has a real effect on activity. However, on a long run perspective, the only consequence of the expansionary monetary policy will be a rise in inflation, as predicted by Friedman and his disciples.

With the New Neoclassical Synthesis, macroeconomics seems to have found again some peace through a new consensus from both a theoretical and a methodological point of view as well as from policy recommendations. Indeed, the greatest part of macroeconomists seems to have accepted the Lucas critique and its dynamic approach of macroeconomics. At the same time, the same greatest part of macroeconomists has admitted that monetary policies is efficient during the short run but ineffective during the long run. However, this consensus will be questioned after the 2007 sub-prime mortgage crisis.

1.3 The New Neoclassical Synthesis challenged: toward a new paradigm?

Because of the recent financial crisis, voices against the New Neoclassical Synthesis begin to be heard. A fundamental question is asked to macroeconomics after the macroeconomists' failure to predict the crisis and after their incapacity to help Greece, for instance, once the financial crisis turns into a debt crisis in Europe. This question is the following: do we attend to a revolution in the sense of Kuhn that will force macroeconomists to change their paradigm, just as the 1970's stagflation has sweep away Keynesian thought, or is it just a minor theoretical crisis that will help macroeconomists to adjust their models? It seems that the truth lies somewhere in the middle.

¹² This assumption will be discussed later.

1.3 The New Neoclassical Synthesis challenged: toward a new paradigm?

Criticisms come from both the civil society and the economics' sphere. From the civil society, macroeconomists are criticized not to have predicted the 2007's financial and European debt crisis. Moreover, they are unable to propose clear reforms to reduce the resulted structural unemployment, in particular in countries such as Greece. Criticisms that the New Synthesis is facing are mainly related to the unrealistic nature of DSGE models. In particular, two elements are targeted: the representative agent and rational expectations. Some other economists might reproach that DSGE models evolve around a steady-state in a linearized framework. Finally, the role of money in this kind of models is also attacked. Let us detail each criticism, one by one.

Concerning rational expectations, one should not paint a gloomier picture of the situation than it deserves. As reported by Milani (2012), rational expectations present numerous advantages. Among them, the fact that in average, agents do not make mistakes implies that expectations are confirmed by the outcomes of models. In contrast, adaptive expectations yield systematic forecast errors. Moreover, rational expectations are not only in line with Lucas critique but also an elegant and simple way to model expectations.

However, according to Akerlof et al. (2000) and Coibion and Gorodnichenko (2015), agents do not actually present rational behavior. During experiments and in general, agents do not reach the rational equilibrium. Agents react slowly to new information and prefer to refer to pre-conceived notions even when contra-evidence are presented to them. As a consequence, agents repeat their errors. *Homo-Oeconomicus* seem to be a boundedly rational agent rather than fully rational one.

Moreover, with rational expectations, RBC and DGSE models fail to replicate persistence of main macroeconomic variables and in particular inflation. Nevertheless, DSGE models have the advantage to be greatly flexible. Macroeconomists are free to adjust and adapt their model to correct the errors that are presented to them. For instance, to correct the over flexibility in consumption behavior, some consumption habits have been introduced. Households are assumed to

have some inclination in terms of consumption, which seems to be more realistic. Some fashion effects can also be introduced since, as reported by Milani (2012), households can maximize their level of consumption regarding the deviation of their neighbors' consumption. Thus, counterfactual results linked to rational expectations can be corrected by adding new realistic behavior in DSGE models.

Besides, two ways are experimented to directly avoid issues concerning rational expectations. The first manner is the introduction of adaptive learning: agents are supposed to try and adjust their behavior through structural mistakes. Another way to incorporate bounded rationality is the introduction of "news" in models. Typically, agents can receive information about a future shock that can be materialized or not. If the shock does not happen, agents have to adjust their expectations. These expectations adjustments can explain a part of business cycle: news imply that recession can be the result of an adjustment in private agents' expectation to an un-materialized shock without referring to a negative productivity shock. In their article, Beaudry and Portier (2006) show that a great driver of business cycle variations can be a shock that does not affect the total factor productivity in the long run. This shock can be interpreted as a news that did not actually happen.

A second great criticism of DSGE model concerns the Representative Agent. The Representative Agent is the simplest way macroeconomists have found to model individuals. It is what its detractors call the *Homo Œconomicus*: a pure rational individual that maximizes his or her utility under budget constraint. The representative agent theory lets no room for heterogeneity. Moreover, this heritage of the Lucas critique implies that an individual behavior at a micro level can be translated to the macro level, after aggregated. This assumption can be validated but only according to restrictive assumptions. However, it triggers that some interesting facts are removed from macroeconomic study. For instance, as reported by Nachane and others (2016), interactions and network effects have been neglected by macroeconomists due to the representative agent assumption.

Third, Buiter (2009) shows that "linearization" in DSGE modeling yields im-

1.3 The New Neoclassical Synthesis challenged: toward a new paradigm?

portant issues. In particular, the size and the direction of shocks have no specific effect in linearized DSGE models since every effect is proportional and neutral. In particular, no asymmetry arises from a negative shock and a positive one. At the same time, DSGE models evolve around a steady-state, which can be seen as the modern name of equilibrium in macroeconomics and that represents economy in normal times. However, by definition, a crisis is a phenomenon that does not happen in normal times and thus not around a steady-state. This leads to two consequences: crisis cannot be predicted and policy implications cannot be perfectly apprehended. Fagiolo and Roventini (2012) exhibit as a perfect example the consequences of austerity policy imposed by IMF and the European Commission to European countries in order to avoid the public debt issue. The rational nature of economic agents in DSGE models in period of crisis is also challenged. Indeed, for Stiglitz (2011), the fact that economic agents know the true model of the economy is particularly wrong in period of crisis, when panic is the rule and when rationality is out of the place. Thus, rational expectations and representative agents are perfectly unrealistic in such a period and yields DSGE models to be irrelevant in this case. Hendry and Mizon (2010) also argue that, during great crisis, structural breaks can disturb agents' learning process and create non-stationarity that finally prevents the economy to reach equilibrium. The return to steady-state is not automatic.

Finally, as reported by Fagiolo and Roventini (2012), there is no strong role for money and banks in DSGE models. In particular, in DSGE models with money, private agents cannot be in default because of the transversality assumption (or No Ponzi Game).¹³ Thus, there is no risk premium and all agents face the same interest rate. Money is only a unit of account and can be easily dropped from DSGE models. Since there is not credit default in DSGE models, this kind of models cannot prevent account for financial crisis.

¹³ Named after Charles Ponzi, a Ponzi game refers to a situation where an operator pays returns to his investors thanks to new capital rather than to new profit. In this game, the operator promotes appealing gains in order to attract always more and more pigeons. At the beginning of the game, the operator uses his or her own capital in order to pay first investors. However, noticing that returns are actually really high, investors pay capital to the operator, without knowing that it is this capital that will serve to pay both their courant return and the operator's commission.

No one can easily deny that all these criticisms are relevant. However, if it true that the financial crisis highlighted real issues in macroeconomic modelling, it is also true that DSGE models are flexible enough to adapt themselves to these criticisms. In that, the financial crisis will not yield a revolution *à la* Kuhn, since no change in paradigm is necessary to respond to this crisis. Indeed, in recent years DSGE models included more and more realistic components in order to improve their capacity to answer these criticisms. This dissertation focuses on two of these criticisms: the lack of persistence, in particular of inflation persistence, and the absence of asymmetric effects linked to the state of the business cycle. As it will be presented below, the labor market analysis provides many parts of the answer.

1.4 Macroeconomic Policies and the Labor Market

In his survey, Yashiv (2007) underlines four main questions in the labor market literature: i) *What are the unemployment, job vacancies and employment determinants at the equilibrium? In particular, why is it possible to have both unemployment and job vacancies at the same time in an economy?.* ii) *What are the determinants of the labor market fluctuations? Why some workers prefer to stay inactive rather than searching actively for a job on the labor market? How can policy makers help unemployed workers to go out from unemployment or inactivity toward employment?* iii) *How are determined wages in this framework? What are the impact of unemployment benefit and firing costs on bargaining process?* iv) *How does the labor market affect the business cycle?*

While these four issues were already documented in the neo-classical model, such a framework was not well-suited for these analyses. In particular, as highlighted by Yashiv (2007), the neo-classical labor market was unable to replicate a high variability of hours worked with a low real wage variability but by assuming a high labor supply elasticity, which is at odd with empirical evidence.

An unsung extension of the IS-LM model, the IS-LM-FE (for Full-Employment) model presents the neo-classical labor market. In this model, everything starts with the labor market: firms and workers meet instantaneously and set both the long run real wage and employment levels at the equilibrium. Since firms pro-

duce thanks to labor services and determine the long run output equilibrium, the labor market structure directly affects this equilibrium. Policy makers can influence in the short run from this long run equilibrium and try to increase the level of employment beyond the level described by the FE curve. However, once firms have time to renegotiate wage and adjust their prices, the economy will return to the long run equilibrium. The only change will be a variation in term of inflation. This basic representation of the labor market is, however, entirely unsatisfactory owing to its unrealistic nature.¹⁴

1.4.1 *The standard search and matching labor market*

Search and matching labor market models start from the principle that a firm and a worker do not meet each other instantaneously. If this point can be obvious for non-economists and everyone who already searches for a job or for each firm that searches for an employee, it took time for macroeconomists to include it in their analysis. As said previously, the notion of frictional unemployment was known by Keynes and his disciples but was left into the global notion of natural unemployment. Frictional unemployment was not considered as a key notion able to explain the dynamics of the main labor market variables.

This representation of the labor market is now perfectly well engraved into macroeconomic literature. If only one article has to be recalled that presents the basic search and matching labor, it would be undeniably the seminal one of Mortensen and Pissarides (1994). However, this article is the conclusion of a larger work started with Phelps (1970) and Mortensen (1970) who were the first to consider the labor market as the meeting of different flows. Thereafter, Diamond (1982a,b), Mortensen (1982) and Pissarides (1979, 1985) will give to the basic search and matching model its skeleton.

From a theoretical point of view, the search and matching labor market stresses the importance of search frictions for explaining unemployment dynamic. In particular, unemployment is no longer considered as a simple variable resulting from

¹⁴ The reader would appreciate the paradoxical nature of the latter sentence in a dissertation on DSGE models.

a disequilibrium in this economy. Wages are now negotiated in order to maximize firms and workers' surplus linked to employment in an efficient Nash (1950) bargaining framework. From now, they not only depend on marginal productivity of labor such as in a Walrasian labor market but also on the labor market tightness, the workers' marginal rate of substitution between labor supply and leisure, the workers' relative bargaining power, for instance. Job creation and destruction conditions are explicitly explained and derived thanks to the structural economy parameters. Vacancy posting costs and productivity reservations become the key variables in these dynamics.

From an empirical perspective, several stylized facts have been highlighted. Both the size and the evolution of the key variables are the ones of the economists' major concerns. For instance, as stressed by Blanchard and Diamond (1989, 1990) and confirmed by Bleakley et al. (1999), flows from employment to unemployment and from unemployment to employment increase during recessions. In turn, flows from employment to out of the labor force and from out of the labor force to employment decrease during recessions. Another characteristic of the labor market is highlighted by Hall (2006) and Shimer (2012). These authors show that the job finding probability is strongly pro-cyclical while the separation rate is quite constant over time. Yashiv (2006) disagree with Hall (2006) and Shimer (2012) on this point and estimates that the separation probability is highly volatile. Finally, it appears that hiring and job destruction rates have the same amplitude. Thus, job finding and separation rates seem to be key variables to explain business cycles.

One of the first authors to introduce the search and matching labor market in a general equilibrium model are Merz (1995) and Andolfatto (1996). They show that such an introduction improve the RBC framework to replicate empirical evidence. For instance, the fact that productivity drives employment, that hours worked is more volatile than wages and that employment and unemployment are persistent variables are now replicated by RBC models.

However, the search and labor market also rises some issues. For instance,

Shimer (2003) reports that the standard search and matching labor market can account only for a small fraction of business fluctuations in particular concerning unemployment and vacancies. The author explains the low volatility of both variables in theory notably because wages are too flexible in these models. In particular, as it will be developed more precisely later in Chapter 2 and Chapter 3, the wage dynamic and its flexible characteristic in theoretical models is a central issue in macroeconomic models that aims to investigate and to study economic policies implementations.

1.4.2 On macroeconomic policies

What is the purpose of economic policies? This question is greatly controversial. The answer can simply be "*to improve the joint welfare*" but then someone could add "in the case that the market cannot achieve it by itself" and someone else could reply "*that is nearly always the case*". To avoid these ideological issues and to provide a scientific answer, the best way is to refer to the seminal work of Richard Musgrave, an American economist who is well-known for his definition of the functions of government. Musgrave (1959) considers a public household composed by three different *branches*: the Allocation, the Distribution and the Stabilization Branches. Each branch has a specific objective to achieve. Both principal objectives of the Allocation branch are to allocate resources to satisfy what Musgrave called *public wants* and *merit wants*. According to Musgrave (1959) and following Colm and Musgrave (1960), because of externalities, private markets might not satisfy individual preferences. In this case, public resources have to be allocated in order to please these neglected wills. Private and public wants are, according to these authors, entirely identical except regarding their origins. Merit wants are, in Musgrave's vision, public services that are not particularly asked by single individuals but that are judged essential by the society as a whole such as education or medical services. The Distribution branch has as objective to reallocate resources between low and high incomes households. This branch answers to social justice issues and its principal tool is the tax system.

In the Musgrave typology, the last branch is the most related to DSGE models. Indeed, the Stabilization branch is much more concerned with achieving full

employment and stabilizing inflation, by using public expenditures, debt management and incomes stimulation, in a Keynesian vision of macroeconomics.

1.4.3 On fiscal policy efficiency

If DSGE models and the *New Neoclassical Synthesis* have embraced the idea that monetary policy is effective, that is to say able to reach the stabilization objective, the ability of fiscal policy has still to be demonstrated - or at least re-demonstrated. In 2002, during the 13th International Economic Association's World Congress, Robert Solow asked "Is fiscal policy possible? Is it desirable?".¹⁵ If R. Solow would have concluded his lecture by showing the effectiveness of automatic stabilizers¹⁶, we would be far away from the Keynesian interventionism of the first Neoclassical Synthesis.

Why do macroeconomics question the fiscal policy efficiency? First, as already mentioned, Kydland and Prescott's (1977) work challenged dramatically Keynesian *fine tuning* and fiscal policy implementation in general. If it would have been possible to imagine an independent monetary policy maker that follows a rule with a single objective, because of the fact that fiscal policy impacts the three levels of the Musgrave's typology and in particular because fiscal policy responds to social justice concerns, it would seem to be inconceivable in democratic systems to take this economic tool away from citizens' judgement. Let us add to this first argument Chicago School ones. Before the work of Nordhaus (1975) and Rogoff and Sibert (1988), quoted earlier, Buchanan and Tullock (1962) explained in which way a government is a standard economical agent, with its own objective function to maximize and especially how its objectives are not necessarily in concordance with social welfare. Then, only fiscal policy can be the tool of this rational and so selfish government, since monetary policy is driven by independent policy makers that have as only objective inflation stability. Finally, a last argument reported by Robert Solow claims that fiscal policy effects are long to be felt.

¹⁵ See Solow (2004).

¹⁶ Automatic stabilizers are economic tools that have as consequences to offset business cycle fluctuations without direct intervention by governments. However, the primary role of automatic stabilizers is not to temper business cycle fluctuations.

Consequently, an expansionary fiscal policy that aimed to stimulate an economy after a crisis could be effective during expansion. This situation would represent a waste of public resources that could be counter-effective since, for instance, an excessive inflation could occur. Hence, the second part of Robert Solow's reasoning is that even if fiscal policy is effective, is it possible to implement a rational fiscal policy, that is not subject to democratic temptations, and that will be operative in time?

Second, after the Lucas critique, doubts are casted on fiscal policy effectiveness. In his seminal article, Barro (1974) demonstrates an intuition made by David Ricardo in his "Essay on the Funding System" a century ago.¹⁷ This reinterpretation of the David Ricardo's work yields the well-known *Ricardian equivalence*. This equivalence states that the different ways that a government has to finance its fiscal policy yield the same effect on aggregate demand. Indeed, let us assume that a government can finance new public goods thanks to either an increase in current taxes or by debt or even by monetary creation. Also, let us assume that households are rational and that an intergenerational solidarity exists. In this framework, if a government finances its fiscal policy by issuing new bonds, private agents expect that the current expansionary fiscal policy will have to be financed in the future by an increase in taxes. Then, private agents will reduce their current consumption in order to buy the new bonds and to be able to pay future taxes. Similarly, if the government finances its fiscal policy thanks to monetary creation, private agents expect an increase in inflation and this will increase their saving in order to avoid future assets deterioration. In both cases, private agents will behave in an equivalent way than as if government financed its fiscal policy by increasing current taxes: they reduce their current consumption in order to pay taxes. Debt and monetary creation are not considered by rational agents as a net wealth creation but only as future taxes. Aiyagari et al. (1992), Baxter and King (1993), Christiano and Eichenbaum (1992) and Fatás and Mihov (2001), among others, analyze in a RBC framework with Ricardian households the effect of fiscal policy and conclude to its ineffectiveness.

¹⁷ See Ricardo (1846).

Robert Solow's question is dual and both part of this question needs an answer. First, can governments use fiscal policy? The answer is given by Robert Solow himself and is yes: by using automatic stabilizers. This solution is actually in line with Kydland and Prescott (1977) since it implies that governments adopt a structural fiscal policy and let it acts without any discretionary interventions are needed. Taxes and unemployment insurance are the best-known automatic stabilizers. Indeed, once a government chooses to protect workers thanks to unemployment benefits, this government no longer has to act: in case of crisis, the number of unemployed workers would increase yielding an automatic increase in public spending. *De facto*, by supporting private consumption during recession, unemployment benefits offset business cycle dynamic and can be considered as an automatic Keynesian stimulus. As well, when incomes are high, tax liabilities rise and thereby improve public finances; reciprocally, when incomes are low, tax liabilities fall and public finances are deteriorated.

Second, should a government use fiscal tool to prevent society from macroeconomic fluctuations? The fact that according to Ricardian equivalence "fiscal policy produces not wealth at all" is questionable both from an empirical and a theoretical point of view. First, from a theoretical point of view, the Ricardian equivalence requires controversial assumptions. Akerlof (2007) enumerates some of them, accentuating some sociological aspects. Indeed, Ricardian equivalence implies that i) individuals evolve in an infinite horizons rather than in a finite one; ii) there is a perfect altruistic connection between generations in this infinite horizon; iii) there is no childless family; iv) there is no crowding out effect of public spending on private sector since an increase in government spending triggers a fall in private consumption and then no consequences on interest rate; v) there is no foreign ownership of the domestic debt; vi) private and public agents borrow on the capital market at the same rate; vii) and finally the capital market is perfect and there is no inter-generational borrowing-lending constraint.

These criticisms are strong enough to assume at least that Ricardian households (that is to say households that adopt Ricardian behavior) do not represent all households in an economy. Moreover, in the RBC framework, Baxter and

King (1993) show that an increase in government consumption yields *in fine* an increase in global output. Even if some Ricardian phenomenon are present in this kind of models, in New Classical literature and in the short-run, fiscal policy is effective. Indeed, after the increase in public spending, Ricardian households expect an increase in future taxes. In reaction, Ricardian households reduce their consumption and increase their labor supply. This negative wealth effect is offset by the reduction of real wage induced by the previous increase in labor supply. Because the labor market follows a neoclassical logical in this kind of models, this fall in labor costs will be directly translated into an increase in firms' production. According to Say's law, supply creates its own demands and global output increases. With DSGE models where real rigidities are introduced, Keynesian results are accentuated. Thus, from a theoretical perspective, it seems that the question is no longer if fiscal policy is effective but rather to which extend it is.

On the size of the fiscal multiplier: Even if this issue is of prime importance for economic policy and after almost a century of modern macroeconomics, it is still an unanswered question. From an empirical perspective, Ramey (2012) reports that a great part of the literature concludes to a fiscal multiplier ranged from 0.5 to 1.5. This result has already serious implications in terms of economic policy implementations since the implication of a government would be not the same if the fiscal multiplier is equal to 0.5 rather than 1.5.

Theory provides several interpretations to explain this empirical fact. For instance, the fact that DSGE models include or not non-Ricardian households will affect the size of the fiscal multipliers. Indeed, if someone assumes that a share of the population in an economy does not have access to the financial market and so if non-Ricardian households are introduced, the size of the fiscal multipliers increases. For instance, Coenen and Straub (2005) build a DSGE model with both Ricardian and non-Ricardian households. They use Bayesian method to estimate their model for the Euro area. The authors conclude that non-Ricardian households are in minority in Europe but they greatly influence the economy and in particular the fiscal policy.

However, the importance of the presence of non-Ricardian or, using the appropriate term, *hand-to-mouth* households has nothing to do with fiscal multipliers issues but comes from the necessity for macroeconomists to correct a fallacious consequence of the presence of Ricardian into DSGE models. Indeed, in baseline DSGE models, an increase in public consumption leads to a decrease in private consumption. However, a great part of the empirical literature concludes to the contrary. For instance, Blanchard and Perotti (2002) and Fatás and Mihov (2001) use a Structural VAR to identify exogenous shocks to government spending. Their results are fourfold: first, they show that a positive shock to government spending yields a persistent increase of this variable; second, this increase yields a positive response in output; third, both of them find a positive fiscal multiplier; finally, Blanchard and Perotti (2002) find that public spending significantly crowds out private investment. All these results are confirmed by Galí et al. (2007). Moreover, the latter find that the increase in public spending triggers an increase in hours worked and real wage and also a persistent increase in deficit.¹⁸ Finally, Perotti (2005) generalizes this study to several OECD countries and concludes to a positive effects of an increase in public spending on private consumption and on output.

In order to reconcile the empirical evidence described above, a solution supported by Mankiw (2000) is the introduction of hand-to-mouth households. The expression of *hand-to-mouth* can wrongly be understood as a modern modelling of the *lowest liquid wealth* households, using the expression of Greg Kaplan in the article of Hotchkiss (2014). In fact, it embraces two different realities. On the one hand, what Kaplan et al. (2014) call *poor hand-to-mouth households* are the traditional representation of hand-to-mouth households that a large part of macroeconomists may have: there are households that do not have access to the financial market and that, even if they intend to, cannot smooth their consumption to face

¹⁸ The response of real wage to a shock to public spending is still controversial. For instance, Ramey and Shapiro (1998) study the consequence of an increase in military spending. They show that it yields a decrease in private consumption and in wages while real wage remains quite constant. Edelberg et al. (1999) follow Ramey and Shapiro's (1998) methodology and conclude to a decrease in real wage after an increase in public spending.

income fluctuations. This kind of households would represent only ten percent of the US population and would not be able to explain the major part of empirical facts. On the other hand, there exists a second category, the *wealthy hand-to-mouth* households, that would represent the greatest part of hand-to-mouth households. Indeed, there exists an optimal portfolio composition that has a positive amount of illiquid wealth, such as housing or retirement account. In this situation, wealthy hand-to-mouth households are better off holding these long run investments and bearing the short run loses from income fluctuations rather than using the financial market to smooth their consumption because of, for instance, the existence of transaction costs.

Furthermore, one has to take into account that the nature of the government intervention affects the size of the fiscal multiplier. Indeed, as stated in Beetsma and Giuliadori (2010), an increase in public consumption or in public investment will not impact the economy in the same proportion since the latter will positively act on the productivity of labor and capital as well as stimulating the aggregate demand.

The impact of the business cycle on the fiscal multiplier: As it will be examined further in the Chapter 3 of this dissertation, the business cycle affects the size of fiscal policy effects on the economy. Indeed, Auerbach and Gorodnichenko (2012) show that, for the US economy, the fiscal multiplier is greater during economic downturns than in normal times. This result is also confirmed for the French economy by Creel et al. (2011). Once again, this will have serious consequences in terms of fiscal policies implementations: a greater knowledge of this phenomenon would have allow European policy-makers to better evaluate the impact of the austerity policies applied after the European debt crisis started. For instance, Blanchard and Leigh (2013) document the difference between the actual cumulative real GDP growth over 2010 and 2011 and the IMF's World Economic Outlook forecasting for the same period for the European Union. The authors show that for every one percentage point of fiscal consolidation, the difference between the IMF's forecasting and the reality increases about 1 percent point in

average. A reason to explain this difference is that IMF economists have not taken into account the fact that these economies were in period of crisis, and so with a larger fiscal multiplier. Thus, the negative consequences of austerity policy were multiplied while the positives ones were covered up.

Until recently, DSGE models were unable to take into account the position of the economy over the business cycle. This limit is directly linked to the criticism about the linearization. Indeed, linearization prevents standard DSGE models to reflect differences between a shock that occurs during economic downturn and a shock that occurs during economic upturn. To settle this issue, progresses have to be made in two different directions. First, from a pure technical point of view, second-order Taylor approximation have been adopted. This approximation allows to linearize equations but through including non-linear elements. From then on, different strategies are introduced to reflect the different states of the economy. One of the most intuitive strategy is introduced by Michailat (2014). Here, the author introduces the different states of the economy supposing that during economic downturn the level of real wage at the steady-state is high while it is low during economic upturn.¹⁹ It is fairly intuitive that the labor market will have an overriding role in this approach.

Second, macroeconomic theory has to explain this asymmetry between economic downturn and economic upturn. Once again, the search and matching labor market will play a crucial role. As expounded by Hairault et al. (2010), the search and matching labor market is a perfect framework to study non-linear effects since its structure incorporates elements that do not react the same way in period of crisis or in period of economic growth. To prove that point, the authors study the consequences of a positive shock on the job finding rate. They assume that economic downturns are represented by a high level of unemployment, and so a large pool of job seekers, while economic upturns are represented by a low level of unemployment and so a small pool of job seekers. In this context, the au-

¹⁹ Real wage cyclicity has not found consensus in the literature. In his model, Michailat (2014) finds that there is a positive relationship between unemployment and real wage. Since unemployment is clearly counter-cyclical, the author shows from a theoretical point of view that real wage is also counter-cyclical.

thors show that a positive shock on the job finding rate will have greater impact during economic downturn than during economic upturn. Indeed, since the pool of job seekers is small during economic growth, the positive shock will concern less workers and then will yield less job creation than usual. In return, during economic recession, since the job seekers pool is large, a positive shock on job finding rate will yield more job creations than in normal time.

Michaillat (2014) investigates a positive shock on public employment and finds similar results. During economic downturn, a positive shock on public employment yields a crowding out effect on private employment. This crowding out effect is lower than the increase in public employment yielding an increase in total employment so that, even though the fiscal multiplier is lower than one, it is still positive. When the real wage is high, the pool of job seekers is also large and the crowding out effect on private employment is low. In return, when the real wage is low, the pool is also low and the crowding out effect has deeper consequences. Thus, just as in Hairault et al. (2010), the fiscal multiplier is more important during economic downturn than during economic upturn. A question remains: are these effects still available in a general equilibrium framework? Answers to this question will be given in Chapter 4.

Fiscal Spillover effects

A last main issue about fiscal policy is its effectiveness in an open economy framework. The standard model of Mundell (1963) and Fleming (1962) says that in a fixed exchange rate framework fiscal policy is fully efficient while in a flexible exchange rates fiscal policy is crowded out by exchange rate and hence is inefficient. Thus, a mere fiscal policy can express a *beggar-thy-neighbor* behavior. Indeed, as reported by Buti and Noord (2004), a government that increases its public spending by purchasing domestic goods and services yields an appreciation of the common exchange rate and exports the external crowding out effect on the other members of the euro area. Moreover, in order to keep the money market balanced, a restrictive monetary policy has to be imposed to the entire

area.²⁰ All these considerations highlight the need for coordination of members of a common economic area.

The fiscal policy coordination is a well-known issue especially in Europe. With the creation of the single market and the Economic and Monetary Union, the interdependence between each European economy has been amplified. From then on, fiscal decisions of a single government spill over the other European countries. If the *Pact of Stability and Growth* with its *Excessive Deficit Procedure* aimed to organize the different fiscal policies and if the financial crisis forced the European Union to reinforce its coordination with the creation of new institutions such as the European Stability Mechanism, among others, this coordination is far from perfect.

A major question that has to be answered: by which channels can fiscal policy in a country A affect a country B? Two main channels can be identified in the literature: the trade and financial channels. First, the trade channel has been the prism with which spillover effects were studied for a long while. Following Weyerstrass et al. (2006), it can be decomposed in sub-channels as follows: i) the *output channel* that is the traditional channel expounded by Mundell (1963) and Fleming (1962). The transmission mechanism is quite simple: if the output in a specific country increases, the level of exportations in this country will also increase and will stimulate its trading partners' importations; ii) the *price channel* affects price competitiveness of the different economies; iii) the *interest rate and exchange rate channel*; iv) the *twin deficit* channel. In a very simple Keynesian and open world, one can easily show that there is a direct link between government budget balance and trade balance. Thus, *ceteris paribus*, if a government decides to increase its deficit to finance a recovery plan, it will have consequences as a fall in trade balance and so a stimulation in its trading partners' exports. Bluedorn and Leigh (2011) estimate that a cut of 1% of GDP in public expenditure yields an increase of 0.6% in current account, which tends to prove the existence of such a phenomenon; v) finally the *structural reform channel*: all reforms that affect com-

²⁰ This consequence has to be put into perspective for someone who focuses on the European Union since it holds only in the case of a small area that cannot influence the rest of the world. It is not the case of the Euro area that can weigh on world interest rates.

petition, productivity growth, unemployment, etc. have consequences on supply side. In return, this will affect exports and imports from trading partners.

There exists a myriad of studies that aim at documenting the trade channel existence. Among them, Beetsma et al. (2006) and Bénassy-Quéré and Cimadomo (2012) conclude that a positive fiscal stimulus in Germany yields an increase in European output. Beetsma et al. (2006) estimate that an increase about 1% in German public spending yields an increase of 0.12% in the rest of Europe output while a cut in tax yields only a positive spillover effect of 0.03% in European output. Auerbach and Gorodnichenko (2012) enlarge the study and document the fiscal spillover effects among OECD countries. They confirm the existence of such spillover effects through the trade channel.

If the trade channel has mainly been used to explain fiscal spillover effects across countries, the sovereign debt crisis highlighted a financial channel. The effect of public debt on the private sector is known: Roeger and In 't Veld (2013) report that there exists co-movement between sovereign debt and nonfinancial corporate debt in a vulnerable country. The principal channel that explain this correlation is the weakness of the banking sector that can suffer from the government difficulties and that reverberates it on private loans. Moreover, Corsetti et al. (2013) use a DSGE model to study the consequence of a cut in public spending for a government that issued a high public debt level. They show that non-linear effects exist regarding the debt level. Above a level of 90% of the ratio debt over output, the negative effect of the public spending cuts are compensated by the positive effects of the decrease in sovereign debt.

However, the transmission channel between these weak economies to the stronger ones has still to be highlighted. Principally, this channel states the existence of negative spillover through the impact of a single member state's risk premium on the other members' one. The intuition behind is quite simple: in a union, because of the existence of trade relationship between members, if a state runs into difficulties facing up its debts, doubts can be casted on the ability of other members to face up their own debts since fiscal solidarity between states

might exist. Caporale and Girardi (2013) estimate a *Global VAR* model²¹ for the Euro area and show that public debt returns depend greatly on the issuer and seem to validate the existence of financial channel. Indeed, when healthy states such as Germany issue new public bonds, global public debt returns seem to fall in the Euro area. In contrary, when states in struggle issue new bonds, the risk premium increases for the entire Euro area. Roeger and In 't Veld (2013) build a two country DSGE model with a banking sector to analyze the relationship between sovereign debt and economic performance in a monetary union. They show that an increase in public sector debt negatively affects private demand because an increase in private sector borrowing costs not only in the indebted country but also in the other countries of the union.

These spillover concerns raise the issue of fiscal policy coordination and more particularly the issue of lack of coordination in the European Union. This lack of coordination introduces strategical behavior between European States that can reduce the global surplus of the entire area, sometime pushes downward the pressure on social and labor standards and can finally encourage Euroscepticism. A large number of non-cooperative examples can be found in the literature. Cameron (2012) shows for instance that the response of European governments to the 2007 crisis have been nothing less than disparate. For instance, Italy government increased its spending by 3% of GDP in 2008 and financed this increase by an increase in taxes of the same amount. Even if Haavelmo (1945) taught us that an increase in public spending financed by an increase in taxes in the same proportion has still a multiplier effect, the Italian recovery plan had nothing to do with the Luxembourg nor the Finland and the German ones since they represent a public deficit worsening of 3.9%, 3.2% and 3.2% respectively. Internal reasons may have forced Italy not to stimulate more its economy. However, a better coordination between European countries should definitely have split the burden in a better way.

Finally, the very recent literature focuses on the structural reform channel and in particular on the impact of labor market reforms in a single member state on

²¹ The methodology of Global VAR models will be presented later.

the other members' activity. After the *Hartz reforms* in Germany, after the Italy's Jobs Act²² and the French *El Khomri law*, it becomes clear that the European Union is engaged in a deep, structural and non-coordinated reform of its labor markets.

While the consequence of the Hartz reforms for Germany are quite well-known, the spill over effects of these reforms for the rest of the member states are unclear both from a theoretical and empirical perspectives.²³

As reported by Bouvard et al. (2013) and Amable and Françon (2014), in the beginning of the 2000's, Germany was concerned by two main issues that will be the main target of the Hartz reforms: a high level of unemployment and an aging population that push downward pressure on the labor force. To reduce unemployment and to encourage workers to reintegrate the labor market, the German Parliament adopted four different packages.²⁴ First, Hartz I (January 2003) created the so-called *Personal-Service-Agentur*, which is a private employment placement agencies specialized in temporary job, and removed the duration limit of 2 years for temporary jobs. Second, Hartz II (April 2003) helped unemployed workers to create their own enterprise and generalized subsidized jobs, called mini and midi jobs.²⁵ Third, Hartz III (January 2004) reformed the Federal Employment Agency, a public employment service, to improve the matching efficiency on German labor market. Moreover, the period used to calculate unemployment benefits and the eligibility duration were both reduced. Finally, Hartz IV (January 2005) brought two different packages together: the unemployment assistance (*Arbeitslosenhilfe*), which was an income-related subsidy for unemployed workers no longer eligible for benefits, and the social assistance (*Arbeitslosengeld II*), which is a lump-sum minimum income, are merged. More precisely, the unemployment assistance disappeared while the social assistance has been rein-

²² The Italian labor market reform is a combination of several laws. Among them, one can quote the Law n.78 of the 16th May 2014, so called *Poletti Decree*, the Budget Law n. 190/2014, the Delegation Law n. 183/2014, etc.

²³ I focus here and for the rest of the thesis on the German case for the mere reason that the Italian and the French cases are too recent to be analyzed on a satisfactory way.

²⁴ See Ebbinghaus and Eichhorst (2006) for more legal details concerning the Hartz reforms.

²⁵ Subsidized jobs are low wage and hours worked employments. Mini-jobs offer a wage ceiling of €400 while midi-jobs offer a wage ceiling of €800 in 2003.

forced and submitted to an active job search. As reported by Arent and Nagl (2013), before Hartz IV, the unemployment assistance was determined by 53% of workers' net wages. With Hartz IV, the social assistance became a non-income-related and means-tested subsidy that cannot go beyond €345.²⁶

From the employment point of view, the Hartz reforms have been conclusive for Germany: between 2004 and 2011, the participation rate increased by 4.6% while the population old enough to work fell by 1.3%. This first fact is principally explained by an increase in seniors (plus 16.2 percentage points) and women (plus 6.0 percentage points) participations. The employment rate moves from 64.9% in 2004 to 72.4% in 2012, which is mainly explained by temporary jobs since they have been multiplied by 2.7 between 2003 and 2011 while full time employment increased by 2.4% between 2004 and 2011 and part-time employment increased by 33% over the same period. Finally, Jacobi and Kluge (2006), Klinger and Rothe (2010) and Hertweck and Sigrüst (2012) show that Hartz III in particular increased the matching efficiency and reduced in the same time the level of structural unemployment in Germany. However, everything was not perfect: this fall in unemployment and this increase in labor force participation went along with an increase in poverty and in inequality. The poverty rate for workers moved from 4.8% in 2004 to 7.5% in 2006, thereby accentuating the working poor phenomenon in Germany. However, as reported by Bouvard et al. (2013), unemployed workers were the most affected part of the population. The poverty rate in unemployed workers' population moved from 41% in 2004 to 68% in 2010. This fact is a direct consequence of Hartz reforms. Indeed, the reduction of unemployment benefits encouraged a part of workers to accept temporary and part-time employment. However, the situation became precarious for workers would could not find a job, such as long-term unemployed workers who can hardly be reintroduced into the labor market.

If these facts cannot be contested, the impact of the Hartz reforms on Germany's partners in the European Union is not clear both from a theoretical and

²⁶ Means-tested payments imply that if a member of a household has sufficiently high income or financial asset, the household's payment can be cancelled.

empirical perspectives. An empirical result is that the decrease in unemployment assistance yielded a decrease in wages as it has been shown by Arent and Nagl (2013). A relative simple reasoning could lead to think that Hartz reforms induced an increase in German price competitiveness and stimulate German exports at the expense of other member states economic growth. In this case, the Hartz reforms would fall into the category of *beggar-thy-neighbor* policies. Dustmann et al. (2014) show that since 1995 Germany's competitiveness improved relatively to European countries by the fact that wage rises lower than productivity. In that, Hartz reforms would have accentuate this dynamic.

From a theoretical perspective, Dao (2013) demonstrates in a two-country DSGE model calibrated for Germany and the rest of the European Union (RoE thereafter) that the Hartz reforms had positive spillover effects on the RoE. Indeed, the author shows that the fall in labor costs yield an increase in Germany output that stimulated the German demand for the RoE exports. *In fine*, RoE's output would had been increased by the Hartz reforms. This result seems to be confirmed by Gadatsch et al. (2015): the authors used a two-country DSGE models with a frictional labor market and fiscal and labor market policies simulations to replicate the Hartz reforms. They show that the Hartz reforms actually increased German output, consumption and employment but weakly affected the German trade balance and current account. In order to explain the persistent Germany current account surplus, the authors propose to study the higher saving rate that is observed in the country.

The impact of the saving rate on German current account is validated by Kollmann et al. (2014). In an estimated DSGE model, the authors show that German trade balance is affected by three elements: German saving rate, RoE demand for German products and the Hartz reforms. If these latter cannot explain by their own the German current account surplus, according to this empirical study they are part of the process. However, according to Gadatsch et al. (2015), the Hartz reforms had a positive impact on GDP of RoE about 0.2% in 2015. The authors explain this positive spillover as follows: the decrease in German unemployment had a positive in German demand for RoE products. This study also admits that

Germany had benefited more than the rest of the Euro Area since German GDP increased about 2%. Identically, German terms of trade slightly increased.

However, the literature does not conclude on the impact of a decrease in unemployment assurance on German wage and price competitiveness while it has been a major argument in German labor market reforms criticisms. Some answers will try to be brought in the Chapter 4 of the present dissertation.

1.4.4 On inflation persistence and monetary policy efficiency

At the beginning of macroeconomics, fiscal and monetary policy effectiveness depended on firms' ability to adjust their price to economic variations. Keynes assumed that prices are totally rigid so that firms have to adjust their quantity to economic shock. Governments can then use fiscal and monetary tools to organize counter-cyclical policies. In the Neoclassical theory, prices move freely and allow the market to remain at the equilibrium no matter shocks that can strike an economy. In this world, economic policies are fully inefficient but also unnecessary since the full employment situation is always reached. These two different points of view are known and are too simple to be fully satisfactory. At least, this opposition has the virtue to highlight the importance of understanding prices formation and price dynamics for both macroeconomic theory and policy implementations. The debate is no longer on knowing if prices are rigid or not. Microeconomic and macroeconomic studies have concluded that prices, and more precisely inflation, are persistent. Fuhrer (2010) provides a great definition of inflation persistence: "*An economic variable is said to be persistent if, other things being equal, it shows a tendency to stay near where it has been recently, absent other economic forces that move it elsewhere*". Thus, truth was between the Keynesian and the Classical visions: prices are not rigid since they evolve even in the short run but prices do not adjust automatically to economic shocks. Nowadays, the literature focuses on two main questions relative to change in price level, that is to say inflation: to what extent inflation is persistent and especially why inflation is persistent. I will focus on the latter.

The New Neoclassical Synthesis has the virtue to provide a framework suf-

ficiently large to incorporate the different explanation for inflation persistence. These different interpretations of inflation persistence can be classified thanks to a mere definition of inflation persistence sources. Using Gordon's (1982) "triangle model", inflation is explained by three different sources: its own lags, a measure of real activity such as unemployment or the output gap and supply shifters. This standard definition of inflation provides the two main sources of inflation persistence: intrinsic and inherited persistence. Intrinsic persistence explains inflation persistence thanks to frictions that can occur during price setting process. Inherited persistence explains inflation persistence through the real activity measure and supply-shifters. From this point, two branches of the literature go in a different direction without necessarily being in contradiction.

Friedman (1968) and Phelps's (1967) "acceleration" Phillips curve highlighted the importance of expectations to explain inflation dynamics. According to their representation, the inflation depends on the output gap and on its own lagged value. In this world, economic agents form expectations through adaptive expectations. Thus, this lagged inflation term is at the root of completely intrinsic inflation persistence. However, since Muth's (1961) rational expectations and Lucas (1972) critique the greatest part of economists rejected adaptive expectations. Then, explaining inflation inertia thanks to its own lag became null and void. However, since prices turn into a pure forward-looking variable, they became flexible and did not match anymore with the stylized facts.

Taylor (1980), Calvo (1983) and Rotemberg (1982), among others, proposed to introduce staggered nominal contracts in order to reconcile rational expectations and inflation inertia. In these models, contracts bargaining depends directly on the value of contracts negotiated in previous periods. In this world, inflation depends on output gap or marginal costs, according to the different models characteristics, and on rational expectations on future inflation. If these contracts allow general equilibrium models to increase their price rigidity, Ball (1994) shows that they have counter-factual consequences: a disinflation policy can yield an increase in output. Moreover, Fuhrer and Moore (1995) show empirically that the degree of inflation persistence in these models is far lower than the actual US

post-war inflation inertia. As a consequence, inflation persistence is too weak and disinflation costs too low. As reported by Fuhrer (2010), the problem is the following: since the lag in the Gordon triangle has disappeared, inflation can jump instantaneously to an output shock. Then, inflation persistence depends directly on persistence inherited from output gap or marginal costs. If there is no persistence in real activity measure, that is to say no real rigidity, then inflation will be flexible.

At this point, it seems that the definition of inflation that fits the most empirical facts is a hybrid form that combine both forward and backward looking expectations. This form is introduced by Gali and Gertler (1999). However, this solution is more a compromise between theory and evidence rather a real explanation of inflation dynamics. Central bankers need to clearly identify what drives inflation dynamics and in what extent. Several reasons will be given to explain theoretically the introduction of such a lag in the New Keynesian Phillips curve. One of the most famous articles is Christiano et al. (2005). In this article, the authors assume that firms evolve in a world *à la* Calvo where prices are reevaluated randomly. It yields that firms are sometimes unable to adjust their price to business cycle for some periods. In this period, the authors assume that prices are indexed on lagged prices. This assumption gives rise to a hybrid New Keynesian Phillips Curve (NKPC thereafter). However, as reported by Woodford (2007), this assumption is purely theoretical since there is no micro evidence of such an indexation. Another interpretation for the incorporation of lagged inflation terms into Phillips Curve is that it can be a proxy for limited rationality. For instance, Erceg and Levin (2003), Collard et al. (2004) and Milani (2005) propose to explain intrinsic persistence thanks to learning and expectation formation. These estimated models are quite conclusive since the level of inflation persistence is closed to the empirical evidence. Finally, a more general criticism is concerned with this entire branch of the literature comes from Cogley and Sbordone (2005). The authors aim to estimate an inflation equation that is supposed to represent long-run inflation dynamics. To do so, Cogley and Sbordone (2005) incorporate log deviations from steady-state values of different variables such as output, marginal cost and expected inflation but also a lagged inflation term. First, the authors show

that there is an inflation trend that evolves slowly over time. Second, they show that once this trend is taken into account, there is no need to include lagged inflation terms to reproduce inflation persistence. However, this result is qualified as "*controversial*" by Fuhrer (2010): the author reports that a study conducted by Barnes et al. (2009) concluded to the exact opposite.

An alternative approach to explain inflation persistence is to focus on inherited persistence and thus to focus on the measure of real activity in Gordon triangle. In New Keynesian models, as already mentioned, firms evolve in both a Calvo's world and in a monopolistic competition framework. In this environment, firms maximize their profit by setting their price and by charging a markup over their marginal cost. This markup depends on their market power and thus on individual product substitutability. In return, inflation dynamics depends directly on firms' marginal costs. Thus, understanding inflation dynamics means understand marginal costs determinant. In that, both labor market institutions and real wage play a crucial role.

One of the first authors who studied the interaction between search and matching labor market and inflation persistence is Hall (2005). The author proposes to incorporate backward looking social norm to introduce nominal wage rigidity into a New Keynesian model. This assumption seems to go in the right direction since Gali et al. (2001), Edge et al. (2003) and Christiano et al. (2005), among others, confirm empirically that wage rigidity has a great influence on both output and inflation dynamics in European and US economies.

However, this kind of models has to face an important criticism: in an efficient bargaining framework, wage rigidity has no direct consequence on inflation persistence. Indeed, in an efficient Nash bargaining framework, firms and workers negotiate both wage and hours worked. As a result, the optimal level of hours worked is reached once firms marginal costs equals workers marginal rate of substitution between labor and leisure. If it is a standard microeconomic result, in this framework wage rigidity has no direct impact on marginal costs and then on inflation dynamics. To avoid this issue, Trigari (2006) introduces another way

for firms and workers to negotiate hours worked into DSGE models. First introduced by Leontief (1946), right-to-manage bargaining assumes that firms and workers negotiate real wage together in order to maximize their conjoint surplus, just as in efficient bargaining. The difference occurs once real wage is set. Indeed, at this point, firms opt for the level of hours worked that maximize their profit, without considering workers' surplus. *In fine*, optimality requires that marginal costs equal real wages. The intuition behind this optimal condition is that firms have no information about workers' marginal rate of substitutions and have to consider real wage as a proxy. This relationship between marginal cost and real wage is known as the *wage channel*. To explore this channel, Christoffel and Linzert (2010) propose to introduce Hall's (2005) wage rigidity. It yields that since the wages are sticky, marginal cost and inflation react less to monetary shocks than in absence of wage rigidity. This kind of models generates a degree of inflation persistence that is in line with empirical evidence.

Several criticisms are addressed to this kind of models. First, as reported by Sveen and Weinke (2007) and Thomas (2011), two subsets of firms, namely retailers and producers, are assumed in order to disentangle job creation decisions to price setting. The authors argue that this assumption makes it impossible to study the impact of search frictions on the price setting process even though there exist connections between labor adjustment decision and price setting. This theoretical separation between hiring firms and producers would be responsible for neutrality of search frictions in an efficient bargaining framework. Another option is presented by Ravenna and Walsh (2008). Both authors relax the assumption that recruiting a worker takes time, as it is the case in standard New Keynesian models, and that once the match between a firm and a worker is done, the latter becomes instantaneously productive. Said differently, the new hired worker does not need training or period of adaptation. Since employment can react faster, firms will adjust their production using the extensive margin of employment rather than the intensive one. Then, in an efficient bargaining framework, since hours worked responses to external shocks are small, marginal costs reaction will be weak and inflation persistence must increase.

Krause and Lubik (2010) introduce on-the-job search into DSGE models and investigate the implication for inflation dynamics. On-the-job search introduces the possibility for workers to find a job that offer of better wage than the job they currently hold. Generally, economists integrate on-the-job-search in a very simple manner. They consider two sectors in the economy: a "good" sector that offers high wages and a "bad" one that offers low wages. Workers that are in a *bad* position search for a better job, even if they are already employed. Workers that are in a good position cannot improve their situation and then content themselves with their actual job. Thus, good jobs can be filled thanks to unemployed or already-employed workers while bad jobs can be filled only thanks to unemployed workers. As a consequence, the real marginal cost in the entire economy is the sum of bad sector and good sector marginal costs that depend on return on hours worked in both sectors. The response of real marginal costs to an external shock will then depend on the response of each sector. Krause and Lubik (2010) show that this response is lower than in standard New Keynesian models and will trigger a lower inflation reactivity.

Finally, Christoffel et al. (2009a) compare all these different assumptions. They build a common framework (basically based on Trigari's (2006) model with an efficient Nash bargaining and no wage rigidity) and introduce one by one the different hypothesis presented earlier. The authors show that models that incorporate the wage channel and real wage rigidities are the most likely to replicate inflation persistence degree in New Keynesian framework. However, if these models have the virtue to lead the way, they stop in the middle of the road. These models impose on exogenous rigidity on real wage without clarifying their origins. A deeper investigation of labor market institutions could allow macroeconomists to clearly identify these rigidities. Labor market institutions can be defined as employment protection legislation (EPL thereafter), unemployment benefits, minimum wage and collective bargaining. If the impact of wage bargaining on inflation dynamics has already been studied, the relationship between inflation and the rest of the institutions remains unclear. In particular, the impact of firing costs on wage dynamics, and so on inflation persistence, has been neglected. Thomas (2006) shows that there is a negative relationship between firing costs and busi-

ness cycle fluctuations. While Thomas (2006) explains it through the impact of firing costs on job destruction, Macit (2010) shows that firing costs affect wage dynamic and have direct consequences on inflation persistence. The introduction of firing costs in a DSGE model with a search and matching labor market could endogenously increase wage rigidities and then inflation persistence. However, Macit (2010) neglects two main elements: first, he forgets to include the wage channel, which has as consequence to limit the impact of firing costs on inflation dynamics; second, he models firing costs as a lump-sum tax for firms; neglecting this way the study of severance pays.²⁷

1.5 Added value to the literature

The earlier literature aims to highlight current theoretical and empirical issues that are asked to macroeconomists. The objective of this thesis is to contribute to answer these questions. In the first part of this dissertation, I investigate the effects of EPL on wage and inflation dynamics (first and second chapters). The second part of the thesis aims to explain differences in fiscal multipliers over the business cycle thanks to the labor market (third chapter). Finally, the last part of the thesis is devoted to the spillover effects of the German labor market reforms over the other European countries from an empirical perspective.

Chapter 2 investigates the impact of firing costs on real wage and on inflation persistence. I develop a New-Keynesian DSGE model following Trigari (2006). Following Macit (2010), I introduce lump-sum firing costs into a search and matching labor market. Real wage is negotiated according to the right-to-manage bargaining in order to incorporate the wage channel into Macit's model and to directly link wage dynamic to the New Keynesian Phillips Curve. In order to compare my results to previous studies, I submit the economy only to monetary shocks. As a first result, I show that firing costs affect real wage in two different manners. First, firing costs force analysts to distinguish longstanding workers to new workers. Indeed, since a trial period exists in most OECD coun-

²⁷ Severance pays is an element of EPL. Apart from severance pay, EPL includes the different legislations relative to advance notification and valid reasons for workers' layoff, temporary work agencies functioning and fixed-term contracts.

tries, workers who recently found a job cannot enjoy EPL. Thus, the impact of firing costs on their wage will be not the same as on longstanding workers one. I show that firing costs negatively affect new workers. However, the way firing costs impact longstanding workers is quite ambiguous. In this model, the length attached to firing costs in real wage is composed by two elements. The first element depends negatively on the variation of profit after an increase in real wage while the second element depends positively on workers' utility after an increase in real wage. Here, two visions of firing costs are present. On the one hand, the first interpretation considers that workers need to be better protected when firms' profit falls since the risk to be laid-off is greater. In return, during economic upturn, workers can be less protected since this risk is weaker. On the other hand, it can be considered that workers have to be more protected when they have more to lose, that is to say when the utility earned from their wage is greater. At the end, this new dynamic reduces the real wage reactivity to monetary shocks. Second, the consequences of lump-sum firing costs on inflation persistence are weak. This result can be explained by the fact that the dynamic at the root of new rigidities is only a sub-set of wage dynamics.

Chapter 3 investigates further the role of firing costs on wage dynamics. The DSGE model used in this chapter is a continuation of the model used in Chapter 2. However, a new element is introduced: severance pay. This element of the EPL has been ruled out because of the Lazear (1990) critique. This critique states that the effects of severance pay are settled during wage bargaining. Indeed, in an efficient wage bargaining framework, workers prefer to cancel the effect of severance pays, that is, to accept a reduction of their wage equal to the level of mandatory severance pay, in order to protect their job. If this result is controversial, it led macroeconomic theory to reject severance pay analysis. However, this study is interesting in many points: as reported by Garibaldi and Violante (2002, 2005), severance pays are quantitatively significant and qualitatively different from lump-sum firing costs. Indeed, severance pays have a particular characteristic compared to lump-sum firing costs to be a one-time new income for dismissed workers just as a transfer from firms to workers. Moreover, the level of severance pay can be bargained between firms and workers, as it has

been reported by Fella (2007).²⁸

In this chapter, I introduce severance pays in a DSGE model step-by-step, in order to clearly identify what characteristic affects inflation persistence the most. As reference, I use Trigari's (2006) model with efficient wage bargaining. First, I introduce lump-sum severance pays in order to study the effect of income transfer on firms' marginal costs. Second, I follow Garibaldi and Violante (2005) and allow firms and workers to negotiate severance pay level in order to maximize their separation. Finally, I reintroduce the wage channel by re-introducing right-to-manage bargaining. I show that the transfer from firms to workers in case of lay-off does not impact greatly inflation persistence. However, the negotiations to set the severance pay level re-introduce Lazear (1990) result: workers accept to pay a part of their severance pays in order to share the EPL burden with firms. This behavior is interpreted as a contribution system that is freely implemented between firms and workers. If a mechanism *à la* Lazear is present in my model, our conclusion splits since I show that, in a right-to-manage bargaining framework, severance pays introduce endogenous real wage rigidity and allow the New Keynesian model to replicate inflation persistence. Indeed, if severance pay introduces the contribution system, this latter needs to be highlighted by the wage channel present thanks to the right-to-manage bargaining. When both elements are merged, the model yields an inflation persistence larger than Trigari's (2006) model and in concordance with empirical evidence.

Chapter 4 focuses on fiscal policy efficiency over the business cycle. Few articles aim to explain why fiscal policy multipliers are greater during economic downturn than during economic upturn, among them, Sims and Wolff (2013) and Michaillat (2014). This chapter falls within this literature. In order to explain to highlight a new channel, I use a large-scale DSGE model with a search and matching labor market with two sectors: a public and a private sector. Austerity policies are simulated thanks to cuts in public sector wage and in public vacancies in order to study austerity plans implemented in European Union during the

²⁸ The author reports that in 1990, 51 per cent of union negotiated non-statutory severance pay for non-manual workers and 42 per cent for manual workers.

public debt crisis. A specific attention is paid to output and public debt reaction to fiscal shocks. In order to fully take into account non-linearity phenomenon resulting from the difference states of the economy, I solve the model using Taylor second-order approximations. Finally, for the sake of realism, I introduce both Ricardian and *hand-to-mouth* households. Economic downturn is modeled thanks to a higher unemployment at the steady-state. It yields that the job seekers pool is greater during economic downturn, just as in Michailat (2014). In turn, this pool is smaller during economic upturn.

In this framework, cuts in public sector wages and in public vacancies yield a larger response in employment during economic downturn. Unlike Michailat (2014), I investigate the impact of the labor market larger response on output and public debt. The labor market response spills over into goods and services market through the response of real wage. Indeed, the larger response in employment translates into a stronger increase of real wage (through a larger response of total marginal productivity of labor). It creates larger inflationary pressures that trigger in return a larger increase in the nominal interest rate. Finally, the nominal interest response creates a larger crowding out effect on Ricardian households' consumptions. As a result, fiscal multiplier is larger during economic downturns as well as the short run negative effects of the austerity policy: output falls deeper while public debt increases more in the short run during economic downturn. These results are not in contradiction with the results expounded by the previous studies. Indeed, they are based on Michailat's (2014) results and are complementary to Sims and Wolf's (2013) channel.

Finally, **Chapter 5** investigates the spillovers effects of the German fiscal and labor market reforms, named Hartz reforms, on the rest of the Euro area. In this chapter, I investigate in particular the effects of Hartz IV and the Social Value-Added Tax (both a cut in social security contributions and a rise in VAT) on both Germany and the rest of the Euro area. In order to do so, I include 8 Euro area economies (Austria, Belgium, Finland, France, Germany, Italy, Netherlands and Spain) that represent about 90% of Euro Area GDP, from 1992Q1 to 2011Q4, into a GVAR model. The GVAR approach allows for the evaluation of international in-

terdependence. It allows to consider Germany and the rest of the Euro area as two groups perfectly separated, ignoring identifications problems. Moreover, it allows for long and short run relationships that are consistent with macroeconomic theory. As individual variables, I focus on output, inflation, current account, real exchange rate, VAT, social contributions, unemployment benefits and nominal interest rate. On the one hand, I show that domestic variables, even inflation, are highly impacted by their European counterpart in the short run.²⁹ On the other hand, the dynamic analyses of the model display three main results. First, unemployment benefits cut negatively impacts German output. This result is new in the sense that theoretical models that focus on that policy studied the Hartz reforms as a whole and conclude to a global positive impact. Here, I show that if Hartz IV encouraged workers to search more actively a job, it would reduce real income and then both German consumption and activity. The Social VAT had more ambiguous impact on German output since the cut in social contribution stimulate German activity while the increase in VAT reduce it. The main consequence of the Social VAT has been to greatly improve German current account. Second, in our model, Germany appears as a driven force in the Euro Area since every policy that increase German output tends to increase consequently the rest of the Euro Area one. Thus, cut in social contribution positively spilled over the rest of the Euro Area, while the increase in VAT and the cut in unemployment benefits negatively affected its output. Finally, the model shows that, in contrast with the theoretical literature, the fiscal devaluation that represent these labor market and fiscal reforms can be at least partly responsible for the great increase in German current account. This increase in German current account has realized at the cost of the degradation of Germany's trading partners even if the different policy did not homogenously affect them.

²⁹ Authors disagree on the contemporaneous influence of foreign prices on domestic ones. For instance, in a GVAR literature, Dees et al. (2007) show that in the Euro Area, individual prices are weakly affected by their European counter-part while Ricci-Risquete and Ramajo-Hernández (2015) show the opposite.

Chapter 2 | Inflation persistence and labor market institutions

2.1 Introduction

The interest for inflation persistence recently knows a surge of interest both for policy implementations, since central bankers need to clearly identify inflation determiners to maintain price stability, and for theoretical perspectives since New Keynesian models fail in accounting joint response of output and inflation. Since Lucas critique and rational expectations, macroeconomic models are not able to explain inflation inertia. Calvo's (1983) and Rotemberg's (1982) staggered nominal contracts have introduced price rigidity to reconcile both rational expectations and inflation persistence. However, if these models succeed in increasing nominal rigidities, inflation reaction to external shocks remains low and disinflation costs too weak. To avoid this issue, inflation dynamic is dissected to fully understand its determiners. In order to do so, an old tradition that links monetary dynamics to labor market frictions is highlighted. Expounded by Phillips (1958), the well-known Phillips curve brings together nominal wage and unemployment dynamics. In DSGE models, the New Keynesian Phillips Curve (NKPC thereafter), where firms evolve in a Calvo's and a monopolistic competition world, the relationship between labor market and inflation is rediscovered: inflation depends directly on inflation expectations and firms' marginal costs, the latter being affected by labor market structure. Thanks to search and matching labor market *à la* Mortensen and Pissarides (1994), this structure and its impact on marginal costs can deeply be analysed.

The aim of this chapter is to investigate the impact of firing costs on wage dynamic and on both firms' marginal costs and inflation persistence. As highlighted by Trigari (2006), in a New Keynesian framework, marginal costs are affected by labor market institutions and in particular by wage bargaining. Indeed, in an efficient Nash's (1950) bargaining framework, real wage and hours worked are conjointly negotiated between firms and workers. The first order condition for hours worked yields a direct link between marginal costs and workers marginal rate of substitution between leisure and labor supply. Thus, wage dynamic has no impact on inflation fluctuation. However, in a right-to-manage framework, real wage is still negotiated between firms and workers but firms unilaterally set hours worked. In this framework, Trigari (2006) shows that marginal costs and wage are linked. This relation is known as the *wage channel*. A crucial result is expounded here: in this framework, wage rigidity can translate into inflation through marginal costs and the NKPC. Consequently, any wage rigidity will explain a part of inflation persistence. This result will be confirmed by Christoffel and Linzert (2010), among others. In this survey, the authors compare different assumptions made to increase New Keynesian models ability to replicate inflation persistence empirical evidence. They show that the wage channel and wage rigidities are the most able to explain inflation persistence. The great influence of wage rigidity on inflation out output dynamics is empirically proved by Christiano et al. (2005), Edge et al. (2003) and Gali et al. (2001) for both European and US economies.

To explain wage rigidity, Hall (2005) propose to introduce backward looking social norm into New Keynesian model while Christoffel and Kuester (2008) and Christoffel and Linzert (2010) introduce Calvo's staggered contracts. This assumption implies that in each period, only a fraction of firms and workers can renegotiate relationship wage contract. Moreover, new hires are also subject to such contracts since only a fraction of new hires can freely negotiate their contract. The other share has to accept previous period wage. If it certain that such a configuration increases inflation inertia in New Keynesian models, it has to face an important criticism: these models impose exogenous rigidity on real wage. If inflation persistence is indeed high and if this result is in line with M. Friedman's

(1953) *as if*, it does not allow a better understanding of inflation dynamic determiners.¹ In particular, if labor market actually affects deeply inflation persistence, given the multiplicity of the European labor market structure, it is essential for the European Central Bank to clearly understand what element of the labor market institutions drives inflation fluctuations.

Another approach is motivated by empirical evidence: as expounded by Thomas (2006) and Veracierto (2008), firing costs affect business cycle fluctuations and in particular output and inflation ones. They show that it is the effect of firing costs on job destruction volatility that affect the different volatilities. Moreover, Macit (2010) demonstrates that firing costs also affect wage dynamic. In particular, firing costs do not impact new hires and existing hires in the same manner. The authors show that firing costs positively impact existing hires and negatively affect new hires. This result is in line with the estimation reported by OECD (2008). In this report, OECD documents the fact that firing costs make it more difficult for outsiders to find a job and decrease their wages while they reduce the probability for long-standing workers to be dismissed and put upward pressure on their wage. Moreover, Macit (2010) includes firing costs into a New Keynesian model in the way of Trigari (2006) and concludes that firing costs positively influence inflation persistence in case of monetary shock. However, since he does not include right-to-manage bargaining in his reasoning, the global effect of firing costs on inflation dynamic is quite weak.

In this chapter, I propose to extend Macit (2010) analysis and to explore the effect of firing costs on inflation dynamic in a right-to-manage bargaining framework. In order to do so, I build a medium scale New Keynesian model with search and matching labor market in the way of Mortensen and Pissarides (1994). I calibrate the model to reflect European Union economy and I submit it to a monetary shock in order to compare the model results to the rest of the literature. My results are the following: first, as in Macit (2010), I show that firing costs differently affect new and existing hires. New hires are negatively affected while

¹ Inflation persistence is generated "by introducing backward-looking price indexation, [...] nearly by assumption", Olivier Blanchard (2016) says. The author argues that these assumptions are "repairs rather than convincing characterizations of [...] the behavior of price and wage setters."

existing hires see their wage increased by the introduction of firing costs. Second, the introduction of right-to-manage bargaining allows to highlight a new consequence of the firing costs introduction on wage dynamic. Indeed, if firing costs are mandatory, the importance attached to firing costs in wage dynamics is balanced by firms and workers. In particular, this importance depends on two main elements: the marginal net gain in utility and profits after an increase in wage for workers and firms, respectively. For firms, the importance attached to firing costs is negatively correlated to this gain. It implies that in firms' perspective, firing costs effects have to be stronger when the probability of dismissal is greater and have to be reduced when workers are protected by the global macroeconomic situation. In turn, workers consider that they have to be better protected and so that firing costs have to be more present when their gains to be employed are greater. In compensation, when they benefit less from a job, the impact of firing costs has to be reduced. In this context, real rigidities are introduced into wage dynamic. If their effects are weak, these rigidities offer an interesting path to follow.

2.2 The model

This section aims to present the New Keynesian framework. As already mentioned, this medium scale DSGE model closely follows Trigari (2006) and Macit (2010).

The economy is composed by a representative household, a Central Bank and three different kind of firms. The representative household is itself composed by an infinite of members indexed on the unit interval. Different kind of firms are assumed for the sake of simplicity: it disentangles price setting to hiring decisions. In that, labor market and price dynamics are easier to analyze. These three firms are the following: first, intermediate goods sector (named simply firms thereafter) buy labor services from workers. Following Christoffel et al. (2009a) among other, I assume that firms evolve in a competitive market and produce only thanks to labor services. These firms sell their products to retailers. These second kind of firms produce in a monopolistic competition market: they buy intermediate goods and turn them into differentiate goods using a one-to-one

technology. Since retailers have a market power inherited from imperfect retail goods substitutability, they set price to maximize their profit. Finally, retailers' goods are sold to the final goods firms that aggregate each differentiate goods into a homogeneous consumption good. This good is finally sold to the representative household. This last distinction allows for introducing Dixit-Stiglitz monopolistic competition.

2.2.1 The representation households' decisions

In this model, there is only a representative household composed by a continuum of homogenous workers indexed on the $[0; 1]$ interval. Each member of the representative household can be either employed or unemployed. However, following Merz (1995) and Andolfatto (1996), the different members are supposed to insure each other in case of unemployment and lower income spells, for instance. The representative household's instantaneous utility is defined as

$$u(c_t) - g(h_t) \tag{2.2.1}$$

where c_t is the final good consumption and h_t the level of hours. In particular, the utility of the final good consumption is defined by

$$u(c_t) = \frac{(c_t - ec_{t-1})^{1-\sigma_c} - 1}{1 - \sigma_c},$$

where e measures the degree of habit in consumption and σ_c the intertemporal elasticity of substitution for consumption. Disutility of the labor supply is given by

$$g(h_t) = \kappa_h \frac{h_t^{1+\phi}}{1+\phi}. \tag{2.2.2}$$

Finally, household's lifetime utility is given by

$$\Omega_t \equiv E_t \sum_{s=0}^{\infty} \beta^s [u(c_{t+s}) - G_{t+s}], \quad (2.2.3)$$

where β represents the intertemporal discount factor and G_{t+s} household's global disutility of labor supply. Since, hours worked level will be negotiated with firms, the representative household takes it as given during the maximization of its lifetime utility.

The household maximization program can be summed up as follows

$$\max_{c_t, B_t} \Omega_t \equiv E_t \sum_{s=0}^{\infty} \beta^s [u(c_{t+s}) - G_{t+s}], \quad (2.2.4)$$

subject to

$$c_t + \frac{B_t}{p_t r_t^n} = d_t + \frac{B_{t-1}}{p_t} \quad (2.2.5)$$

where B_t is the nominal bond hold by the representative household to smooth its consumption over time, p_t the consumers price index, r_t^n the nominal interest rate and d_t the household's income, composed by both dividend link to bonds holding and labor supply remuneration.

The household's program can be reduced to the following Bellman's equation

$$\Omega_t(B_t) = \max_{c_t, B_t} \left\{ \frac{(c_t - \epsilon c_{t-1})^{1-\sigma_c} - 1}{1 - \sigma_c} - G_t \right\} + \beta \Omega_{t+1}(B_{t+1}), \quad (2.2.6)$$

subject to the previous constraint.

First order conditions with respect to c_t and B_t yields the standard consumption Euler equation

$$\begin{aligned} \frac{\partial \Omega_t}{\partial c_t} &= 0 \\ \Leftrightarrow \lambda_t &= [c_t - ec_{t-1}]^{-\sigma_c} - \beta e E_t [c_{t+1} - ec_t]^{-\sigma_c} \end{aligned} \quad (2.2.7)$$

$$\begin{aligned} \frac{\partial \Omega_t}{\partial B_t} &= 0 \\ \Leftrightarrow \lambda_t &= r_t \beta E_t [\lambda_{t+1}], \end{aligned} \quad (2.2.8)$$

where λ_t is the marginal utility of consumption and π_t the level of inflation. Real interest rate is equal to

$$r_t = \frac{r_t^n}{E_t \beta [\pi_{t+1}]} \quad (2.2.9)$$

2.2.2 Final good

Final good firms buy differentiated goods from retailers, aggregate them into a final good and sell them to household.

The technology used during final good production is given by the Dixit-Stiglitz aggregator function such as

$$y_t = \left[\int_0^1 y_{it}^{\varepsilon-1/\varepsilon} di \right]^{\varepsilon/(\varepsilon-1)} \quad (2.2.10)$$

where y_t represents the final goods and y_{it} the individual retailers' good. The elasticity of substitution between each retail goods is noted $\varepsilon > 1$.

Because the final goods sector is in perfect competition, final good firms are price takers. Their profit is defined as follows

$$\Pi_t = p_t y_t - \int_0^1 p_{it} y_{it} di, \quad (2.2.11)$$

Final good firms will maximize their profit regarding retail goods quantity addressed to each single retailer. First order condition yields the demand for each differentiated retail goods. This demand is defined as

$$y_{it} = \left(\frac{p_{it}}{p_t} \right)^{-\varepsilon} y_t \quad \forall i. \quad (2.2.12)$$

Equation (2.2.12) shows that demand for each specific differentiated goods is negatively correlated to individual price and positively correlated to aggregate demand y_t .

Since perfect competition implies zero economic profits, it is possible to define general price index such as

$$p_t = \left[\int_0^1 p_{i,t}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}} \quad (2.2.13)$$

2.2.3 Retail firms and price setting

The retail good sector is composed by a continuum of firms i indexed on interval $[0, 1]$. Retailers buy labor good to firms and turn them into differentiated goods. Each firm produces a specific good y_i that is imperfectly substitutable each other. Because of this imperfect substitutability, retailers get a market power that allow them to set their own price.

As in Calvo (1983), only $(1 - \varphi)$ of retailers are able to adjust their price at each period. The remaining φ of retailers that cannot adjust their prices keep the optimal level of the next period. When retailers can adjust their prices, they will

do it in order to maximize their profit. Retailers' profit can be written as

$$p_{it}y_{it} - x_t y_{it},$$

and their maximization program can be sums up as

$$\max_{p_{it}} E_t \sum_{s=0}^{\infty} (\varphi \beta_{t,t+s})^s \left(\frac{p_{it}}{p_{t+s}} y_{it+s} - \frac{x_{t+s}}{p_{t+s}} y_{it+s} \right), \quad (2.2.14)$$

subject to equation (2.2.12).

Since a theoretical separation is assumed between hiring firms and price setters, x_t represents both intermediate goods price and retailers' marginal production cost. $\beta_{t,t+s} = \beta^s = \frac{\lambda_{t+s}}{\lambda_t}$ is the stochastic discount factor.

First order condition yield

$$p_{it}^* = \frac{\varepsilon}{(\varepsilon - 1)} \frac{E_t \sum_{s=0}^{\infty} \varphi \beta_{t,t+s}^s (x_{t+s} p_{t+s}^{\varepsilon-1} y_{t+s})}{E_t \sum_{s=0}^{\infty} \varphi \beta_{t,t+s}^s (p_{t+s}^{\varepsilon-1} y_{t+s})}, \quad (2.2.15)$$

where p_{it}^* stands for the optimal individual price.

Optimal individual price p_{it}^* is a function of both the expected marginal cost during the period where retailer i cannot adjust its price and the expected aggregate demand. Moreover, this price is balanced by a mark-up. This mark-up depends positively on retailers' market power and so on retail goods substitutability. The weaker retail goods substitutability, the higher optimal individual price.

Finally, since the law of motion of prices is given by

$$p_t = [(1 - \varphi) p_t^{*1-\varepsilon} + \varphi p_{t-1}^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}, \quad (2.2.16)$$

after log-linearize both equations (2.2.15) and (2.2.16) and after some algebra, one can obtain the standard NKPC

$$\hat{\pi}_t = \frac{(1 - \varphi)(1 - \beta\varphi)}{\varphi} \hat{x}_t + \beta E_t [\hat{\pi}_{t+1}], \quad (2.2.17)$$

where a variable with a hat represents this variable dynamic.

2.2.4 *The intermediate goods sector's firms*

There is a continuum of firms in the intermediate goods sector. To produce, firms are supposed to enter the labor market in order to buy labor services. Once firms and workers match together, the new relationship is supposed to be productive only at the end of the period. This assumption has as consequence to make employment a predetermined variable while hours worked is free to adjust.

Moreover, since firms can produce only thanks to labor service, their production function is defined as

$$f(h_t) = zh_t^\alpha, \quad (2.2.18)$$

where z is a technological factor common to all firms and $\alpha \in]0; 1[$.

2.2.5 *The labor market*

There are only two kind of actor on labor market: firms and workers. Workers can be either employed or unemployed. When a firm and a worker match together, they negotiate the real wage associated to the relationship. When workers are unemployed, they receive unemployed benefits that are assumed to be constant. Workers are assumed to passively search for a job in the sense that no cost has be paid in terms of utility.

The number of new matches on labor market is noted m_t and is defined according to the standard matching function

$$m_t = \sigma_m \tilde{u}_t^\sigma v_t^{1-\sigma}, \quad (2.2.19)$$

where v_t is the number of vacancies, \tilde{u}_t is the number of workers who search for a job and σ_m is matching technology which measure labor market's efficiency.

Since labor force is normalize to one, unemployment level is defined as

$$u_t = 1 - n_t, \quad (2.2.20)$$

with n_t the level of employment. It can be noted that the number of workers who search for a job and unemployment are different. Indeed, when a worker is laid-off, he or she automatically starts to search for a job while it takes time to be considered as unemployed. Thus, if $\rho \in (0;1)$ is the probability for a worker to be fired, the number of workers who search for a job is given by

$$\tilde{u}_t = 1 - (1 - \rho)n_t, \quad (2.2.21)$$

such as $\tilde{u}_t > u_t$.

The matching function allows for the definition of the probability q_t for a firm to provide its vacancy

$$q_t = \frac{m_t}{v_t} \quad (2.2.22)$$

Similarly, the probability for a worker to find a job can be defined

$$s_t = \frac{m_t}{\tilde{u}_t} \quad (2.2.23)$$

The labor market tightness is defined as

$$\theta_t = \frac{s_t}{q_t} = \frac{m_t}{\tilde{u}_t} \times \frac{v_t}{m_t} = \frac{v_t}{\tilde{u}_t}. \quad (2.2.24)$$

Finally, employment dynamic is given by

$$n_t = (1 - \rho)(n_{t-1} + m_{t-1}) \quad (2.2.25)$$

At each period, a relationship continues with a probability $(1 - \rho)$. Moreover, following Trigari (2006), there exist a trial period that implies that a relationship can be instantaneously destroyed with a probability ρ . Thus, only a share $(1 - \rho)$ of every new matches m_t becomes productive at the end of a period.

Bellman's equations

In this economy, workers are protected in two different manners. First, in order to support private consumption, workers receive unemployment benefits b in case of unemployment spell. These unemployment benefits are assumed to be constant. Second, firing costs are introduced to dissuade firms to dismiss workers. To do so, when a firm decides to break its relationship with a worker, firing costs, noted F , have to be paid. Firing costs do not yield a transfer between firms and worker in terms of income. Indeed, in this economy, firing costs are not modeled as severance pays and represent only administrative costs. Finally, in line with Macit (2010), firing costs have to be paid only if workers started to be productive. In case of new hires, a firm can decide to break the new match without fearing to pay firing costs. It yields that the value of a new hire and an existing job are different for firms.

Given all these considerations, the value of job and of a vacancy for a firm as well as the value of a job and of unemployment for a worker can be defined.

Firms: The value J_t^n of a new hire and the value J_t of an existing job for a firm are given by

$$J_t = x_t f(h_t) - w_t h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} + \rho (V_{t+1} - F)], \quad (2.2.26)$$

$$J_t^n = x_t f(h_t) - w_t^n h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} + \rho (V_{t+1} - F)], \quad (2.2.27)$$

with w_t^n and w_t the real wage for a new job and an existing one, respectively. x_t represents the intermediate goods price. V_t is vacant job value for firms. Generally, equations (2.2.26) and (2.2.27) show that the value of a job for a firm is equal the instantaneous value of this job, which is the difference between the job production in value $x_t f(h_t)$ and the labor costs, plus the expected value of the job. This value depends on the state the job: if the relationship is destroyed, with the probability ρ , firms will receive the expected value of a vacant job at the next period minus firing costs that have to be paid in this case; in turn, if the job is not destroyed with a probability $(1 - \rho)$, firms will receive the expected value of the job at the next period. One can note that in both case, firms have to paid firing costs. This is due to the fact that even in the new hire case, dismissal occurs after that a period is spend. Thus, workers fall under the EPL protection even in this case.

The value of a vacancy is defined by

$$\begin{aligned} V_t &= -\frac{\kappa}{\lambda_t} + E_t \beta_{t,t+1} [q_t (1 - \rho) J_{t+1}^n + q_t \rho V_{t+1} + (1 - q_t) V_{t+1}] \\ &\Leftrightarrow V_t = -\frac{\kappa}{\lambda_t} [q_t (1 - \rho) J_{t+1}^n + (1 + \rho) V_{t+1}] \end{aligned} \quad (2.2.28)$$

where κ is the vacancy posting cost. If a firm provide its job and if this new match is not destroyed after the trial period with a probability $q_t (1 - \rho)$, this firm get the expected value of a filled job at the next period. However, if a firm does not match with a worker or if the relationship ends up during the trial period, the firm get the expected value of a vacancy at the end of the period.

Since firms are supposed to freely enter the labor market, at the equilibrium, vacancies value is equal to zero. In this case and after some algebra, (2.2.28) provides the following job creation condition

$$\frac{\kappa}{\lambda_t q_t} = E_t \beta \left[x_{t+1} f(h_{t+1}) - w_{t+1}^n h_{t+1} + \frac{\kappa}{\lambda_{t+1} q_{t+1}} - \rho F \right] \quad (2.2.29)$$

If the value of vacancies is positive, firms are encouraged to enter the labor market. In this case, because of congestion effects, the balanced posting cost of a vacancy increases. Thus, the cost for firms to enter the market increases and the equilibrium is reached again. In turn, if the value of a vacancy is negative, firms will leave the market and increase the probability of remaining firms to find a worker. In this situation, the balanced posting cost decreases and the equilibrium is also reached again.

Workers: W_t and U_t represent the value of a job and unemployment for a worker, respectively. W_t^n is the transition value of a new job for a worker. The value of an existing job is defined as follows

$$\begin{aligned} W_t &= w_t h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho)W_{t+1} + \rho U_{t+1}] \\ \Leftrightarrow W_t &= w_t h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1}] \end{aligned} \quad (2.2.30)$$

The value of a new job for a worker is defined as

$$W_t^n = w_t^n h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1}] \quad (2.2.31)$$

The net instantaneous value of an existing job for a worker is equal to $w_t h_t - g(h_t)/\lambda_t$ the hourly real wage minus the loss in terms of utility linked to the labor supply. Besides, employment gives to workers an expected earning which depends on if the relationship between firms and worker continues - with a probability $(1 - \rho)$ - or not - with a probability ρ . If it continues, workers earn the

expected value of jobs at the next period. If the relationship ends up, workers become unemployed and receive the expected value of unemployment. As already mentioned, workers do not receive of share of firing costs since these latter are models as administrative costs. Another way to consider these firing costs is to interpret Blanchard and Tirole's (2008) results. Indeed, the authors show that optimality requires firing costs and unemployment benefits to be equal in order to allow firms to internalize the social cost of a lay-off. In this case, workers get benefits from firing costs via the unemployment benefits. The absence of transfer between firms and workers in case of dismissal has another consequence: the value of a job for a worker is not affected by the introduction of firing costs in the economy in the sense that no distinction between a new hire and an existing job has to be done in the workers' perspective.

Moreover, unemployment has also a value for workers. This value can be defined as follows

$$\begin{aligned} U_t &= b + E_t \beta_{t,t+1} [s_t(1 - \rho)W_{t+1} + s_t \rho U_{t+1} + (1 - s_t)U_{t+1}] \\ &\Leftrightarrow U_t = b + E_t \beta_{t,t+1} [s_t(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1}] \end{aligned} \quad (2.2.32)$$

When a worker is unemployed, he or she receives unemployment benefits b which are supposed to be fixed. Once again, unemployment offers an expected earning linked to worker's situation at the next period. If workers find a job with a probability s_t and if this job does not end up during the trial period with a probability $(1 - \rho)$, they will earn the expected value of a job value at the next period. If the trial period is unsuccessful or if workers do not find a job, they receive the expected value of unemployment at the next period.

2.2.6 The Right-to Manage-bargaining with firing costs and the wage canal

Once a firm and a worker match, real wage and hours worked have to be set. In order to do so, firms and workers consider their own surplus of the match. Indeed, because of the search frictions in the labor market, every single match yields a net surplus that a be to be share between firms and workers that can be

defined as follows

$$\tilde{S}_t^n = J_t^n - V_t + W_t - U_t \quad (2.2.33)$$

and

$$\tilde{S}_t = J_t - (V_t - F) + W_t - U_t, \quad (2.2.34)$$

where \tilde{S}_t^n is the surplus of a new hire and \tilde{S}_t the surplus of an existing job. Match surplus can be defined as the difference between what would be obtained if the relationship between firms and workers exists and would be obtained if it is broken.

While in efficient bargaining framework, wage and hours worked are jointly negotiated, in the right-to-manage bargaining firms set hours worked in order to maximize their own surplus. In both cases, real wage is set in order to maximize joint surplus, named the Nash product. Thus, the Nash product represents the bargaining process. For a new hire, this Nash product is defined as

$$S_t^n = (W_t - U_t)^\eta (J_t^n - V_t)^{1-\eta}, \quad (2.2.35)$$

while the Nash's product for an existing job is given by

$$S_t = (W_t - U_t)^\eta (J_t - (V_t - F))^{1-\eta} \quad (2.2.36)$$

The capacity of workers and firms to impose their view during wage negotiation depends on their bargaining power, noted η and $(1 - \eta)$, respectively. Moreover, one can note that firing costs only affect the existing job Nash product. Indeed, if firms and workers do not agree during real wage negotiation and decide to break an existing relationship, firms will have to pay firing costs. Thus, the

latter directly affect firms exist option. In turn, if during a new hire real wage negotiation firms and workers disagree, the relationship can be broken without firms have to pay firing costs.

Hours worked setting and the wage channel

As already mentioned, once the real wage negotiated, firms set the level of hours worked in order to maximize their own surplus. When the free entry condition is reached, $V_t = 0$ which triggers that firms' surplus is equal to J_t^n for new hire and to $J_t + F$ for an existing job.

Maximization of the two surplus according to hours worked yields

$$\begin{aligned} \frac{\partial J_t^n}{\partial h_t} &= 0 \\ \Leftrightarrow x_t f_h(h_t) &= w_t \end{aligned} \quad (2.2.37)$$

and

$$\begin{aligned} \frac{\partial (J_t - F)}{\partial h_t} &= 0 \\ \Leftrightarrow x_t f_h(h_t) &= w_t^n. \end{aligned} \quad (2.2.38)$$

If firing costs do not directly affect hours worked allocation, one can note that, since firing costs affect the real wage, they indirectly do it. For the sake of simplicity, firms are supposed to not discriminate between new and existing hire through the worked hours allocation.

Then, rearranging equation (2.2.38) as follows

$$x_t = \frac{w_t}{mpl}, \quad (2.2.39)$$

yields the *wage channel*. As already mentioned, since firms sell labor products to retailers, x_t is both firms prices and retailers marginal costs. Thus, wage

dynamic will directly affect retailers marginal costs and then inflation dynamic through the NKPC.

The wages bargaining

Existing job wage: Nash product maximization according to existing job wage yields

$$\begin{aligned} \frac{\partial S_t}{\partial w_t} &= 0 \\ \Leftrightarrow \eta \delta_t^W [J_t + F] &= (1 - \eta) \delta_t^F [W_t - U_t], \end{aligned} \quad (2.2.40)$$

with²

$$\begin{aligned} \delta_t^W &= h_t + w_t h_w(w_t) - \frac{g_h h_w(w_t)}{\lambda_t} \\ \Leftrightarrow \delta_t^W &= \frac{h_t}{(1 - \alpha)} \left(\frac{mrs_t}{w_t} - \alpha \right) \end{aligned} \quad (2.2.41)$$

and³

$$\delta_t^F = -[x_t mpl_t h_w(w_t) - h_t - w_t h_w(h_t)] \delta_t^F = h_t.$$

As in Trigari (2006), δ_t^W and δ_t^F measure the net marginal benefit after an increasing of wage for workers and firms, respectively.

Replacing J_t, W_t and U_t by their value and after some algebra,⁴ it yields

$$\begin{aligned} w_t &= \chi_t \left[\frac{x_t mpl_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1 - \chi_t) \left[\frac{mrs_t}{1 + \phi} + \frac{b}{h_t} \right] \\ &+ \chi_t (1 - s_t) \frac{\kappa}{\lambda_t q_t h_t} \left[1 - \frac{1 - \chi_t}{\chi_t} E_t \beta_{t,t+1} [\xi_{t+1}] \right] + \frac{\mathcal{F}_t}{h_t} \end{aligned} \quad (2.2.42)$$

² Given that *mrs* means *marginal rate of substitution* and $mrs_t = g_h(h_t) / \lambda_t$.

³ Given that *mpl* means *marginal productivity of labor*.

⁴ Complet derivation of existing job and new hire wages are presented in Annexe 2.6.1.

with

$$\chi_t = \frac{\eta \delta_t^W}{\eta \delta_t^W + (1 - \eta) \delta_t^F}, \quad (2.2.43)$$

$$\mathcal{F}_t = FE_t[\chi_t(1 - \beta\rho) - (1 - \chi_t)\tilde{\zeta}_{t+1}(1 - s_t)(1 - \rho)] \quad (2.2.44)$$

and

$$\tilde{\zeta}_t = \frac{\chi_t}{1 - \chi_t}. \quad (2.2.45)$$

Thus, existing job wage depend on firms' expected gains, labor market structure and workers' constraints. Indeed, the real wage remunerates workers' disutility linked to labor supply and gives a compensation to influence workers' trade-off between employment and unemployment since unemployment benefits are taken into account. Finally, firing costs directly affects the real wage.

To understand in which manner firing costs influence existing job wage, one has to focus on the weight attached to firing costs in equation . After some rearrangement, one can obtain

$$\mathcal{F}_t = FE_t \left[\frac{\eta \delta_t^W}{\eta \delta_t^W + (1 - \eta) \delta_t^F} (1 - \beta\rho) - \frac{(1 - \eta) \delta_t^F}{\eta \delta_t^W + (1 - \eta) \delta_t^F} \tilde{\zeta}_{t+1} (1 - s_t) (1 - \rho) \right] \quad (2.2.46)$$

At first sight, firing costs have an unspecified impact on the wage level. However, it can be noticed that the weight attached to firing costs in real wage depends on two principal factors: gains for firms and workers after an increase in real wage. Thus, this weight depends on global macroeconomic situation. Nevertheless, two contradictory effects are then introduced.

The first effect is influenced by firms' reaction after an increase in real wage.

As the second part of equation (2.2.46) shows, the greatest firms earn from an increase in real wage, the lowest the weight attached to firing costs in the wage dynamic. Given (2.2.42) and given the pro-cyclical nature of δ_t^F , this result can be interpreted as follows: in this model, firms consider that workers must be better protected when global macroeconomic situation increase the probability for workers to be laid-off. In this case, firing costs weight in the real wage equation increases. In turn, when circumstances make it less probable for workers to be laid-off, firms make firing costs less important in real wage dynamic. Thus, firms influence on firing costs weight make real wage more persistent. Workers gains due to an increase in real wage, describe thanks to equation (2.2.41), is also pro-cyclical. However, unlike firms, workers' influence on firing costs weight is positive. It implies that, in workers perspective, firing costs have to be stronger when workers have the most to lose, *id est* when their gains from an increase in wage are the strongest. In turn, when these gains decrease, the impact of firing costs on real is tempered. As a consequence, since it is pro-cyclical, workers influence on firing costs tends to increase wage volatility.

Thus, even if firing costs are supposed to be constant, the weight of these costs in the real wage is depending of the global macroeconomic situation. The global effect of firing costs on real wage dynamic depend on which influence, from firms or workers' ones, will prevail on the other. This will have great consequence on inflation persistence.

New hire wage: When a firm and a worker just meet each other, they set new hire wage maximizing the Nash product defined by (2.2.35). It yields

$$w_t^n = \chi_t^n \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} - \frac{\beta \rho F}{h_t} \right] + (1 - \chi_t^n) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] + \chi_t^n (1 - s_t) \frac{\kappa}{\lambda_t q_t h_t} \left[1 - \frac{(1 - \chi_t^n)}{\chi_t^n} \frac{\chi_{t+1}^n}{(1 - \chi_{t+1}^n)} \right] \quad (2.2.47)$$

Thus, new hire wage is also function of marginal productivity of labor, of labor

market tightness and of unemployment benefits. Moreover, one can notice that firing costs, independently of its weight in real wage, reduce new job's wage. This result can be seen as the New Keynesian interpretation of the insider-outsider theory of unemployment. In fact, firing costs have a positive impact only for existing relationship. However, this protection is paid by new entrants on the labor market.

2.2.7 The monetary policy

In each period, the monetary authority set the nominal interest rate according to a standard Taylor rule, such as

$$\frac{r_t}{r_s} = \left(\frac{r_{t-1}}{r_s} \right)^{\rho_m} \left(\frac{y_t}{y_s} \right)^{\gamma_y} \left(\frac{\pi_t}{\pi_s} \right)^{\gamma_\pi} e^{\varepsilon_t^m} \quad (2.2.48)$$

where ρ_m is the interest rate smoothing and γ_π and γ_y the relative weights given by the monetary authority to the inflation and output stabilization, respectively. r_s is for the value of nominal interest rate at the steady-state.⁵ Finally, ε_t^m represent a *i.i.d.* monetary policy shock.

2.2.8 Aggregation and market clearing

In order to clear the model, total demand addressed by the representative household to final good firms is expressed as

$$y_t = c_t \quad (2.2.49)$$

Balanced condition on goods market yields

$$y_t = n_t(1 - \rho)f(h_t), \quad (2.2.50)$$

⁵ Thereafter, any variable x_s stand for variable x_t at the steady-state

with $n_t(1 - \rho)$ the number of firms which are indeed producing on intermediate goods market and $f(h_t)$ the individual production on this market.

2.3 Calibration

In this section, calibration choices are represented as well as the targeting values at the steady-state. Table 2.1 sums-up the different choices.

In line with Trigari's (2006) choices, discount factor β is set to 0.99 in order to obtain a real interest rate r_t around 1%. Moreover, according to Clarida et al. (2000), the nominal interest rate elasticity according to its own lag ρ_m is set to 0.9. The relative weight of inflation stability γ_π and of output gap stability γ_y in Taylor rule are respectively set to 1.5 and to 0.5.

Regarding the utility function and according to Card's (1991) microeconomic studies, ϕ is set to 10 in order to obtain a labor supply elasticity equal to 0.1. κ_h is set to 1.2, in line with Blanchard and Galí (2010).

In accordance with Hall (2005), the employment destruction rate is equal to 0.08. σ is set to 0.5 according to Petrongolo and Pissarides's (2001) estimation. Furthermore, workers' bargaining power η is, first, fixed to 0.1 in order to do not give a too great importance of the wage rigidity to this parameter. Thereafter, different values will be given to workers' bargaining power in order to test its influence on inflation dynamic due to its role in wage equation. Moreover, unemployment benefits are set in line with Macit (2010): b is equal to 0.4 in order to obtain a ratio unemployment benefits - workers production, $\bar{b} = b/xh^\alpha$, equal to 11%. Following Krause and Lubik (2010), vacancy costs is set to 0.16 in order to include both recruitment and training costs.

The technology level of the intermediate goods sector z is normalized to 1 while technologic parameter α is fixed to 0.9. Calvo's coefficient is set to $\varphi = 0.85$ in order to obtain an average duration between each optimal price adjustment of 4 quarterly.

Tab. 2.1: Parameters and their calibrated values

Preferences		
e	0.7	Consumption habits persistence
ϕ	10	Inverse of the labor supply elasticity
β	0.99	Discount factor
Labor Market		
ρ	0.08	Job destruction rate
κ	0.16	Vacancy posting cost
η	0.1	Workers' bargaining power
σ	0.5	Matching function elasticity
b	0.4	Unemployment benefit
Firms and Production		
z	1	The technology of the intermediate goods sector
φ	0.85	Calvo's coefficient
α	0.0	Technologic parameter
Monetary Authority		
ρ_m	0.9	Interest rate smoothing
γ_π	1.5	Response coefficient to inflation
γ_y	0.5	Response coefficient to the output gap

Regarding the long-run targeted value, the different choices are presented in Table 2.2. First, output, inflation, prices and nominal interest rate are normalized to 1 at the steady-state. Unemployment at the steady-state is equal to 6%. Furthermore, in line with Zanetti (2011), the probability s_s for a worker to find a job at the steady-state is set to 0.6, while the probability q_s for a firm to fill its job is equal to 0.9. Finally, existing job wage at the steady state is set to 2.2.

2.4 Results

In order to study the impact of firing costs on inflation persistence, the economy is submitted to an increase of 25 basis point in nominal interest rate.⁶ Then, three different situations are studied: a first situation where firing costs are equal to the

⁶ Simulation are realized thanks to the Adjemian et al.'s (2011) Dynare program.

Tab. 2.2: Targeted Values

π_s	1	Inflation
p_s	1	Prices
y_s	1	Output
u_s	0.06	Unemployment
w_s	2.2	Existing Job Real Wage
w_s^n	w_s	New Hire Real Wage h_s
1	Hours Worked	
r_s^n	1	Nominal interest rate

existing job wage at the steady-state; a second situation where there are no firing costs in the economy; finally, a third situation where firing costs are equal to $8w_s$. Every single case enables to disentangle the different way firing costs affect inflation persistence. The first case is used as frame of reference. It is a model very close to Trigari (2006) with right-to-manage bargaining. The second case allows to measure the evolution of inflation persistence and to compare it to the reference frame while the third case highlights the different dynamics involved. The second case will be referred as "baseline model" while the third case will be referred as "alternative model".

2.4.1 The reference frame

As already mentioned, the economy is submitted of an increase in nominal interest of 25 basis points. As it appears in Figure 2.1, the rise in nominal interest rate triggers a decrease in private consumption. This standard result is explained by the fact that the representative household is composed only by Ricardian members, that have a perfect access to the financial market and who choose to enjoy the increase in saving returns. The decrease in private consumption will directly be translated into a decrease in aggregate demand.

Because aggregate demand falls, a part of retailers will reduce their price while firms that are constraint by Calvo's contract will reduce their production. This fraction will reduce their purchases in intermediate goods and force firms to destroy jobs. This can be seen in Figure 2.2.

Figure 2.2 present the way firms adapt their production to the fall in aggregate

Fig. 2.1: Consumption's and global output's reactions after a monetary shock

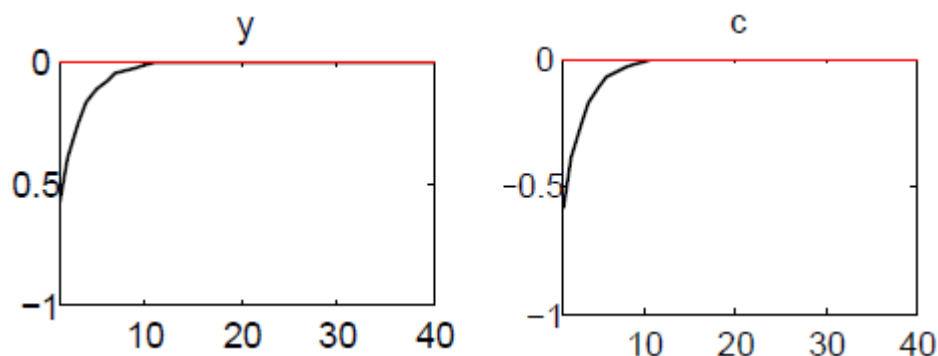
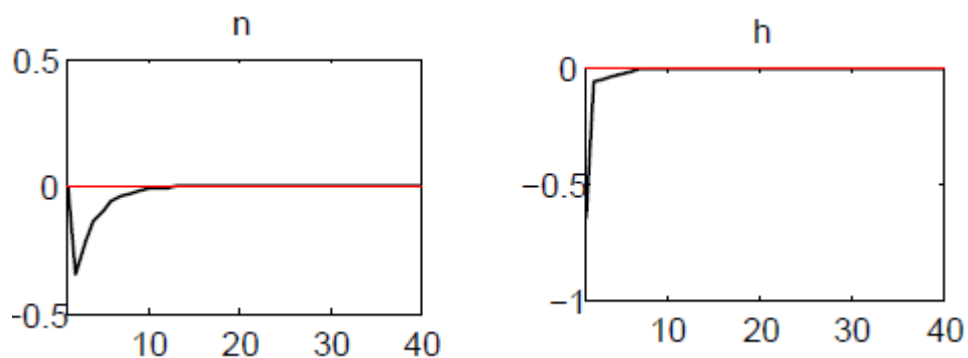


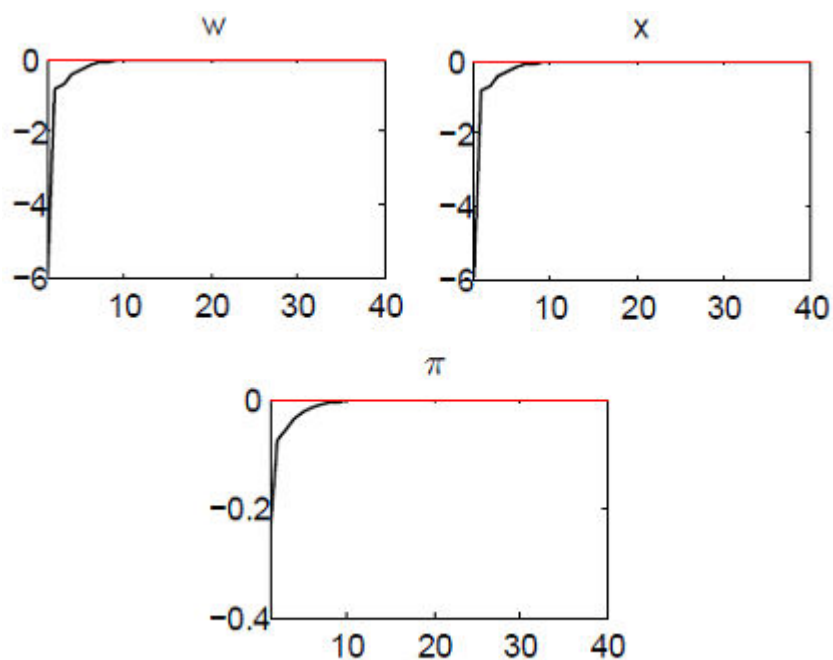
Fig. 2.2: Production's adjustment



demand. One can clearly see that firms will immediately reduce the number of hours worked and they will decrease more slowly the extensive margin of employment. Once the shock passed, the intensive margin of employment will be the first lever to be reactivated, since it takes time for a new hire to be productive. When the production capacity is fully employed, vacancies are created and employment return to its steady state.

Finally, Figure 2.3 presents retailers' marginal costs, existing job wage and inflation reactions to the monetary shock. The decrease in real wage can mainly be explained by a decrease in marginal productivity of labor. Because of the wage channel, this fall in real wage is translated into a fall in retailers' marginal costs and then, via the NKPC, into a fall in inflation.

Fig. 2.3: Wage's, marginal costs' and inflation's reactions



2.4.2 Alternative calibrations and workers' bargaining power

In order to study deeper inflation reaction to monetary shock, one has to focus on the value of the inflation first order autocorrelation coefficient, a measure for inflation persistence proposed by Fuhrer (2010). This value has to be compared to the one obtained in the reference frame. Table 2.3 presents the different results regarding inflation persistence.

Tab. 2.3: Inflation persistence, firing costs and workers' bargaining power

	F=0	F=w	F=8w
$\eta = 0.1$	0.4128	0.4247	0.355
$\eta = 0.01$	0.4128	0.4317	0.4203

At first sight, the baseline model results are not conclusive. Indeed, both inflation measure in the reference frame and in the baseline modes are really close. Even if there is positive impact of the introduction of firing costs in the sense that

inflation persistence increase, this effect seems to be marginal.

The next step consists to increase the level of firings costs in order to measure in which proportion these costs have a real impact on inflation persistence. Moreover, this increase allows for highlighting which firing costs weight element described earlier prevail on the other. To do so, firing costs are set to $F = 8w$ in order to accentuate all the mechanisms present in the baseline model economy. When firing costs increase this way, inflation persistence appears to be lower than previously since we obtained a first order autocorrelation coefficient around 0.355. It seems that under the baseline calibration, workers' influence is greater on real wage dynamic than firms' one. This last result can be confirmed by reducing workers' bargaining power: such a decrease will yield an increase in firms influence on firing costs weight and an increase in inflation persistence.

The second line in Table 2.3 confirms this assumption. The first result underlined shows that, in the reference frame, reducing workers' bargaining power has no impact on inflation persistence. This fortifies the idea that firing costs is one channel through which workers' bargaining power can affect inflation dynamic. Besides, the fact that inflation persistence does not react when workers' bargaining power changed means that it is not the variations in bargaining power that affect inflation persistence. The second result shows that both in baseline and alternative model, the introduction of firing costs has a positive impact on inflation persistence. In the first case, when $\eta = 0.1$, inflation persistence increases from 0.4128 to 0.4247 when firing costs are introduced. In the second case, when $\eta = 0.01$, inflation persistence increases from 0.4128 to 0.4317 in the same situation.

The third result appears here and is confirmed when the level of firing costs increases. This result is the following: inflation persistence increases when workers' power bargaining decreases. Indeed, for $F = 8w$ and $\eta = 0.1$, inflation persistence is equal to 0.355 while for $F = 8W$ and $\eta = 0.01$, it is equal to 0.4203. One can see here a proof that when workers' influence on firing costs weigh fall, the pro-cyclical dynamic has a weaker effect on wage dynamic and then on inflation

inertia. As a result, a direct extension of this model could consist in introducing firing costs levels directly into the collective bargaining.

2.5 Conclusion

In this chapter, a medium scale New Keynesian DSGE model is build. Different kind of firms are introduced in order to disentangle hiring decisions to price setting. Calvo's staggering contracts are introduced so as to obtain nominal rigidities and to derive the New Keynesian Phillips Curve. Firing costs are brought into a search and matching labor market in order to analyze their effects on wage dynamic. These costs are modeled as administrative costs that do not yield a transfer from firms to workers. Only long-standing job are under the protection of firing cots. Moreover, the *wage channel* is introduced thanks to right-to-manage bargaining.

The different results are the following: first, as in Macit (2010), firing costs positively affect existing job and negatively affect new hires. Second, the firing costs weight in existing job wage dynamic depends on two important factors: negatively on firms gains after an increase in real wage and positively on workers ones. Thus, these two elements introduced a counter and pro cyclical dimension in real wage dynamic, respectively. Firms' influence pushes upward pressure on firing costs weight during economic downturn in order to offer a better protection to workers when circumstances tend to increase the risk of dismissal. In turn, workers encourage firing costs when gain from an increase of real wage are high so that unemployment spells a greater loss. As a result, firms' behavior increases real wage rigidities while workers' one tend to make real wage more flexible.

Under the standard calibration choices and after an increase in nominal interest rate, it appears that the introduction of firing costs increases inflation persistence. Inflation persistence in this chapter is measured thanks to the inflation first order autocorrelation coefficient. To reach to this result, a reference frame is build where firing costs are supposed to be equal to zero. This reference frame

yields a model really close to Trigari (2006). When firing costs are introduced, one can easily see that the inflation first order autocorrelation coefficient increases regarding the reference frame. However, when the level of these fixed firing costs is increased, inflation persistence has a tendency to decrease. This result can be explained as follows: under the standard calibration, workers' influence is greater than firms' one. In order to validate this theory, workers' bargaining power is reduced. As a first consequence, the decrease in workers' bargaining power positively impacts inflation persistence in the reference frame. It tends to prove that, in this model, the channel that links workers' bargaining power to inflation inertia goes through firing costs. Indeed, when firing costs are reintroduced, the level of inflation inertia increases both regarding the reference frame with a medium and low workers bargaining power. Finally, inflation persistence decreases less when firing costs are increased.

To conclude, this chapter has shown that firing costs have a tangible impact on wage dynamics. Thanks to the wage channel, this impact can be turned into inflation persistence. However, they do not allow to increase the ability of New Keynesian models to replicate inflation persistence as it appears in empirical evidence. This result can be greatly improved if firms and workers can directly negotiate the level of firing costs instead of influencing their weight during the real wage bargaining process. This highlights that negotiation could engrave workers and firms' treatment of firing costs into wage dynamics and into inflation persistence.

2.6 Appendix

2.6.1 Existing job and new hire wages derivation

The existing job wage

Firms and workers maximize Nash product defined by equation (2.2.36). It yields

$$\frac{\partial S_t}{\partial w_t} = 0$$

$$\eta \left[h_t + w_t h_w(w_t) - \frac{g_w(h_t)}{\lambda_t} \right] [W_t - U_t]^{\eta-1} [J_t + F] 1 - \eta$$

$$+ (1 - \eta) [x_t f_h(h_t) - h_t - w_t h_t] [W_t - U_t] [J_t - F] - \eta = 0 \quad (2.6.1)$$

$$\eta \delta_t^W [W_t - U_t] \eta - 1 [J_t + F] 1 - \eta = (1 - \eta) \delta_t^F [W_t - U_t] [J_t + F] - \eta. \quad (2.6.2)$$

Given equations (2.2.26), (2.2.30) and (2.2.32), the previous equation yields

$$\begin{aligned} & \eta \delta_t^W [x_t f(h_t) - w_t h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} - \rho F] + F] \\ & = (1 - \eta) \delta_t^F [w_t h_t - b - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho)(W_{t+1} - U_{t+1})] \\ & [\eta \delta_t^W + (1 - \eta) \delta_t^F] w_t h_t = \eta \delta_t^W [x_t f(h_t) + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1}] + (1 - \beta \rho) F] \\ & \quad + (1 - \eta) \delta_t^F \left[\frac{g(h_t)}{\lambda_t} + b - E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho)(W_{t+1} - U_{t+1})] \right] \\ & w_t h_t = \chi_t [x_t f(h_t) + f_t^F + (1 - \beta \rho) F] + (1 - \chi_t) \left[\frac{g(h_t)}{\lambda_t} + b - f_t^W \right] \end{aligned} \quad (2.6.3)$$

where

$$f_t^F = E_t \beta_{t,t+1} [(1 - \rho) J_{t+1}],$$

$$f_t^W = E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho)(W_{t+1} - U_{t+1})]$$

and

$$\chi = \frac{\eta \delta_t^W}{\eta \delta_t^W + (1 - \eta) \delta_t^F}.$$

One can note that

$$\begin{aligned} & \chi_t f_t^F - (1 - \chi_t) f_t^W = \chi_t [E_t \beta_{t,t+1} [(1 - \rho) J_{t+1}]] \\ & - (1 - \chi_t) E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho)(W_{t+1} - U_{t+1})]. \end{aligned} \quad (2.6.4)$$

Given that

$$\begin{aligned} W_t - U_t &= \frac{\eta \delta_t^W}{(1 - \eta) \delta_t^F} [J_t + F] \\ \Leftrightarrow W_t - U_t &= \frac{\chi_t}{1 - \chi_t} [J_t + F] \end{aligned} \quad (2.6.5)$$

And noting $\frac{\chi_t}{1 - \chi_t} = \xi_t$, it yields

$$\begin{aligned} & \chi_t f_t^F - (1 - \chi_t) f_t^W \\ = & \chi_t [E_t \beta_{t,t+1} [(1 - \rho) J_{t+1}]] - (1 - \chi_t) E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho) \xi_{t+1} [J_{t+1} + F]] \\ \Leftrightarrow & \chi_t f_t^F - (1 - \chi_t) f_t^W = \chi_t \frac{\kappa}{\lambda_t q_t} - (1 - \chi_t) E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho) \xi_{t+1} F] \\ & - (1 - \chi_t) E_t \beta_{t,t+1} [(1 - s_t)(1 - \rho) \xi_{t+1} J_{t+1}] \\ \chi_t f_t^F - (1 - \chi_t) f_t^W &= \chi_t \frac{\kappa}{\lambda_t q_t} - (1 - \chi_t)(1 - s_t) \frac{\kappa}{\lambda_t q_t} E_t \beta_{t,t+1} [\xi_{t+1}] \\ & - (1 - \chi_t)(1 - s_t)(1 - \rho) F E_t \beta_{t,t+1} [\xi_{t+1}] \end{aligned} \quad (2.6.6)$$

Bringing equations (2.6.3) and (2.6.6) together yields

$$\begin{aligned} w_t h_t &= \chi_t \left[x_t f(h_t) + (1 - \beta \rho) F + \frac{\kappa}{\lambda_t q_t} \right] \\ &+ (1 - \chi_t) \left[\frac{g(h_t)}{\lambda_t} + b - (1 - s_t) \frac{\kappa \theta_t}{\lambda_t} E_t \beta_{t,t+1} [\xi_{t+1}] \right] \\ &- (1 - \chi_t)(1 - s_t)(1 - \rho) E_t \beta_{t,t+1} [\xi_{t+1}] F \\ \Leftrightarrow w_t h_t &= \chi_t \left[x_t f(h_t) + (1 - \beta \rho) F + \frac{\kappa}{\lambda_t q_t} \right] \\ &+ (1 - \chi_t) \left[\frac{g(h_t)}{\lambda_t} + b - (1 - s_t) \frac{\kappa \theta_t}{\lambda_t} E_t \beta_{t,t+1} [\xi_{t+1}] \right] + \mathcal{F}_t \\ \Leftrightarrow w_t &= \chi_t \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1 - \chi_t) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] \\ &+ \chi_t (1 - s_t) \frac{\kappa}{\lambda_t q_t h_t} \left[1 - \frac{1 - \chi_t}{\chi_t} E_t \beta_{t,t+1} [\xi_{t+1}] \right] + \frac{\mathcal{F}_t}{h_t} \end{aligned} \quad (2.6.7)$$

where

$$\mathcal{F}_t = F[\chi_t(1 - \beta\rho) - (1 - \chi_t)(1 - s_t)(1 - \rho)E_t\beta_{t,t+1}[\zeta_{t+1}]] \quad (2.6.8)$$

The new hire wage

In the case of a new hire, firms and workers maximize the Nash product defined by equation (2.2.35). It yields

$$\begin{aligned} \frac{\partial S_t^n}{\partial w_t^n} &= 0 \\ \Leftrightarrow \eta \left[h_t + w_t^n h_w(w_t^n) - \frac{g_w(h_t)}{\lambda_t} \right] [W_t^n - U_t] \eta - 1 [J_t^n] 1 - \eta \\ &\quad + (1 - \eta)[x_t f_w(h_t) - h_t - w_t h_t] [W_t^n - U_t] \eta [J_t^n] - \eta = 0 \\ \Leftrightarrow \eta \left[h_t + w_t^n h_t - \frac{g_w(h_t)}{\lambda_t} \right] [W_t^n - U_t] \eta - 1 [J_t^n] 1 - \eta \\ &= -(1 - \eta)[x_t f_w(h_t) - h_t w_t^n] [W_t^n - U_t] \eta [J_t^n] - \eta \\ \Leftrightarrow \eta \delta_t^{Wn} [W_t^n - U_t] \eta - 1 [J_t^n] 1 - \eta &= (1 - \eta) \delta_t F n [W_t^n - U_t] \eta [J_t^n]^{-\eta} \\ \Leftrightarrow \eta \delta_t^{Wn} J_t^n &= (1 - \eta) \delta_t F n [W_t^n - U_t] \end{aligned} \quad (2.6.9)$$

where

$${}_t W n = h_t + w_t^n h_t - \frac{g_w(h_t)}{\lambda}$$

and

$$\delta_t F n = x_t f_w(h_t) - h_t - w_t h_t.$$

Replacing J_t^n , W_t^n and U_t by their value defined by equations (2.2.27), (2.2.31) and (2.2.32), respectively, yields

$$\begin{aligned}
 & \eta \delta_t W_n [x_t f(h_t) - w_t^n h_t + E_t \beta_{t,t+1} [(1-\rho) J_{t+1} - \rho F]] \\
 (1-\eta) \delta_t^{Fn} & \left[w_t^n h_t - \frac{g(h_t)}{\lambda_t} - b + E_t \beta_{t,t+1} [(1-s_t)(1-\rho)(W_{t+1} - U_{t+1})] \right] \\
 & \Leftrightarrow \left(\eta \delta_t^{Wn} + (1-\eta) \delta_t^{Fn} \right) w_t^n h_t \\
 & = \eta \delta_t^{Wn} [x_t f(h_t) + E_t \beta_{t,t+1} [(1-\rho) J_{t+1} - \rho F]] \\
 + (1-\eta) \delta_t^{Fn} & \left[\frac{g(h_t)}{\lambda_t} + b - E_t \beta_{t,t+1} [(1-s_t)(1-\rho)(W_{t+1} - U_{t+1})] \right] \\
 w_t^n h_t = \chi_t^n & [x_t f(h_t) + f_t^F - \beta \rho F] + (1-\chi_t^n) \left[\frac{g(h_t)}{\lambda_t} + b - f_t^W \right] \quad (2.6.10)
 \end{aligned}$$

where

$$\chi_t^n = \frac{\delta_t^{Wn}}{\delta_t^{Wn} + (1-\eta) \delta_t^{Fn}} \eta \delta_t^{Wn} + (1-\eta) \delta_t^{Fn}.$$

According to equation (2.6.9),

$$W_t - U_t = \frac{\eta \delta_t^{Wn}}{(1-\eta) \delta_t^{Fn}} J_t.$$

Given that, it yields

$$\begin{aligned}
 & \chi_t^n f_t^F - (1-\chi_t^n) f_t^W = \chi_t^n E_t \beta_{t,t+1} [(1-\rho) J_{t+1}] \\
 & - (1-\chi_t^n) \left[(1-s_t) \frac{\eta \delta_{t+1}^{Wn}}{(1-\eta) \delta_{t+1}^{Fn}} E_t \beta_{t,t+1} (1-\rho) J_{t+1} \right] \\
 \Leftrightarrow \chi_t^n f_t^F - (1-\chi_t^n) f_t^W & = \chi_t^n \frac{\kappa}{\lambda_t q_t} - (1-\chi_t^n) (1-s_t) E_t \beta_{t,t+1} \left[\frac{\chi_{t+1}^n}{1-\chi_{t+1}^n} \right] \frac{\kappa}{\lambda_t q_t} \\
 \Leftrightarrow \chi_t^n f_t^F - (1-\chi_t^n) f_t^W & = \chi_t^n \frac{\kappa}{\lambda_t q_t} + \chi_t^n \frac{\kappa}{\lambda_t q_t} s_t - \chi_t^n \frac{\kappa}{\lambda_t q_t} s_t
 \end{aligned}$$

$$\begin{aligned}
 & -(1-s_t) \frac{\kappa}{\lambda_t q_t} (1-\chi_t) E_t \beta_{t,t+1} \left[\frac{\chi_{t+1}^n}{(1-\chi_{t+1}^n)} \right] \\
 \Leftrightarrow & \chi_t^n f_t^F - (1-\chi_t^n) f_t^W = \chi_t^n \frac{\kappa \theta_t}{\lambda_t} + \chi_t^n (1-s_t) \frac{\kappa}{\lambda_t q_t} \\
 & - \chi_t^n (1-s_t) \frac{\kappa}{\lambda_t q_t} \frac{(1-\chi_t^n)}{\chi_t^n} E_t \beta_{t,t+1} \left[\frac{\chi_{t+1}^n}{(1-\chi_{t+1}^n)} \right] \\
 \Leftrightarrow & \chi_t^n f_t^F - (1-\chi_t^n) f_t^W = \chi_t^n \frac{\kappa \theta_t}{\lambda_t} \\
 & + \chi_t^n (1-s_t) \frac{\kappa}{\lambda_t q_t} \left[1 - \frac{(1-\chi_t^n)}{\chi_t^n} E_t \beta_{t,t+1} \frac{\chi_{t+1}^n}{(1-\chi_{t+1}^n)} \right]. \tag{2.6.11}
 \end{aligned}$$

Bringing equations (2.6.10) and (2.6.11) together yields

$$\begin{aligned}
 w_t h_t &= \chi_t^n \left[x_t f(h_t) + \frac{\kappa \theta_t}{\lambda_t} - \beta \rho F \right] + (1-\chi_t^n) \left[\frac{g(h_t)}{\lambda_t} + b \right] \\
 & + \chi_t^n (1-s_t) \frac{\kappa}{\lambda_t q_t} \left[1 - \frac{(1-\chi_t^n)}{\chi_t^n} E_t \beta_{t,t+1} \left[\frac{\chi_{t+1}^n}{(1-\chi_{t+1}^n)} \right] \right] \\
 \Leftrightarrow w_t &= \chi_t^n \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} - \frac{\beta \rho F}{h_t} \right] + (1-\chi_t^n) \left[\frac{m r s_t}{1+\phi} + \frac{b}{h_t} \right] \\
 & + \chi_t^n (1-s_t) \frac{\kappa}{\lambda_t q_t h_t} \left[1 - \frac{(1-\chi_t^n)}{\chi_t^n} E_t \beta_{t,t+1} \left[\frac{\chi_{t+1}^n}{(1-\chi_{t+1}^n)} \right] \right] \tag{2.6.12}
 \end{aligned}$$

2.6.2 Steady-States derivations

Starting from the long-run targeted values describes in Table 2.2, steady-states derivations are now described.

From equation (2.2.20), one can easily define the value of employment at the steady-state. It is given by

$$n_s = 1 - u_s. \tag{2.6.13}$$

From equation (2.2.21), the number of job seekers is equal to

$$\tilde{u}_s = 1 - (1 - \rho)n_s. \quad (2.6.14)$$

Given the clearing condition (2.2.50), the level of consumption at the steady-state is equal to

$$C_s = y_s. \quad (2.6.15)$$

According to equation (2.2.7), the value of the marginal utility of consumption at the steady-state is

$$\lambda_s = (1 - \beta e) [(1 - e)c_s] - \sigma_c. \quad (2.6.16)$$

Given equation (2.2.8), real interest rate at the steady-state is equal to

$$r_s = \frac{1}{\beta}. \quad (2.6.17)$$

Given the definition of employment law of motion firms are facing $n_t^f = (1 - \rho)n_{t-1}^f + q_t v_t$, one can define the value of vacancies at the steady-state such as

$$v_s = \rho \frac{n_s}{q_s}. \quad (2.6.18)$$

Employment dynamic described by equation (2.2.25) allows for defining new match at the steady state

$$m_s = \rho n_s \quad (2.6.19)$$

This definition and the matching function definition given by equation (2.2.19) allow for the definition of the matching technology such as

$$\sigma_m = \frac{\tilde{u}_s^\sigma v_s^{1-\sigma}}{m_s}. \quad (2.6.20)$$

It is now possible to define both the probability for a worker to find a job as well as the level of labor market tightness at the steady-state:

$$s_s = \frac{m_s}{\tilde{u}_s}, \quad (2.6.21)$$

$$\theta_s = \frac{v_s}{\tilde{u}_s}. \quad (2.6.22)$$

By definition, the marginal productivity of labor at the steady-state is equal to

$$mpl_s = z\alpha h_s^{\alpha-1}, \quad (2.6.23)$$

while the marginal rate of substitution is equal to

$$mrs_s = k_h \frac{h_s^\phi}{\lambda_s}. \quad (2.6.24)$$

According to the wage channel given by equation (2.2.39), retailers marginal costs at the steady-state is equal to

$$x_s = \frac{w_s}{mpl_s}. \quad (2.6.25)$$

Given equations (2.2.41), (2.2.42), (2.2.43), (2.2.45) and (2.6.8), one can easily show that

$$\delta_s^W = \left(\frac{h_s}{1-\alpha} \right) \left(\frac{mrs_s}{w_s} - \alpha \right), \quad (2.6.26)$$

$$\delta_s^F = h_s, \quad (2.6.27)$$

$$\chi_s = \frac{\eta \delta_s^W}{(1 - \eta) \delta_s^F}, \quad (2.6.28)$$

$$\zeta_s = \frac{\chi_s}{(1 - \chi_s)} \quad (2.6.29)$$

and

$$\mathcal{F}_s = F[\chi_s(1 - \beta\rho) - (1 - \chi_s)(1 - s_s)(1 - \rho)\beta\zeta_s]. \quad (2.6.30)$$

Finally, the different firms' Bellman equations at the steady state can be defined under the free entry condition and thanks to equations (2.2.26) and (2.2.27):

$$J_s = \frac{x_s z h_s^\alpha - w_s h_s - \beta\rho F}{1 - \beta(1 - \rho)}, \quad (2.6.31)$$

$$J_s = \frac{x_s z h_s^\alpha - w_s^n h_s - \beta\rho F}{1 - \beta(1 - \rho)}, \quad (2.6.32)$$

Regarding workers' Bellman equations, it can be easily shown using equation (2.2.30) that

$$W_s = \frac{w_s h_s - \kappa_h \frac{h_s^{1+\phi}}{1 + \phi} + \rho U_s}{1 - \beta(1 - \rho)}. \quad (2.6.33)$$

Using equations (2.2.32) and (2.6.33), one can obtain that

$$U_s = \left[b + \beta s_s \left[\frac{w_s h_s - \kappa_h \frac{h_s^{1+\phi}}{1 + \phi}}{1 - \beta(1 - \rho)} \right] \right] \left[1 - (1 - s_s(1 - \rho) - \frac{\rho}{1 - \beta(1 - \rho)})\beta \right]^{-1} \quad (2.6.34)$$

Bringing equations (2.6.33) and (2.6.34) together allows for defining W_s . In the same manners, one can define W_s^n as

$$W_s^n = \frac{w_s^n h_s - \kappa_h \frac{h_s^{1+\phi}}{1+\phi} + \rho U_s}{1 - \beta(1 - \rho)}. \quad (2.6.35)$$

Chapter 3 | A new insight on the inflation persistence: the role of severance pay*

3.1 Introduction

Recent literature focuses on factors driving inflation persistence because of two main reasons: first, from a theoretical point of view, recent DSGE models are unable to replicate the sluggish response of inflation in concert with a large response of output. Secondly, in order to stabilize inflation central bankers need to understand what drives inflation dynamics. For instance, the amplitude of monetary policy response to a shock will directly depend on the degree of inflation persistence. From a pure European point of view, inflation persistence is a central preoccupation for policymakers as it is highlighted by Altissimo et al. (2006). In this chapter, the authors present the different results of the Eurosystem Inflation Persistence Network (IPN *hereafter*). One of them is the uncertainty about the qualitative and the quantitative nature of inflation persistence. This uncertainty affects the conduct of the monetary policy such as a more gradual response to economic shock.

The aim of this chapter is to provide a theoretical framework able to replicate inflation persistence as measured in empirical data. Thus, I stress the role of firing costs and, in particular, of severance pay in explaining inflation persistence.

⁰ This Chapter is based on **Coudert, Thomas**, "A new insight on the inflation persistence: the role of severance pay", *Brussels Economic Review*, forthcoming.

Following Garibaldi and Violante (2005), I extend the model of Trigari (2006) with right-to-manage bargaining. I compare three situations: a first one in which firing costs are set by the law; a second one in which bargained firing costs are introduced but where the real wage is efficiently bargained; a third one in which firing costs are efficiently bargained but where the real wage is set thanks to right-to-manage bargaining. I show that right-to-manage bargaining combined with bargained firing costs are able to increase inflation persistence in DSGE models.

The structural form of inflation persistence highlights three sources of persistence: the central bank behavior, intrinsic persistence (that is transmitted from inflation itself) and inherited persistence from other variables such as the output gap or marginal cost. As expounded by Fuhrer (2010), in a world Calvo (1983), the New Keynesian Phillips Curve (NKPC hereafter) takes the form of a pure forward-looking curve where inherited persistence as only source of inflation persistence, where marginal cost is the key variable. Because of this NKPC that links the inflation level and firms' marginal cost, both labor market institutions and the real wage play a fundamental role in inflation persistence. For instance, Trigari (2006) shows that wage bargaining has a great impact on inflation persistence. The author distinguishes two different Nash bargaining process : the efficient bargaining where workers and firms negotiate conjointly both the real wage and the hours worked; and the right-to-manage bargaining where firms and workers negotiate together the real wage but where firms set the hours worked unilaterally and according to the level of the real wage. Right-to-manage bargaining triggers a wage channel and links the real wage to firms' marginal cost. This channel engraves wage dynamics into inflation dynamics thanks to the NKPC. Following this literature, Christoffel and Linzert (2006), Blanchard and Gali (2007), Christoffel et al. (2009b), Tsoukis et al. (2011) among others show the importance of the real wage rigidity for explaining inflation persistence.

As expounded by Galí (2010), the introduction of wage rigidity has been realized thanks to two main approaches: a stream of the literature suggests to introduce rigidity on the intensity in which the real wage is renegotiated. Among them, Christoffel and Linzert (2006) introduce a wage norm into a DSGE model.

In this case, the real wage is forced to stay close to its recent history. In a right-to-manage framework, the authors show that wage norm significantly increases inflation persistence. The second approach assumes that the real wage is no longer continuously bargained. A nominal rigidity *à la* Calvo (1983) is assumed so that, while a share of the real wages is re-optimized, another share of the real wages remains unchanged for several periods. In this chapter, I suggest a third approach using severance pay. Specifically, wage rigidity is *per se* obtained thanks to the model and there is no "*ad hoc*" rigidity added concerning wage dynamics.

This approach is motivated by an empirical assessment: as expounded by Thomas (2006), there is a negative correlation between the level of firing costs and the business cycle fluctuations. In a search and matching model, the author shows that firing costs decrease the volatility of job destruction. In turn, this reduction translates into a lower volatility of business cycle fluctuations. Veracierto (2008) finds similar results in a real business cycle model following a productivity shock. Macit (2010) emphasizes that there is a negative correlation between the OECD's Employment Protection Legislation (EPL *hereafter*) index and the real wage and inflation volatilities. Macit (2010) introduces a lay-off tax into a DSGE model with search and matching frictions in order to analyse how firing costs affect the real wage negotiation. In an efficient bargaining framework, firing costs increase insiders' real wage while their decrease outsiders' one. However, even if firing costs impact the real wage dynamics, they do not improve the degree of inflation persistence into New Keynesian models. Two main reasons can explain this fact. First, in the efficient bargaining framework, real wage does not affect directly the firms' marginal cost, which is the key variable in the NKPC. Secondly, lay-off tax is assumed to be constant and does not vary depending on the business cycle fluctuations. Starting from this assessment, I propose to analyse the impact of severance pay on inflation persistence in a right-to-manage bargaining framework.

Since the work of Lazear (1990), severance pay of firing costs have been neglected from theoretical models. Severance pay represents a transfer from firms to workers that can be undone freely by workers in case of perfect flexible wage bar-

gaining framework. Thus, severance pay has no impact on firms' decisions. This theoretical point is known as the bonding critique. From a theoretical perspective, the consequence of the bonding critique is straightforward: firing costs are modeled as a tax, without transfers from firms to workers. However, Garibaldi and Violante (2002, 2005) recently showed that severance pay must be reintroduced into theoretical models for two main reasons. First, from a quantitative point of view, severance pay is at least as important as taxes in global firing costs. In Italy, they represent approximately 80% of global firing costs. Secondly, severance pay and tax component of firing costs do not have the same impact on employment expect in the case of full wage rigidity. Thus, transfers induced by severance pay play a crucial role in labor market dynamics. Moreover, Fella (2007) also argues that severance pay has no impact in firms' decisions because the theoretical framework in which they are studied is not relevant. Finally, I show that the optimal behavior highlighted by Lazear, which allows workers to avoid the effects of severance pay, can be understood as a contribution system to the worker's job protection. This contribution system will introduce a new intrinsic rigidity in wage dynamics that will be turned into inflation persistence thanks to the wage channel and the NKPC.

For this purpose, I model firing costs similarly to Garibaldi and Violante (2005). I assume they are composed by two elements: a tax component and a transfer component. The tax component generally represents a notice period that is a cost for firms in case of lay-off. It does not affect workers' decisions. By contrast, severance pay is both a cost for firms and a temporary new income for workers. Then, I compare four different situations. I take as reference the model of Trigari (2006): I model a labor market in which the real wage is efficiently bargained and in which there is no firing cost. Then, I compare this situation to three others. I gradually introduce severance pay in order to identify which bargained severance pay characteristic affects inflation persistence. First, I reintroduce into a New Keynesian model a fix severance pay in order to study the impact of the transfer resulting from this severance pay. Then, I allow workers and firms to efficiently negotiate the level of severance pays, following Garibaldi and Violante (2005). Thereafter, two situations are distinguished: a first situation in which the real

wage is efficiently negotiated and a second situation in which the real wage is negotiated following the right-to-manage bargaining framework. This distinction is essential in order to evaluate the importance of the wage channel expounded by the literature.¹²

My findings can be summarized as follows: in the right-to-manage bargaining framework, the contribution system implied by bargained severance pay improves inflation persistence in the standard New Keynesian model. When firing costs are fixed, their two components act similarly on wages: they both increase insiders' the real wage and they decrease outsiders' the real wage. When severance pay is bargained, the impact of firing costs on insiders' wage becomes ambiguous: as it has usually been shown in the literature, the contemporary impact of firing cost on wage is positive. However, because workers and firms can optimally bargain the level of severance pay, workers agree to contribute for a part of the job protection of the next period. This effect decreases the level of the real wage. This contribution system introduces a new source of rigidity in the wage dynamics that, in return, increases the level of inflation persistence when the wage channel is present.

The rest of the chapter is structured as follows. Section 2 presents the New Keynesian framework and section 3 focuses on the negotiation of wage and hours worked. Section 4 presents the wage channel under the right-to-manage bargaining. Section 5 presents the calibration choice while section 6 presents my results. Section 7 concludes.

3.2 *The New Keynesian framework*

In this section, I give details about the New Keynesian framework that closely follows Trigari (2006). The economy is composed of a representative household,

¹ Another case can be found in the literature: Macit (2010) investigates the case where there is only a fixed tax on lay-off and where wage is efficiently bargained. Especially, the author shows that firing costs affect differently outsider and insiders. However, this distinction does not allow the model to replicate inflation persistence.

² Only the last case will be presented in the chapter. The three other cases that I study are presented in Appendix 3.8.1.

a Central Bank and three industrial sectors: an intermediate goods sector, a retail goods sector and a final goods sector. For simplicity's sake, firms producing in the intermediate goods sector are simply called *firms*; firms producing in the retail goods sector are called *retailers*; and finally the firm producing in the final good sector is called the *final goods firm*. This separation allows me to study distinctly the labor market *à la* Mortensen and Pissarides (1994) and the price setting.

Retailers evolve in a monopolistic competition market. Nevertheless, firms and retailers meet each other in a perfect competitive market, just as the representative household and the final goods firm. One can note that this artificial separation is neutral regarding inflation persistence.³

3.2.1 The representative household

I assume that there is a representative household composed by a continuum of homogeneous workers indexed on the unit interval. As in Merz (1995), each worker insures each other members of the household by sharing his earned income, namely his wage or his unemployment benefits. Following Christoffel et al. (2009a), the instantaneous utility function is separable in consumption and leisure. The latter is given for each member of the representative household by:

$$U(c_t, c_{t-1}) - g(h_t), \quad (3.2.1)$$

where

$$g(h_t) = \kappa_h \frac{h_t^{1+\phi}}{1+\phi}, \quad (3.2.2)$$

and

$$U(c_t, c_{t-1}) = \log(c_t - ec_{t-1}), \quad (3.2.3)$$

where (c_t, c_{t-1}) represents the utility derived from consumption and $g(h_t)$

³ This neutrality has been showed by Sveen and Weinke (2007), Christoffel et al. (2009a), Kuester (2010) and Thomas (2011).

represents the disutility derived from the labor supply h_t . The degree of habit formation in consumption is represented by $e > 0$. The labor supply elasticity is $1/\phi$, and $\kappa_h > 0$ is a scale parameter. I assume that there are some consumption habits in the household members' behavior in order to let retailers adjust their production to a shock thanks to the extensive margin rather than the intensive margin, that is to say employment rather than hours worked. This assumption is in line with Trigari (2009) for the US economy and Rogerson and Shimer (2011) for the OECD countries.

The representative household's maximization problem is

$$\max_{c_t, B_t} E_t \sum_{s=0}^{\infty} \beta^s [U(c_{t+s}, c_{t+s-1}) - G_{t+s}], \quad (3.2.4)$$

subject to

$$c_t + \frac{B_t}{p_t r_t^n} = d_t + \frac{B_{t-1}}{p_t}. \quad (3.2.5)$$

The utility of the representative household depends on the level of consumption per capita as well as the total cost of labor supply G_{t+s} . Here, I assume there is no inactive worker in the economy. A member of the representative household can only be employed or unemployed.

The discount factor is represented by $\beta \in [0, 1]$. The representative household holds one-period bonds B_t at the cost of $1/r_t^n$, where r_t^n is the nominal interest rate. The Consumer Price Index is noted p_t and d_t is the real income per capita in t .

The maximization of the household's program yields the standard Euler equation

$$\lambda_t = \frac{1}{c_t - ec_{t-1}} - E_t \beta \frac{e}{c_{t+1} - ec_t} \quad (3.2.6)$$

$$\lambda_t = r_t E_t \lambda_{t+1}, \quad (3.2.7)$$

where λ_t is the marginal utility of consumption in t and where

$$r_t = \frac{r_t^m}{E_t[\pi_{t+1}]} \quad (3.2.8)$$

3.2.2 The labor market

In the model, workers can be either employed or unemployed. When they are unemployed, workers seek for a job without paying any cost in terms of utility whereas the supply of labor is painful. Firms can have their job filled or vacant. Unlike workers, firms have to pay a cost to post a vacancy. This cost is assumed to be constant.⁴

I assume that firms and workers meet each other in the labor market according to the following standard matching function:

$$m_t = \sigma_m u_t^\sigma v_t^{1-\sigma}, \quad (3.2.9)$$

where m_t is for the number of new matches in the labor market, $\sigma_m > 0$ measures the efficiency of the matching process, u_t is the number of job seekers and v_t is the number of vacancies. I assume that there is no on-the-job search: a worker looks for a new job only when he is fired. The job separation rate is assumed to be exogenous and equal to ρ .

According to the matching function, I define the probability q_t for a firm to fill its job and the probability s_t for a worker to find a job, respectively, as:

$$q_t = \frac{m_t}{v_t} \quad (3.2.10)$$

⁴ Authors as Gertler and Trigari (2006) have made the assumption of variable vacancy costs. Indeed, Gertler and Trigari (2006) assume that hiring costs can be a convex function of the firms' hiring rate. They assume that the more the hiring rate increases, the more costly hire will be. However, for sake of simplicity, I assume that no such costs are present in the economy since it makes no difference in terms of inflation persistence.

and

$$s_t = \frac{m_t}{u_t}. \quad (3.2.11)$$

Moreover, employment dynamics are given by:

$$n_t = (1 - \rho)n_{t-1} + m_{t-1}, \quad (3.2.12)$$

where n is the level of employment. Equation (3.2.12) reads that employment is function of the number of jobs that are not destroyed during the previous period plus the number of new matches during the previous period. Here, I assume that new matches are made at the end of the period. It implies that a new match can only be productive at the beginning of the following period and that hiring a worker is costly in terms of time.

Furthermore, the number of job seekers is equal to the $(1 - n_t)$ workers unemployed at the beginning of the period plus the ρn_t workers who lost their job at the beginning of the period. Thus, I can define the number of job seekers as

$$u_t = 1 - (1 - \rho)n_t. \quad (3.2.13)$$

Finally, the level of unemployment is given by

$$\Omega_t = 1 - n_t. \quad (3.2.14)$$

3.2.3 The different firms

I present the relationship between the different kind of firms. Firms on the intermediate goods sector and firms on the retail goods sector are separated in order to distinguish the labor market interactions from the price setting.

Intermediate goods firms are hiring workers on the labor market. These firms produce intermediate goods only thanks to labor services and sell them to retailers. Then, retailers turn these goods into differentiated goods thanks to a one-to-one technology to finally sell these goods to the final good firms. At the end, the

final goods firm aggregates the differentiated goods and sells the final goods to the representative household.

The intermediate goods firms

There is an continuum of firms in monopolistic competition in the intermediate goods sector. Following Mortensen and Pissarides (1999), I assume that firms can hire only a unique worker. When it is the case, they produce only thanks to labor services and according to the production function:

$$f(h_t) = zh_t^\alpha, \quad (3.2.15)$$

where z is the technological factor for all the firms and with $\alpha \in (0,1)$ a scale parameter. When firms do not find a worker, they produce nothing.

Retailers, the final good firms and the price setting

I assume there is a continuum i of retailers indexed on the unit interval. These retailers produce their goods according to a technology that changes an intermediate good x_t in a perfect competitive market into a differentiated good y_{it} . Differentiate goods are then imperfect substitute goods and give retailers a market power. Thus, retailers become price setters and can maximize their profits according to their price.

Then, differentiate goods are sold to the final goods firm that aggregates them into final goods y_t .

The final goods firm produces thanks to the following CES production function:

$$y_t = \left[\int_0^1 y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}, \quad (3.2.16)$$

with $\varepsilon > 1$ the elasticity of substitution between each differentiate goods.

The final goods firm maximizes its profit by choosing the level of each differentiated good that it will include as factor of production. The maximization of profit yields the following demand function for each good y_{it} :

$$y_{it} = \left(\frac{p_{it}}{p_t} \right)^{-\varepsilon} y_t, \quad (3.2.17)$$

The CPI is defined as follows

$$p_t = \left[\int_0^1 p_{it}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}. \quad (3.2.18)$$

I assume that the economy is subject to some nominal rigidities following Calvo (1983). Retailers can re-optimize their price each period given the probability $(1 - \varphi)$. Then, a share φ of retailers is stuck with its previous price while a share $(1 - \varphi)$ of retailers can optimally re-optimize its price. The maximization of the retailers' program yields the optimal level of p_{it}^* :

$$p_{it}^* = \mu \frac{E_t \sum_{s=0}^{\infty} (\beta\varphi)^s u'(c_{t+s}) x_{t+s} p_{t+s}^{\varepsilon-1} y_{t+s}}{E_t \sum_{s=0}^{\infty} \beta\varphi c_{t+s} p_{t+s}^{\varepsilon-1} y_{t+s}}, \quad (3.2.19)$$

where x_t is the retailers' marginal cost and where $\mu = \frac{\varepsilon}{\varepsilon-1}$ is the optimal mark-up. One can note that in this economy, the retailers' marginal cost is equal to the firms' price.

Finally, given that the law of motion for p_t can be expressed as

$$p_t = \left((1 - \varphi) p_t^{*1-\varepsilon} + \varphi p_{t-1}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}, \quad (3.2.20)$$

after log-linearizing equations (3.2.19) and (3.2.20) and after some rearrangements, one can obtain the NKPC

$$\hat{\pi}_t = \frac{(1 - \varphi)(1 - \beta\varphi)}{\varphi} \hat{x}_t + \beta E_t \hat{\pi}_{t+1}. \quad (3.2.21)$$

Finally, a resource constraint for the whole economy is given by

$$y_t = c_t. \quad (3.2.22)$$

The clearing condition for the retailers market is

$$y_t = n_t(1 - \rho)f(h_t), \quad (3.2.23)$$

where the aggregate demand y_t is equal to the production $f(h_t)$ of each $n_t(1 - \rho)$ firm that actually produces.

3.2.4 Monetary policy

I assume that the monetary authority sets the nominal interest rate according to the following standard Taylor rule:

$$\frac{r_t^n}{r_s^n} = \left(\frac{r_{t-1}^n}{r_s^n} \right)^{\rho_m} \left(\frac{y_t}{y_s} \right)^{\gamma_y(1-\rho_m)} \left(\frac{\pi_t}{\pi_s} \right)^{\gamma_\pi(1-\rho_m)}, \quad (3.2.24)$$

with ρ_m the interest rate smoothing. The relative weights given by the monetary authority to the stabilization of output and inflation are γ_π and γ_y , respectively. ε_t^m is an *iid* monetary shock.

3.3 The severance pay bargaining

In this section I present how severance pay is negotiated. I assume that severance pay is renegotiated each period as in Garibaldi and Violante (2005).

First, let us define *ex post* and *ex ante* firing costs according to a court decision. The former refer to firing costs that are imposed by a judge after a lay-off is judged unfair while the latter are referring to firing costs that are negotiated with the fired worker.

Following Goerke (2006), I assume that *ex post* firing costs noted \hat{F}_t are equal

to

$$\hat{F}_t = \hat{S}_t + T, \quad (3.3.1)$$

with

$$\hat{S}_t = w_t^Y. \quad (3.3.2)$$

\hat{S}_t represents legal severance pay and Y the wage elasticity of legal severance pay.

However, these costs are valuable only if a judge declares the lay-off unfair with a probability ρ_u . As emphasized by Garibaldi and Violante (2005), many lay-off are not contested. In that case, severance pay can be bargained between the two parties. Assuming that *ex ante* severance pay bargaining follows a Nash process, whose maximization program is

$$\max_{S_t} (S_t - \rho_u \hat{S}_t)^\eta [-S_t + \rho_u (\hat{S}_t + T)]^{1-\eta}, \quad (3.3.3)$$

where S_t is the level of bargained severance pay. The bargaining will answer to two contradictory objectives: workers' objective is to maximize the difference between what they could obtain from a court decision and what they could obtain from the negotiation; for firms, the objective is to minimize the difference between legal firing costs, if the lay-off is judged unfair, and the bargained severance pay. Each objective is balanced by the bargaining power of each party.

The maximization of the previous program yields

$$S_t = \rho_u (\hat{S}_t + \eta T). \quad (3.3.4)$$

Equation (3.3.4) defines *ex ante* severance pay. One can note that it is profitable for each party to bargain rather than to stand in front of a court:

$$\rho_u \hat{S}_t < \rho_u (\hat{S}_t + \eta T) < \rho_u (\hat{S}_t + T), \quad (3.3.5)$$

that means that the two parties obtain more from the bargaining than from the court's judgment.

Finally, in order to fully define *ex ante* firing costs, I need to define the probability ρ_a that an agreement is found between firms and workers without resorting to a court. Moreover, I assume that if the court judges the lay-off fair, neither firms nor workers will pay something to the other parties. Finally it yields

$$F_t = \rho_a \rho_u (\hat{S}_t + \eta T_t) + (1 - \rho_a) \rho_u \beta_{t,t+1} E_t[\hat{F}_{t+1}]. \quad (3.3.6)$$

3.4 The Right-to-Manage Wage Bargaining

Following Trigari (2006), Christoffel and Kuester (2008) and Christoffel et al. (2009a), I explore the wage channel deeper, which links directly the marginal cost of firms to the real wage. During the right-to-manage bargaining, the real wage is used as a proxy of the marginal rate of substitution by firms and workers. I discuss here the impact of dynamic firing costs *à la* Garibaldi and Violante (2002) into the right-to-manage bargaining framework.

3.4.1 The Bellman equations

As in Macit (2010), the introduction of firing costs leads to distinguish insider workers, who can enjoy Employment Protection Legislation (EPL), to outsider workers who just find a job. Indeed, here I assume that firms will have to pay firing costs when the relationship is broken, only when workers were working during the previous period. Otherwise, firms can freely break the relationship.

Firms: The marginal value of job J_t is defined by

$$J_t = x_t f(h_t) - w_t h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} - \rho F_{t+1}], \quad (3.4.1)$$

$$(3.4.2)$$

where w_t is the real wage for an *old* job and x_t the relative price for intermediate goods. The stochastic discount factor $\beta_{t,t+1}$ is defined by $\beta_{t,t+s} = \beta^s \frac{\lambda_{t+s}}{\lambda_t}$. The marginal value of a job is equal to the sum of the instantaneous profits $x_t f(h_t) - w_t h_t$ plus expected average gains linked to the status of the job at the next period. If the job is destroyed, firms will receive the marginal value of a vacancy minus firing costs. If the job is not destroyed, firms will get the marginal value of job at the next period.

Moreover, the marginal value of a vacant job is defined by V_t . I assume that the cost for firms to post a vacancy is constant, expressed in terms of consumption goods and is equal to κ . Expected average gains depend on firms' ability to fill their job, with a probability q_t . If the job is filled and if it is not destroyed at the end of the period, the firm will receive the marginal value of a job at the next period, J_{t+1}^n . If firms cannot fill their job, they will receive the marginal value of a vacant job at the next period. Thus, V_t is defined such as

$$V_t = \frac{-\kappa}{\lambda_t} + E_t \beta_{t,t+1} [q_t(1 - \rho)J_{t+1}^n + (1 - q_t)V_{t+1}]. \quad (3.4.3)$$

Moreover, I assume that the free entry condition is achieved. This assumption implies that the marginal value of a vacant job is null. It yields the job creation condition such as

$$\frac{\kappa}{\lambda_t q_t} = E_t \beta_{t,t+1} [(1 - \rho)J_{t+1}^n], \quad (3.4.4)$$

Equation (3.4.4) implies, for λ_t and κ constant, that if the expected profits of a filled job increase, a new firm will enter the market and will create a new job. Therefore, the number of vacancies will increase, reducing the probability for firms to find a worker. In return, when the expected profit of a filled job decreases, some firms leave the market and the probability for the other firms to match a worker increases. Consequently, the real cost of posting a vacancy decreases and the equilibrium is achieved again.

The marginal value of a new job J_t^n is defined by

$$J_t^n = x_t f(h_t) - w_t^n h_t + E_t \beta_{t,t+1} [(1 - \rho)J_{t+1} + \rho(V_{t+1} - F_t)]. \quad (3.4.5)$$

One can note that firing costs are present in equation (3.4.5). Indeed, if at the end of the period t , firms decide to break the relationship with the new worker, this worker would have lost his outsider status and he would be protected by EPL.

Workers: The marginal utility of a job for workers is W_t for an old job and W_t^n for a new job. Furthermore, the marginal utility for an unemployed worker is equal to U_t .

When a worker has a job, he receives $w_t h_t$ minus the disutility linked to the labor supply in terms of goods of consumption. The expected utility linked to the job depends on whether the relationship is broken or not. It yields

$$W_t = w_t h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1} + \rho S_{t+1}], \quad (3.4.6)$$

The same pattern holds for a worker newly in a job with a difference in terms of wage:

$$W_t^n = w_t^n h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1} + \rho S_{t+1}] \quad (3.4.7)$$

Finally, the situation for an unemployed worker is such as:

$$U_t = b + E_t \beta_{t,t+1} [s_t(1 - \rho)(W_{t+1} - U_{t+1}) + U_{t+1}]. \quad (3.4.8)$$

When a worker is unemployed, he receives unemployment benefits b . Moreover, expected gains for an unemployed worker is the value of a job at the next period weighted by the probability s_t that he finds a job and by the probability $(1 - \rho)$ that the new match is successful. In the case where the new match is unsuccessful or that the worker does not find a job, with a probability $(1 - s_t)$, this

worker will stay unemployed and he will receive the marginal value of unemployment at the next period.

3.4.2 The wage channel

Under the right-to-manage bargaining, firms and workers negotiate only the real wage. Firms unilaterally set the level of hours worked in order to maximize their own surplus linked to employment. For sake of simplicity, I assume that differentiation between old and new workers is just made through wage and not through hours worked.

The maximization of this program yields the following optimal condition:

$$w_t = x_t m p l_t \quad (3.4.9)$$

Equation (3.4.9) presents the wage channel that links directly the wage level to the firms marginal cost. Thus, the real wage becomes a proxy of the marginal rate of substitution of workers since the latter is not present in the hours worked setting process.

3.4.3 The wages bargaining in the right-to-manage bargaining framework with dynamic firing costs

I present here the wage bargaining. The two parties will jointly maximize the Nash product that, in the case of an old job, can be defined as:

$$[W_t - (U_t + S_t)]^\eta [J_t - (V_t - F_t)]^{1-\eta}, \quad (3.4.10)$$

where η represents the workers' bargaining power.

In the case of a new job, the Nash product is defined as

$$[W_t^\eta - U_t]^\eta [J_t^\eta - V_t]^{1-\eta} \quad (3.4.11)$$

Here, one can note the difference between an insider worker and an outsider

worker accordingly to the EPL. When an insider worker and a firm disagree on a wage level and when the relationship ends, the firm has to pay F_t . When an outsider worker and a firm disagree on a wage level, the separation goes freely.

The old job case: The maximization of the Nash product in the case of an old job yields:

$$\eta\delta_t^W[J_t + F_t] = (1 - \eta)\delta_t^F[W_t - U_t - S_t], \quad (3.4.12)$$

where

$$\delta_t^W = \frac{h_t}{(1 - \alpha)} \left(\frac{mrs_t}{w_t} - \alpha \right) \quad (3.4.13)$$

and

$$\delta_t^F = h_t. \quad (3.4.14)$$

δ_t^W and δ_t^F are the expected gains for workers and firms after an increase of the real wage, respectively. Substituting J_t , W_t and U_t by their value and after some algebra, one can obtain

$$\begin{aligned} w_t = \chi_t \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} + \frac{F_t}{h_t} \right] + (1 - \chi_t) \left[\frac{mrs_t}{1 + \phi} + \frac{b}{h_t} + \frac{S_t}{h_t} \right] \\ + (1 - s_t) \frac{\kappa}{\lambda_t q_t h_t} [\chi_t - (1 - \chi_t) \zeta_{t+1}] - \mathcal{A}_t E_t \beta_{t,t+1} [F_{t+1}] \\ - \mathcal{B}_t E_t \beta_{t,t+1} [S_{t+1}] \end{aligned} \quad (3.4.15)$$

with $m p l_t = f'(h_t)$ the marginal productivity of labor, $mrs_t = \frac{g'(h_t)}{\lambda_t}$ the marginal rate of substitution and $\theta_t = s_t/q_t$ the labor market tightness. Furthermore,

$$\chi_t = \frac{\eta\delta_t^W}{\eta\delta_t^W + (1 - \eta)\delta_t^F}, \quad (3.4.16)$$

$$\bar{\zeta}_t = \frac{\eta \delta_t^W}{(1 - \eta) \delta_t^F}, \quad (3.4.17)$$

$$\mathcal{A}_t = \frac{1}{h_t} [\chi_t \rho + (1 - s_t)(1 - \rho)(1 - \chi_t) \bar{\zeta}_{t+1}] > 0 \quad (3.4.18)$$

and

$$\mathcal{B}_t = \frac{[\rho + (1 - s_t)](1 - \rho)(1 - \chi_t)}{h_t} (1 - \chi_t) > 0 \quad (3.4.19)$$

Moreover, one can note that EPL increases the real wage of an insider. One can note that firms prefer to promote only legal severance pay whereas workers promote the whole firing costs.

As in Trigari (2006), the real wage remunerates some traditional items such as a share of the marginal productivity of labor and a share of the marginal rate of substitution of workers. The situation in the labor market is also taken into account thanks to the labor market tightness. Finally, in order to encourage workers to participate in the labor market, firms agree to pay a share of unemployment benefits. In order to analyze the impact of firing costs on the real wage, one has to distinguish the impact during the current period to the impact at the next period. Indeed, during the current period, firing costs increase the real wage. This result matches the result of Macit (2010). However, thanks to the severance pay bargaining, a contribution system appears. Indeed, following Lazear (1990), since workers and firms freely negotiate the level of severance pay, workers agree to reduce their level of the real wage in order to reduce the burden that EPL imposes upon firms. This component simply tells that workers will pay today a share of their tomorrow job protection. From this point of view, the bonding critique still holds: the optimal contract between firms and workers leads to avoid a part of firing costs.

The new job case: The maximization of the Nash product in the case of a new job yields

$$\eta \delta_t^W J_t^n = (1 - \eta) \delta_t^F (W_t^\eta - U_t), \quad (3.4.20)$$

Replacing J_t^n , W_t^n and U_t by their values and after some algebra yields

$$\begin{aligned} w_t^n = & \chi_t \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda h_t} \right] + (1 - \chi_t) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] \\ & + (1 - s_t) \frac{\kappa}{\lambda_t q_t h_t} [\chi_t - (1 - \chi_t) \xi_{t+1}] \\ & - \frac{\chi_t}{h_t} E_t \beta_{t,t+1} [\rho F_{t+1}] - \frac{(1 - \chi_t)}{h_t} E_t \beta_{t,t+1} [\rho S_{t+1}]. \end{aligned} \quad (3.4.21)$$

Equation (3.4.21) shows that EPL negatively affects outsiders' wage, as it is usually the case. However, here, outsiders do not pay for the insiders protection. Outsiders pay contribution for their own protection of the next period and not for the EPL of the current period.

3.5 The calibration choices

In this section, I present the calibration values that I chose as well as the targeted values at the steady-state.

Table 3.1 presents the different calibration choices. Regarding the preference of the representative household, I set the degree of habit formation in consumption to 0.7 in accordance with the empirical evidence that can be found in Smets and Wouters (2003, 2007) for instance. Besides, I follow Card (1991), who estimates the elasticity of substitution, $1/\phi$, between 0.1 and 0.5. Following Trigari (2006) and Christoffel et al. (2009b), I set ϕ equal to 10. Moreover, I set $\beta = 0.99$ in order to have a quarterly real rate of interest of almost 1%.

Tab. 3.1: Parameters and their calibrated values

Preferences		
e	0.7	Consumption habits persistence
ϕ	10	Inverse of the labor supply elasticity
β	0.99	Discount factor
Labor Market		
ρ	0.08	Job destruction rate
κ	0.16	Vacancy posting cost
η	0.1	Workers' bargaining power
σ	0.1	Matching function elasticity
Υ	0.35	Severance pay elasticity
ρ_u	0.5	Probability for a lay-off to be considered as unfair
ρ_a	0.5	Probability to find an agreement about severance pay
T	0.18	Firing costs tax component
b	0.3 Υ_s	Unemployment benefit
Firms and Production		
φ	0.85	Calvo's coefficient
α	0.3	TFP elasticity
Monetary Authority		
ρ_m	0.85	Interest rate smoothing
γ_π	1.5	Response coefficient to inflation
γ_y	0.5	Response coefficient to the output gap

Regarding the labor market parameters, I set the employment destruction rate ρ to 0.08, as Trigari (2006). This value is an intermediate value to the one chosen by Christoffel et al. (2009b), Krause and Lubik (2010) and Macit (2010) who set ρ between 0.06 and 0.1, respectively. This choice allows me to take into account the exit from employment to unemployment as the exit of the labor market. Following Krause and Lubik (2010) and Macit (2010), I set hiring costs equal to 0.16 in order to take into account both costs of recruitment and of training. Regarding the bargaining power, I follow Hagedorn and Manovskii (2008) and set $\eta = 0.1$. Following Petrongolo and Pissarides (2001), Trigari (2006) and Christoffel and Kuester (2008), I set $\sigma = 0.5$. Finally, following Garibaldi and Violante (2005), I

Chapter 3: A new insight on the inflation persistence: the role of severance pay

set $\rho_u = \rho_a = 0.5$. According to OECD (2013), I set Y to 0.35 in order to obtain an average severance pay equal to 4.2 month's wage by years worked.

Regarding Calvo's coefficient, I set the average duration between each optimal price adjustment to 4 quarterly and set $\varphi = 0.85$. Furthermore, I assume that firms have returns to scale almost constant and I set $\alpha = 0.99$, following Christoffel and Kuester (2008) and Christoffel et al. (2009a).

Moreover, the Taylor rule parameters are set according to Clarida et al. (2000) and Trigari (2006): the elasticity ρ_m of the gross nominal interest rate with regards to its own lag to 0.9. Besides, the elasticity of the nominal interest rate with regards to inflation and the output gap are set to 1.5 and 0.5, respectively.

Then, I set T to 0.18 in order to have legal costs equal to 20% of the average wage, following Thomas and Zanetti (2009). Finally, following Garibaldi and Violante (2005), I set \hat{F} equal to 0.6 and I compute the other steady-states accordingly.

The long-run targeted values are presented in Table 3.2.

Tab. 3.2: Targeted Values

π_s	1	Inflation
p_s	1	Prices
y_s	1	Output
q_s	0.7	Job filling probability
Ω_s	0.06	Unemployment
w_s	2.2	Real Wage
h_s	1	Hours Worked
r_s^n	1	Nominal interest rate

3.6 Simulation Results: the importance of bargained firing costs and the wage channel for the explanation of inflation persistence

Tab. 3.3: The auto-correlation coefficients

	i=1	i=2	i=3	i=4	i=5
Case 1: Fixed firing costs	0.27	0.17	0.08	0.03	0.04
Case 2: Dynamic firing costs and EB ^a	0.29	0.17	0.08	0.02	0.03
Case 3: Dynamic firing costs and RTMB ^b	0.60	0.37	0.20	0.08	0.06
Case 4: No firing costs	0.27	0.17	0.09	0.03	0.04

^a EB means Efficient Bargaining

^b RTMB means Right-To-Manage Bargaining

3.6 Simulation Results: the importance of bargained firing costs and the wage channel for the explanation of inflation persistence

Simulations represent the case of an expansionary monetary shock.⁵ I follow Fuhrer (2010) and I take as a definition of inflation persistence the auto-correlation function. While Pivetta and Reis (2007) retained only the first order auto-correlation coefficient as a measure of inflation persistence, I choose to adopt the first five coefficients as a measure since the auto-correlation function sums up a great part of the information.

3.6.1 The auto-correlation functions

Table 3.3 shows the different auto-correlation functions according to the different cases. Index i refers to the time lag of the different inflation auto-correlation functions.

The first results provided by Figure 3.3 are given by the comparison of case 1 and case 4. One can see that simply introducing severance pay in a New Keynesian model does not improve inflation persistence. All the coefficients of auto-correlation are quite similar.

⁵ Simulation are realized thanks to the Adjemian et al.'s (2011) Dynare program.

The comparison of case 1 and case 2 shows that the introduction of bargained firing costs increase the first lag of inflation dynamics. This result shows that it is the contribution system to the worker protection that affects the most inflation persistence and not the transfer from firms to workers in case of lay-offs.

Indeed, after an expansionary monetary shock, the nominal interest rate decreases that positively impacts households' consumption. In return, this stimulation will positively impact aggregate demand and then firms' production. Since the whole economy is in expansion, this will be translated into an increase of the real wage as well as an increase in job protection. Because of the existence of the contribution system, this increase of the job protection yields an increase in the workers' contribution. This increase will end the real wage increase and so it will increase wage rigidities.

However, this increase is quite weak and holds only for the first auto-correlation coefficient. This can be explained by the fact that in the efficient bargaining framework, the real wage has no direct impact on marginal cost. Accordingly, any change in wage dynamics will have no significant impact on inflation dynamics.

Finally, the introduction of the wage channel with bargained firing costs leads to double inflation for the whole auto-correlation function. The impact of bargained firing costs is thus well exploited by the wage channel.

3.6.2 The Impulse Response Functions

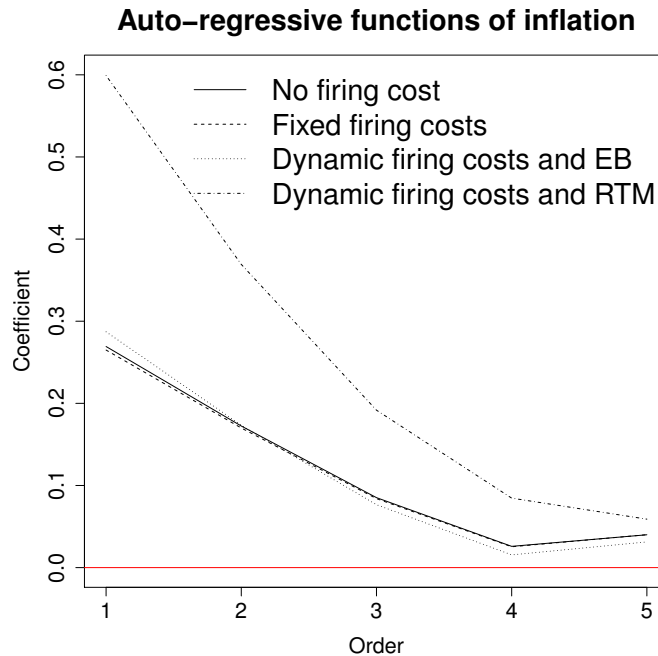
This section presents the impulse response functions of the economy after the expansionary monetary shock. First, I present the global behavior of the model accordingly to the three cases: fixed firing cost (FFC), the efficient bargaining (EB) and the right to manage bargaining (RTBM) with bargained firing costs.

The stylized facts and the whole economy reaction

I compare the different cases with the stylized facts highlighted by Christiano et al. (2005), Trigari (2009) and Christoffel et al. (2009a). These authors show that:

3.6 Simulation Results: the importance of bargained firing costs and the wage channel for the explanation of inflation persistence

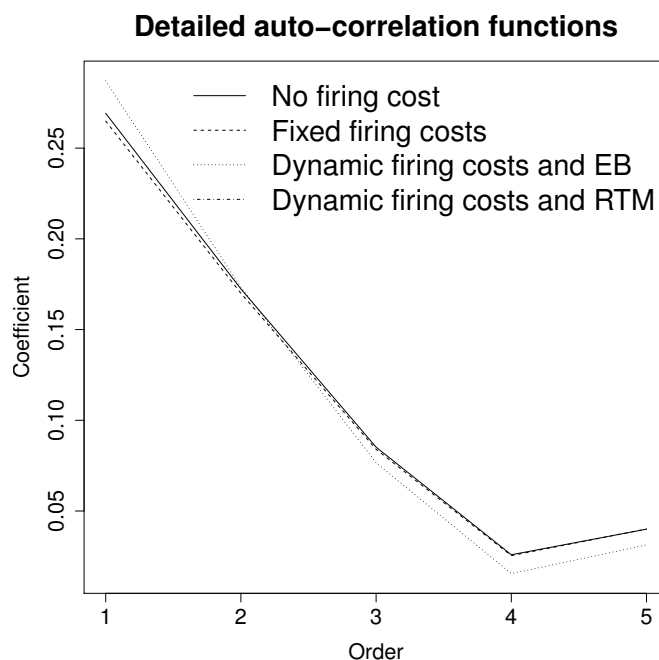
Fig. 3.1: The auto-correlation functions



1. after a positive monetary shock, **output** increases significantly with a peak response around 0.3 and 0.7 percentage point;
2. **inflation** rises - with a peak response around 0.2 percentage point - but less than output as well as **wages**;
3. **employment** rises while **unemployment** falls. However, the variation of the number of job seekers is stronger than the employment's one - with a peak response around 3-4.5 percentage points;
4. finally, the **intensive margin** increases but greatly less than the extensive margin.

The different impulse response functions are presented in Appendix 3.8.4. First, as the IRF shows, the economy reacts qualitatively in the same way for the three cases (fixed firing costs, efficient bargaining and right-to-manage bargaining), except for the wage dynamics. In the fixed firing cost and the efficient bargaining cases, the economy also reacts in a same amplitude. After the monetary shock output increases instantaneously in the three different cases. This can

Fig. 3.2: Detailed auto-correlation functions



be explained by a stimulation of the private consumption linked to the fall of the nominal interest rate, since here the economy is composed only by a Ricardian representative household. Regarding both the fixed firing cost case and the efficient bargaining case, the response peak is reached at the second period for a deviation from the steady state around 0.6 %. In the right-to-manage bargaining framework, the response peak is reached at the third period for a deviation from the steady state around 0.5% that is below the stylized facts. The inflation reaction is the same as the fixed firing cost and the efficient bargaining cases and, as previously, the reaction in the right-to-manage framework is below the stylized facts.

Regarding the wage reaction, one can note that the efficient bargaining framework wage reaction is quite different from the two other cases. Indeed, in the efficient bargaining framework, the real wage is driven by the global firing costs. Moreover, in this case, global firing costs react instantaneously, strongly and positively to the monetary shock. From the second period, the negotiation of firing costs leads to correct this over-reaction. In the right-to-manage bargaining frame-

work, the global firing costs reaction are more balanced during the first period and do not need to be corrected. This mainly explains the difference in the wage reaction between the two different frameworks.

Releasing the nominal rigidities

As it has been expounded in Table 3.1, the combination of bargained firing costs and the right-to-manage bargaining is the most able to reproduce inflation persistence. Nevertheless, this framework provides too weak responses to the monetary shock.

In order to solve this problem, I choose to release the nominal rigidity, especially by reducing the Calvo's coefficient.

Tab. 3.4: Alternative Calibration for the Calvo coefficient

	$\varphi = 0.85$	$\varphi = 0.7$
Inflation first Autocorrelation Coefficient	0.5991	0.5870
Inflation peak Response	0.0373	0.1753

Table 3.4 shows that the degree of nominal rigidities has not an important impact on inflation persistence. Moreover, choosing a value closer to Christoffel et al. (2009b) and Macit's (2010) choices yields an inflation peak closer to the stylized facts.

Appendix 3.8.5 presents the impulse response functions under the right-to-manage bargaining framework with both the baseline calibration and the alternative calibration with $\varphi = 0.7$.

3.7 Conclusions

In this chapter, I reintroduce severance pay which has been neglected by the economic literature since the bonding critique. I consider four cases: in the first one, I introduce the severance pay into a DSGE model within a frictional labor market; in the second and the third cases, following Garibaldi and Violante (2005),

I introduce a negotiation of severance pay. The second and the third cases are different in the wage bargaining process since the second case corresponds to the case where the real wage is efficiently negotiated while the third case is for the right-to-manage bargaining. Finally, I compare these first three models to a model close to the model of Trigari (2006) where there is no firing costs.

The simple introduction of severance pay into the New Keynesian framework does not allow to increase inflation persistence. Indeed, comparing with the model of Macit (2010), the simple introduction of a transfer from firms to workers in case of lay-off does not introduce strong rigidities into wage's dynamics. However, the negotiation of severance pay gives to firing costs new dynamics. As expounded by Lazear (1990), the introduction of the transfer component of firing costs leads to the introduction of a contribution system into the economy. Workers agree to reduce the impact of firing costs for firms by reducing the level of the real wage. However, these dynamics are not strong enough in the efficient bargaining framework because the real wage does not play a crucial role in firms' marginal cost. The contribution system yields an improvement of inflation persistence in the right-to-manage bargaining framework where the wage channel is active and where the real wage has a direct impact on firms' marginal cost. In this case, through the NKPC, the firing cost bargaining process impacts directly inflation persistence.

Political implications of the model for the Euro-zone are double. First, the Euro-zone is known as an economic zone with a single monetary policy and labor markets that are structurally different. As it has been shown in the model, the labor market institutions affect directly inflation dynamics. These differences regarding the labor market must be taken into account in order to optimize the monetary policy. Secondly, in return, a harmonization of the labor market in Europe will have some consequences in terms of monetary policy that the European Central Bank should take into account.

3.8 Appendix

3.8.1 Fixed firing costs

This section presents the case where severance pay is imposed by an external authority.

Firing costs are composed by a fixed tax component (*e.g.* a notice period) and a fixed transfer component (a legal severance pay).

The Bellman equations

Firms:

$$J_t = x_t f(h_t) - w_t h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} + \rho (V_{t+1} - F)] \quad (3.8.1)$$

$$J_t^n = x_t f(h_t) - w_t^n h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} + \rho (V_{t+1} - F)]. \quad (3.8.2)$$

$$V_t = \frac{-\kappa}{\lambda_t} + E_t \beta_{t,t+1} [q_t (1 - \rho) J_{t+1} + (1 - q_t) V_{t+1}]. \quad (3.8.3)$$

$$\frac{\kappa}{\lambda_t q_t} = E_t \beta_{t,t+1} [(1 - \rho) J_{t+1}]. \quad (3.8.4)$$

Workers:

$$W_t = w_t h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho) (W_{t+1} - U_{t+1}) + U_{t+1} + \rho S] \quad (3.8.5)$$

$$W_t^n = w_t^n h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho) (W_{t+1} - U_{t+1}) + U_{t+1} + \rho S] \quad (3.8.6)$$

$$\begin{aligned} U_t &= b + E_t \beta_{t,t+1} [s_t(1-\rho)W_{t+1} + s_t \rho U_{t+1} + (1-s_t)U_{t+1}] \\ &\Leftrightarrow U_t = b + E_t \beta_{t,t+1} [s_t(1-\rho)(W_{t+1} - U_{t+1}) + U_{t+1}] \end{aligned} \quad (3.8.7)$$

Efficient bargaining

In this case, the wage is assumed to be efficiently bargained. The Nash product is

$$[W_t - (U_t + S)]^\eta [J_t - (V_t - F)]^{1-\eta}, \quad (3.8.8)$$

In the case of a new job, the Nash product is defined as

$$[W_t^\eta - U_t]^\eta [J_t^\eta - V_t]^{1-\eta} \quad (3.8.9)$$

One can see here that the difference between an insider worker and an outsider worker still holds.

Wages bargaining

The old job case: According to the efficient bargaining and supposing that the free entry condition holds, the maximization of the Nash product with respect to wage leads to the following optimal condition

$$(1-\eta)[W_t - U_t - S] = \eta[J_t + F]. \quad (3.8.10)$$

Substituting the expression for J_t , W_t and U_t by their values yields

$$\begin{aligned} w_t &= \eta \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1-\eta) \left[\frac{m r s_t}{1+\phi} + \frac{b}{h_t} \right] \\ &\quad + \eta \frac{s_t(1-\rho)}{h_t} F + (1-\eta) \frac{s_t(1-\rho)}{h_t} S, \end{aligned} \quad (3.8.11)$$

The new job case: Here, the Nash product is defined by

$$[W_t^n - U_t]^\eta J_t^{1-\eta}. \quad (3.8.12)$$

The maximization of this product with respect to wage yields

$$w_t^n = \eta \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1 - \eta) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] - \frac{\eta \rho}{h_t} F - \frac{(1 - \eta) \rho}{h_t} S \quad (3.8.13)$$

3.8.2 Bargained severance pay and the efficient bargaining

The old job case: In the case of a old job wage, the Nash product is

$$[W_t - (U_t + S_t)]^\eta [J_t + F_t]^{1-\eta}. \quad (3.8.14)$$

The maximization of this product leads to the following condition

$$(1 - \eta) (W_t - U_t - S_t) = \eta (J_t + F_t) \quad (3.8.15)$$

$$\Leftrightarrow W_t - U_t = \frac{\eta}{1 - \eta} (J_t + F_t) + S_t \quad (3.8.16)$$

Replacing J_t , W_t and U_t by their values yields

$$w_t = \eta \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1 - \eta) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] + \frac{(1 - \eta)}{h_t} S_t + \frac{\eta}{h_t} F_t - \frac{[1 - (1 - \rho) s_t]}{h_t} \{ (1 - \eta) E_t \beta_{t,t+1} [S_{t+1}] + \eta E_t \beta_{t,t+1} [F_{t+1}] \}. \quad (3.8.17)$$

The new job case: The Nash product for the new job wage bargaining is

$$(W_t^n - U_t)^\eta (J_t^n)^{1-\eta}, \quad (3.8.18)$$

where

$$J_t^n = x_t f(h_t) - w_t^n h_t + E_t \beta_{t,t+1} [(1 - \rho) J_{t+1} - \rho F_{t+1}] \quad (3.8.19)$$

$$W_t^n = w_t^n h_t - \frac{g(h_t)}{\lambda_t} + E_t \beta_{t,t+1} [(1 - \rho) (W_{t+1} - U_{t+1}) + U_{t+1} + \rho S_{t+1}] \quad (3.8.20)$$

The maximization of the Nash product with respect to the outsiders wage

yields after some algebra

$$w_t^n = \eta \left[\frac{x_t m p l_t}{\alpha} + \frac{\kappa \theta_t}{\lambda_t h_t} \right] + (1 - \eta) \left[\frac{m r s_t}{1 + \phi} + \frac{b}{h_t} \right] - \frac{(1 - \eta) \rho}{h_t} E_t \beta_{t,t+1} [S_{t+1}] - \frac{\eta \rho}{h_t} E_t \beta_{t,t+1} [F_{t+1}]. \quad (3.8.21)$$

The hours worked bargaining and the extensive margin

This section presents the determination of hours worked in the framework of the efficient bargaining. In this framework, firms and workers maximize jointly their surplus according to the hours worked.

The maximization of the Nash product leads to the following optimal condition

$$\eta \left[w_t - \frac{g'(h_t)}{\lambda} \right] (J_t + F) = (1 - \eta) [w_t - x_t f'(h_t)] [W_t - U_t - S] \quad (3.8.22)$$

According to equation (3.8.10), one can obtain *in fine* the channel of the extensive margin

$$x_t m p l_t = m r s_t \quad (3.8.23)$$

Equation (3.8.23) emphasizes the channel of the extensive margin, according to Trigari (2006). In this economy where x_t is both the intermediate goods price and the retailers marginal cost, the existence of the channel of the extensive margin will push firms to adjust their production *via* the employment rather than the hours worked. Besides, an increase of employment is without additional costs for firms whereas an increase in the hours worked will lead to an increase in the retailer marginal cost.

Moreover, one can note that the determination of hours worked for a new worker or for an old and a new worker in the case of bargained firing costs leads to the same optimal condition. The EPL has thus no impact on the determination of hours worked in the case of efficient bargaining process.

3.8.3 Steady-State Calculations

Starting from the long-run targeted values described in table 3.1, I now describe the steady-state calculations.

From equations (3.2.14) and (3.2.13), one can define the value of employment and the number of job seekers at the steady-state such as

$$n_s = 1 - \Omega_s \quad (3.8.24)$$

$$u_s = 1 - (1 - \rho)n_s. \quad (3.8.25)$$

From the clearing market condition given by equation (3.2.22), I obtain

$$c_s = y_s \quad (3.8.26)$$

The value of the marginal utility of consumption at the steady-state is given by

$$\lambda_s = \frac{(1 - \beta e)}{(1 - e)c_s} \quad (3.8.27)$$

$$r_s = \frac{1}{\beta} \quad (3.8.28)$$

$$(3.8.29)$$

From the employment law of motion which firms are facing, which is $n_t^f = (1 - \rho)n_{t-1}^f + q_t v_t$, at the steady state value, one can get

$$v_s = \rho \frac{n_s}{q_s} \quad (3.8.30)$$

Thanks to the definition of the job filling probability, given by equation(3.2.10), and to the matching function defined by equation (3.2.9), I can define the match-

ing technology parameter such as

$$\sigma^m = q_s \frac{v_s^{(\sigma-1)}}{u_s^{(1+\sigma)}}. \quad (3.8.31)$$

Equation (3.8.31) allows me to define the number of new matches at the steady state such as

$$m_s = \sigma^m u_s^\sigma v_s^{(1-\sigma)}. \quad (3.8.32)$$

Finally, thanks to equation (3.8.32), I can define the probability for a worker to find a job as well as the labor market tightness at the steady state such as

$$s_s = \frac{m_s}{u_s} \quad (3.8.33)$$

$$\theta_s = \frac{v_s}{u_s}. \quad (3.8.34)$$

Given the definition of the marginal productivity of labor, one can easily see that its value at the steady-state is equal to

$$mpl_s = \alpha h_s^{(\alpha-1)}. \quad (3.8.35)$$

According to the wage channel defined by equation (3.4.9), the value of the firms' marginal cost at the steady-state is equal to

$$x_s = \frac{w_s}{mpl_s}. \quad (3.8.36)$$

Given the definition of the marginal rate of substitution, I obtain

$$mrs_s = \kappa_h \frac{h_s^\phi}{\lambda_s}. \quad (3.8.37)$$

Given equations (3.3.1), (3.3.2), (3.3.4) and (3.3.6), I obtain

$$FP_s = SP_s + T \quad (3.8.38)$$

$$SP_s = w_s^v \quad (3.8.39)$$

$$S_s = \rho_u(SP_s + \eta T) \quad (3.8.40)$$

$$F = \rho_a \rho_u(SP_s + \eta T) + (1 - \rho_a)\rho_u \beta FP_s. \quad (3.8.41)$$

Thanks to equations (3.4.13), (3.4.14), (3.4.16), (3.4.17), (3.4.18) and (3.4.19), one can easily obtain

$$\delta_s^w = \frac{h_s}{(1 - \alpha)} \frac{mrs_s}{w_s - \alpha} \quad (3.8.42)$$

$$\delta_s^f = h_s \quad (3.8.43)$$

$$\chi_s = \frac{n_s \delta_s^w}{(\eta \delta_{w_s} + (1 - \eta) \delta_s^f)} \quad (3.8.44)$$

$$\xi_s = \frac{\eta \delta_s^w}{(1 - \eta) \delta_s^f} \quad (3.8.45)$$

$$A_s = \frac{1}{h} [\chi_s \rho + (1 - s_s)(1 - \rho)(1 - \chi_s) \xi_s] \quad (3.8.46)$$

$$B_s = \frac{(1 - \chi_s)(\rho + (1 - s_s))(1 - \rho)(1 - \chi_s)}{h_s} \quad (3.8.47)$$

Finally, the marginal value of a job for a firm, defined by equation (3.4.1), at the steady-state is given by

$$J_s = \frac{x_s z h_s^\alpha - w_s h_s - \beta \rho F_s}{1 - \beta(1 - \rho)}. \quad (3.8.48)$$

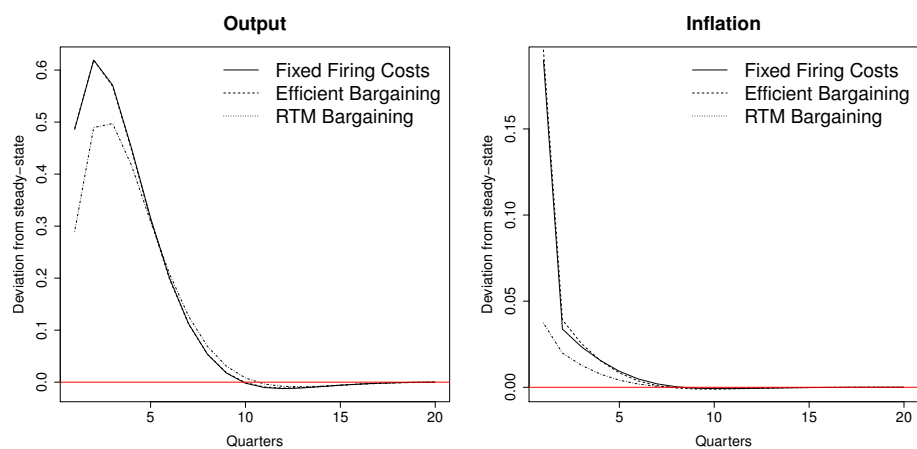
The marginal value of job, equation (3.4.6), and unemployment, equation (3.4.8), for a worker at the steady-state are given after some algebra by

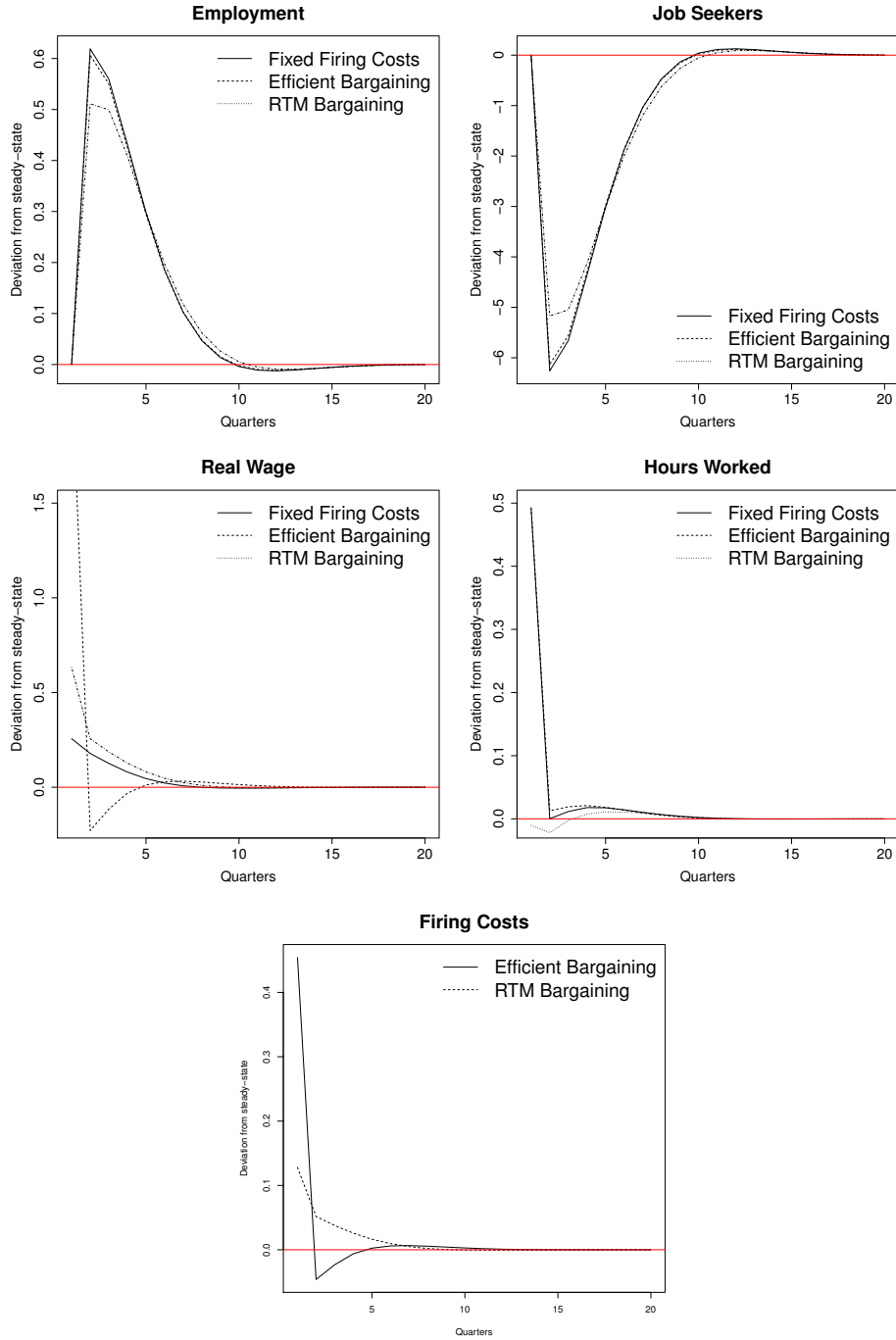
$$W_s = \frac{w_s h_s - \frac{\kappa_h h_s^{(1+\phi)}}{\lambda_s} + \beta \rho \left(\frac{b}{1 + \beta[s_s(1 - \rho) - 1]} + S_s \right)}{1 - \beta(1 - \rho) \left(1 + \frac{\rho \beta s_s}{1 + \beta[s_s(1 - \rho) - 1]} \right)} \quad (3.8.49)$$

$$U_s = \frac{b + \beta s_s(1 - \rho)W_s}{1 - \beta + \beta[s_s(1 - \rho)]} \quad (3.8.50)$$

3.8.4 Impulse Response Functions under the FFC, the EB and the RTMB frameworks

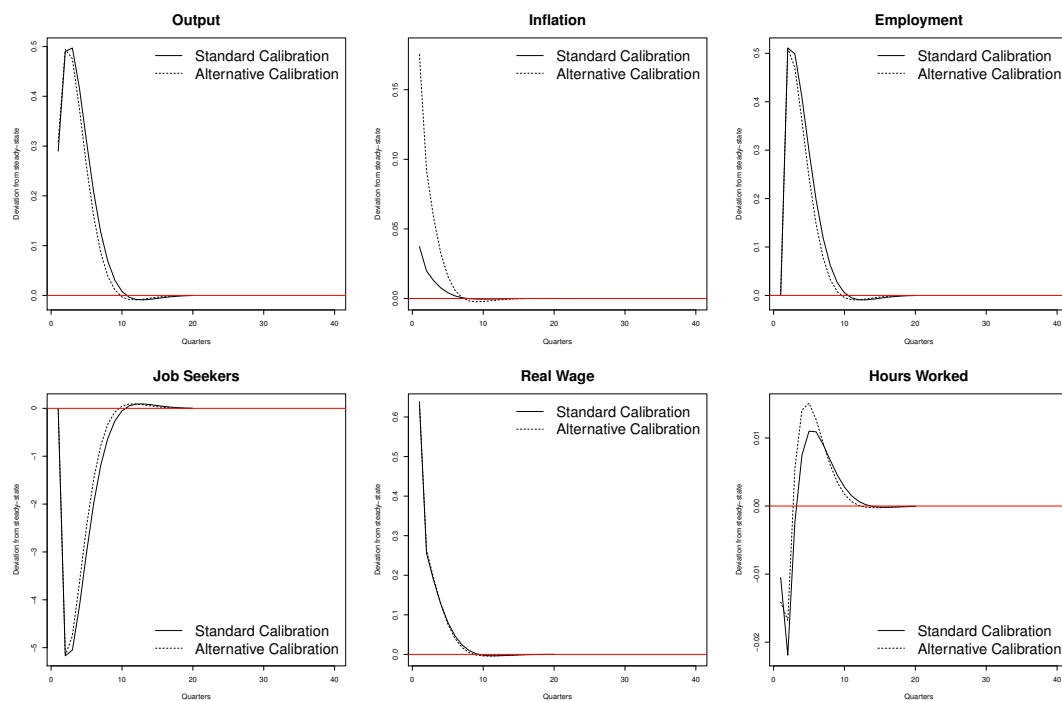
I present here the Impulse-Response Functions (IRF) to an unexpected monetary policies shock of 100 basis points.





3.8.5 The IRF under the Baseline Calibration and the Alternative Calibration

I present here the IR functions in two different cases: the first case corresponds to the right-to-manage bargaining case where the Calvo coefficient is fixed to 0.85. The second case corresponds to the right-to-manage bargaining framework where the Calvo coefficient is fixed to 0.7.



Chapter 4 | How harmful are cuts in public employment and wage in times of high unemployment?*

4.1 Introduction

Eight years after the crisis, European economies seem to be enmeshed in a period of weak GDP growth. The European Central Bank forecasts a 1.4% growth of GDP for 2015, that is significantly lower than in the US and in the UK (respectively 2.4% and 2.1%). Also, despite positive elements like a falling Euro and historically low oil prices, unemployment falls only slightly and remains above 10% in the Euro Area. This weak performance of the European economy could be due, at least partly, to the fiscal orientation chosen by most Euro Area members in recent years: since 2010, European policymakers have implemented particularly large fiscal consolidation plans.

Blanchard and Leigh (2013) show that forecasters have underestimated the cost on GDP growth of recent fiscal consolidation episodes leading to large growth forecast errors. In other words, fiscal austerity in the Euro Area would have had particularly strong and unexpected negative effects on GDP since fiscal multipliers would have been large during this period. For instance, a 5% contraction of

⁰ This Chapter is based on an article co-written with Thierry Betti, titled "How harmful are cuts in public employment and wage in times of high unemployment?".

Chapter 4: How harmful are cuts in public employment and wage in times of high unemployment?

GDP was forecasted in Latvia while the actual contraction was 18%. In Hungary, the forecasted contraction was 1% but the actual figure was 6.7%.

Different reasons have been advanced to explain unusually large fiscal multipliers. As summarized by Blanchard and Leigh (2013), at least three factors can be pointed out: central banks' interest rates close to 0 (the Zero Lower Bound), badly functioning financial markets and a large fall in GDP following the crisis. Regarding the latter element, there would be a sizable difference in the output fiscal multiplier according to the position of the economy over the business cycle. This result has been highlighted in recent empirical studies and notably in Auerbach and Gorodnichenko (2012): estimates based on US data indicate that the output fiscal multiplier is close to 0 in normal times but can reach 2.5 in periods of recession.¹

Alongside these empirical contributions, only few articles investigate the transmission channels at work in a theoretical framework. Sims and Wolff (2013) examine in a small-scale DSGE model the size of the fiscal multiplier along the business cycle. The authors show that a standard (non-linear) New Keynesian model can generate a countercyclical output fiscal multiplier. The intuition is straightforward: marginal utility of consumption is larger during economic downturn because of a lower average consumption level. In a Ricardian economy, households reduce less their level of consumption following the rise in real interest rates after fiscal expansions during economic downturn, *i.e* when the marginal utility of consumption is high. A lower negative wealth effect of public consumption on private consumption thus implies a larger output fiscal multiplier in bad times. As detailed later on, this chapter is closely related to Sims and Wolff (2013) since a larger output fiscal multiplier in bad times is also obtained through a lower crowding-out effect of government expenditure on private activity.

In the present chapter, I focus on the non-linear effects of cuts in public employment and public wage on total employment and economic activity. These

¹ Other studies bring similar results. See among others Creel et al. (2011), Baum et al. (2012) or Batini et al. (2012)

two fiscal instruments have been extensively used in the recent European austerity plans. In Spain, 14000 public jobs have been cut and a replacement rate of 10% has been implemented for the period 2012-2013. Also, public-sector salaries were decreased by 5% in 2010 and then frozen in 2011. In Greece, fiscal efforts have been particularly violent: only 10% of retirements have been replaced while public-sector salaries have been frozen. Moreover, thirteenth and fourteenth month pay have been removed. Overall, compensations to employees in the public sector are frozen in Germany, France, Italy, Greece and Portugal and public employment is significantly reduced.

In Creel et al. (2011), the authors estimate a significant difference as to the effects of changes in public employment on output according to the position of the economy over the business cycle. In the long run, the output fiscal multiplier is estimated to 1.5 in good times and to -1.1 during economic downturn. Michailat (2014) analyses the non-linear effects of public employment on private employment. In a search and matching model for the labor market in which both a public and a private sector coexist, a rise in public vacancies tends to crowd-out private employment despite that the effects on total employment remains positive.² Michailat (2014) studies the effects of a rise in public vacancies on private and total employment according to the unemployment level at the steady state. The main result is that the higher the unemployment rate, the lower the crowding-out effect of public employment on the private sector. This induces that decreasing the number of public employees is more costly in terms of total employment when the unemployment rate is large.

In the present chapter, I also demonstrate that cuts in public employment and public wage affect more negatively total employment when the unemployment rate is large. In addition, I exhibit that cuts in public employment and public-sector salaries trigger a larger degradation of output in periods of high unemployment. As a consequence, the reduction in debt induced by restrictive fiscal policies is significantly lower when cuts in government employment and public-

² Ramey (2012) estimates the effects of public employment on private activity and also argue for a negative effect of public employment on private employment

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sector salaries are implemented in times of high unemployment. Hence, this chapter argues that recent fiscal contractions based on public employment have been particularly harmful in the Euro Area.

I construct a large-scale DSGE model with a two-sector labor market *à la* Mortensen and Pissarides. The model is solved at the second order to take into account the influence of the steady-state unemployment on the response of the economy following cuts in government employment and wage.³ As in Michailat (2014), I show that cuts in government employment and public-sector salaries are more harmful in terms of employment when the initial unemployment rate is high. Let us consider the case of a rise in public vacancies. Intuitively, the larger the number of job seekers, the lower the crowding-out effect of government employment on private employment. Hence, cuts in government employment have more costly effects on total employment when unemployment is already high.

Unlike Michailat (2014) I also focus on the response of output following fiscal policy shocks. I demonstrate that the greater negative effect on employment of cuts in public employment and wage in times of high unemployment triggers a larger negative effect on output. The stronger decrease in employment tends to generate a larger degradation of consumption of *hand-to-mouth* households. Moreover, the private-sector real wage remains larger when cuts in public-sector employment and salaries are implemented in times of high unemployment. As a consequence, inflation and then the real interest rate tend to be larger in the case of a high steady-state unemployment rate so that the response of Ricardian consumption is better in this case.

The model used in this chapter is close to Sims and Wolff (2013) since I focus on state-dependent output fiscal multipliers according to the position over the business cycle in a large-scale DSGE model and my result is based on a lower crowding-out effect of fiscal policy on private consumption. However, I depart from Sims and Wolff (2013) since a lower crowding-out effect on private con-

³ Hairault et al. (2010), analyzing the welfare costs of business cycles thanks to the matching unemployment theory show that the search and matching framework can be quite non-linear.

sumption is, in my case, not due to a different behavior from the representative household according to the position over the business cycle but to larger inflation pressures in bad times following a negative fiscal shock.

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 my model does not include this transmission channel. On the contrary, my definition of the steady-state value of Ricardian's consumption implies a lower marginal utility of consumption during economic downturn. The transmission channel I 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 sizeable 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 presents the model, section 3 describes the calibration and the simulation strategy. Section 4 highlights the main results of the chapter and section 5 concludes.

4.2 The DSGE model

The model used in this chapter features nominal rigidity on prices and matching frictions on the labor market in which both a public and a private sector are introduced. I 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.

4.2.1 Definitions and the matching process

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

$$1 - (1 - \rho)E_t^{tot} = U_t + \rho E_t^{tot}, \quad (4.2.1)$$

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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

$$S_t = U_t + \rho E_t^{tot}. \quad (4.2.2)$$

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:

$$E_t^i = (1 - \rho)E_{t-1}^i + p_{t-1}^i(1 - \rho)S_{t-1}, \quad (4.2.3)$$

with $i = p, g$ where p characterizes the private sector and g the public sector. 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

$$S_t = (1 - p_{t-1}^p - p_{t-1}^g)S_{t-1} + \rho(p_{t-1}^p + p_{t-1}^g)S_{t-1} + \rho(E_{t-1}^p + E_{t-1}^g). \quad (4.2.4)$$

According to equation (4.2.4), the number of job seekers in the current period is equal to the number of job seekers who did not find a job neither in the private sector nor in the public sector in the previous period plus the number of jobs which are destroyed in the previous period. Finally, I assume that there is a 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 exogenously.

Let us now define the matching process M_t^i that occurs on a specific labor market sector, such as:

$$M_t^i = \kappa_e^i (S_t)^{\varphi^i} (V_t^i)^{(1-\varphi^i)}, \quad (4.2.5)$$

where κ_e^i denotes the matching technology in a particular sector while φ^i denotes

the elasticity of employment for a supplementary unemployed worker. V_t^i defines the number of vacancies in the sector i . Vacancies in the public sector are assumed to be set as exogenous by the government.

I can therefore set the following usual definitions:

$$p_t^i = \frac{M_t^i}{S_t}, \quad (4.2.6)$$

$$\text{and } q_t^i = \frac{M_t^i}{V_t^i} \quad (4.2.7)$$

with p_t^i the job finding probability in the sector i and q_t^i the probability for a firm to fill a vacancy.

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

$$\theta_t^i = \frac{V_t^i}{S_t} = \frac{p_t^i}{q_t^i}. \quad (4.2.8)$$

4.2.2 Households' decisions

In this model two different types of agents are introduced. I 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. *Hand-to-mouth* consumers can neither loan nor save so that they simply consume their disposable income in each period, while 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

As in Merz (1995), I consider a representative Ricardian household who maximizes its lifetime utility, with instantaneous utility defined as:

$$u(C_t^o, C_{t-1}^o, G_t, e_{jt}) = \frac{(C_t^o - HC_{t-1}^o)^{1-\sigma_c} - 1}{1 - \sigma_c} + M^o(e_{jt}) \quad (4.2.9)$$

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

Following Ravn (2005, 2008), e_{jt} with $j = n, u, l$ denotes 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:

$$e_{nt} = 1 - h - s, \quad (4.2.10)$$

$$e_{ut} = 1 - s, \quad (4.2.11)$$

$$e_{lt} = 1, \quad (4.2.12)$$

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

Function $M^o(e_{jt})$ contains the different possible statuses of a worker on the labor market, such as:

$$M^o(e_{jt}) = \frac{[(E_t^{op} + E_t^{og})(1 - h - s)^{1-\zeta} + S_t^o(1 - s)^{1-\zeta} + (1 - (E_t^{op} + E_t^{og}) - S_t^o)]}{1 - \zeta} \quad (4.2.13)$$

where $-1/\zeta$ is the Frisch elasticity of labor supply and S_t^o denotes the job seekers

among Ricardian households. 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:

$$\max_{C_t^o, K_t^o, B_t, E_t^o, S_t^o, I_t^o} E_t \sum_{s=t}^{\infty} \beta^s u(C_{t+s}^o, C_{t-1+s}^o, G_{t+s}, e_{t+s}). \quad (4.2.14)$$

subject to

$$(1 + \tau_t^c)C_t^o + \frac{B_t}{P_t} + I_t^o \leq R_{t-1}^k K_{t-1} + \frac{R_{t-1}B_{t-1}}{P_t} + b(S_t^o) \\ + (1 - \tau_t^w)[W_t^g h E_t^{og} + W_t^p h E_t^{op}] \quad (4.2.15)$$

$$K_t^o = (1 - \delta^k)K_{t-1}^o + [1 - A(I_t^o / I_{t-1}^o)]I_t^o \quad (4.2.16)$$

$$E_t^{op} = (1 - \rho)E_{t-1}^{op} + p_{t-1}^p(1 - \rho)S_{t-1}^o \quad (4.2.17)$$

$$E_t^{og} = (1 - \rho)E_{t-1}^{og} + p_{t-1}^g(1 - \rho)S_{t-1}^o \quad (4.2.18)$$

$$S_t^o = (1 - p_{t-1}^p - p_{t-1}^g)S_{t-1}^o + \rho(p_{t-1}^p + p_{t-1}^g)S_{t-1}^o + \rho(E_{t-1}^{op} + E_{t-1}^{og}) \quad (4.2.19)$$

Equation (2.14) can be reduced to the following Bellman equation:

$$\Omega_t^o(K_t^o, E_t^o, B_t, I_t^o) = \max_{C_t^o, K_t^o, S_t^o, n_t^o, B_t, I_t^o} \left\{ \frac{(C_t^o - HC_{t-1}^o)^{1-\sigma_c}}{1 - \sigma_c} + \frac{\zeta_g g_t^{1-\sigma_c} - 1}{1 - \sigma_c} \right. \\ \left. + \frac{[(E_t^{op} + E_t^{og})(1 - h - s)^{1-\zeta} + S_t^o(1 - s)^{1-\zeta} + (1 - (E_t^{op} + E_t^{og}) - S_t^o)]}{1 - \zeta} \right\} \\ + \beta \Omega_{t+1}^o(K_{t+1}^o, E_{t+1}^o, B_t, I_t^o), \quad (4.2.20)$$

where β is the discount factor. Equation (4.2.15) represents the household's budget constraint. Households have access to a riskless asset B_t . Furthermore, households invest 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

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respectively in the public and in the private sector. P_t defines the consumer price index (CPI thereafter). τ_t^c represents a VAT and τ_t^w a labor income tax. Equation (4.2.16) represents the law of motion of capital accumulation. I introduce an adjustment cost to investment changes with $A(I_t^o/I_{t-1}^o) = \frac{\kappa}{2}(I_t^o/I_{t-1}^o - 1)^2$ in lines with Christiano et al. (2005) or Smets and Wouters (2007), 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:

$$\lambda_t^{rio} = \frac{[C_t^o - HC_{t-1}^o]^{-\sigma_c} - \beta H E_t \{ [C_{t+1}^o - HC_t^o]^{-\sigma_c} \}}{1 + \tau_t^c} \quad (4.2.21)$$

$$\lambda_t^{rio} = r_t \beta E_t \left[\frac{\lambda_{t+1}^{rio}}{\pi_{t+1}} \right], \quad (4.2.22)$$

$$1 = Q_t [1 - A(I_t/I_{t-1})] \quad (4.2.23)$$

$$Q_t = \beta E_t \left[\frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} [(1 - \delta^k) Q_{t+1} + R_t^k] \right] \quad (4.2.24)$$

$$\begin{aligned} \lambda_t^{Eop} &= (1 - \tau_t^w) \lambda_t^{rio} W_t^p h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} \\ &\quad + \beta E_t [(1 - \rho)(\lambda_{t+1}^{Eop} - \lambda_{t+1}^{So}) + \lambda_{t+1}^{So}] \end{aligned} \quad (4.2.25)$$

$$\begin{aligned} \lambda_t^{Eog} &= (1 - \tau_t^w) \lambda_t^{rio} W_t^g h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} \\ &\quad + \beta E_t [(1 - \rho)(\lambda_{t+1}^{Eog} - \lambda_{t+1}^{So}) + \lambda_{t+1}^{So}] \end{aligned} \quad (4.2.26)$$

$$\begin{aligned}
 \lambda_t^{S_o} &= b\lambda_t^{rio} - \frac{1 - (1-s)^{1-\zeta}}{1-\zeta} \\
 &+ (1 - p_t^p - p_t^s)\beta E_t[\lambda_{t+1}^{S_o}] + \rho(p_t^p + p_t^s)\beta E_t[\lambda_{t+1}^{S_o}] \\
 &+ (1 - \rho)\beta E_t[p_t^p \lambda_{t+1}^{E_{op}} + p_t^s \lambda_{t+1}^{E_{os}}]
 \end{aligned} \tag{4.2.27}$$

where $\pi_{t+1} = p_{t+1}/p_t$ defines the CPI inflation rate, λ_t^{rio} the marginal utility of consumption for Ricardians, $\lambda_t^{E_{op}}$ the marginal utility of working in the private sector, $\lambda_t^{E_{os}}$ the marginal utility of working in the public sector and $\lambda_t^{S_o}$ the marginal utility to be currently a job seeker.

Equation (4.2.25) defines the value of a job for a Ricardian household in the private sector while equation (4.2.26) determines the value of a job in the public sector. Also, equation (4.2.27) describes 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 simply consume their disposable income each period. For a representative non-Ricardian household, consumption can be expressed as:

$$(1 + \tau_t^c)C_t^r = (1 - \tau_t^w)[W_t^s h E_t^s + W_t^p h E_t^p] + bS_t^r \tag{4.2.28}$$

with C_t^r the consumption of non-Ricardians households.

Similarly to Ricardian households, the utility function of *hand-to-mouth* households is given by:

$$u(C_t^r, C_{t-1}^r, G_t, e_{it}) = \frac{(C_t^r - HC_{t-1}^r)^{1-\sigma_c} - 1}{1-\sigma_c} + \frac{\zeta_g G_t^{1-\sigma_c}}{1-\sigma_c} + M^r(e_{jt}) \tag{4.2.29}$$

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with

$$M^r(e_{it}) = \frac{[(E_t^{rp} + E_t^{rg})(1-h-s)^{1-\zeta} + S_t^r(1-s)^{1-\zeta} + (1 - (E_t^{op} + E_t^{og}) - S_t^r)]}{1-\zeta} \quad (4.2.30)$$

The corresponding Bellmann equation and constraints for this optimization program are therefore:

$$\Omega_t^r = \max_{S_t^r, E_t^{rp}, E_t^{rg}} \left\{ \frac{(C_t^r - HC_{t-1})^{1-\sigma_c}}{1-\sigma_c} + \frac{[(E_t^{rp} + E_t^{rg})(1-h-s)^{1-\zeta} + S_t^r(1-s)^{1-\zeta} + (1 - (E_t^{op} + E_t^{og}) - S_t^r)]}{1-\zeta} \right\} + \beta \Omega_{t+1}^r \quad (4.2.31)$$

s.t.

$$(1 + \tau_t^c)C_t^r \leq (1 - \tau_t^w)[W_t^g h E_t^{rg} + W_t^p h E_t^{rp}] + b S_t^r \quad (4.2.32)$$

$$E_t^{rp} = (1 - \rho)E_{t-1}^{rp} + p_{t-1}^p(1 - \rho)S_{t-1}^r \quad (4.2.33)$$

$$E_t^{rg} = (1 - \rho)E_{t-1}^{rg} + p_{t-1}^g(1 - \rho)S_{t-1}^r \quad (4.2.34)$$

$$S_t^r = (1 - p_{t-1}^p - p_{t-1}^g)S_{t-1}^r + \rho(p_{t-1}^p + p_{t-1}^g)S_{t-1}^r + \rho(E_{t-1}^{rp} + E_{t-1}^{rg}) \quad (4.2.35)$$

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

$$\lambda_t^{E_{rp}} = (1 - \tau_t^w)\lambda_t^{r_{ir}}W_t^p h - \frac{1 - (1-h-s)^{1-\zeta}}{1-\zeta} + \beta E_t[(1 - \rho)(\lambda_{t+1}^{E_{rp}} - \lambda_{t+1}^{S_r}) + \lambda_{t+1}^{S_r}] \quad (4.2.36)$$

$$\begin{aligned} \lambda_t^{Erg} = & (1 - \tau_t^w) \lambda_t^{rir} W_t^g h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} \\ & + \beta E_t [(1 - \rho)(\lambda_{t+1}^{Erg} - \lambda_{t+1}^{Sr}) + \lambda_{t+1}^{Sr}] \end{aligned} \quad (4.2.37)$$

$$\begin{aligned} \lambda_t^{Sr} = & b \lambda_t^{rir} - \frac{1 - (1 - s)^{1-\zeta}}{1 - \zeta} \\ & + (1 - p_t^p - p_t^s) \beta E_t [\lambda_{t+1}^{Sr}] + \rho (p_t^p + p_t^s) \beta E_t [\lambda_{t+1}^{Sr}] \\ & + (1 - \rho) \beta E_t [p_t^p \lambda_{t+1}^{Erp} + p_t^s \lambda_{t+1}^{Erg}] \end{aligned} \quad (4.2.38)$$

where λ_t^{Erp} is the marginal utility of working in the private sector for a non-Ricardian household, respectively λ_t^{Erg} in the public sector and λ_t^{Sr} denotes the marginal utility for a non-Ricardian household to seek employment on the labor market.

Equation (4.2.36) defines the value of a job in the private sector for a non-Ricardian household while (4.2.37) defines the value of a job in the public sector. Also, equation (4.2.38) relates to the decision of a non-Ricardian worker to seek a job.

Maximization of (4.2.31) with respect to C_t^r yields the marginal utility of consumption for non-Ricardian households, such as:

$$\lambda_t^{rir} = \frac{(C_t^r - HC_{t-1}^r)^{\sigma_c} - \beta E_t [H(C_{t+1}^r - HC_t^r)^{\sigma_c}]}{1 + \tau_t^c} \quad (4.2.39)$$

4.2.3 Firms

For the purposes of the model, I need to introduce three kinds of firms as in Trigari (2006). First, some firms I refer as "producers" produce goods with labor and private capital in a competitive environment. The producers then sell their aggregate goods to "intermediate firms", which transform the aggregate good on a continuum of differentiated goods in a monopolistic competition environment.

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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 price-setting at the producer level would greatly complicate the decision of these firms on the labor market. However, this simplifying assumption has no important consequences neither on the price dynamic nor on the labor market dynamics.⁴

Producers

A representative firm in a perfectly competitive environment seeks to maximize its profits according to the following optimization program:

$$\max_{\tilde{K}_t, E_t^p, V_t} E_0 \sum_{t=0}^{\infty} \beta_{t,t+1} \{Y_t - R_t^k \tilde{K}_t - W_t^p E_t^p h - \kappa^v V_t\} \quad (4.2.40)$$

s.t.

$$Y_t = \epsilon_t^A [\tilde{K}_t]^\alpha [E_t^p h]^{1-\alpha} \quad (4.2.41)$$

$$E_t^p = (1 - \rho) E_{t-1}^p + q_{t-1}^p V_{t-1}^p \quad (4.2.42)$$

where $\beta_{t,t+1} = \beta \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}}$ defines the firm's discount factor. Moreover, the producer takes the probability to fill a vacancy q_t^p as given. V_t^p denotes the vacancies posted by the producer and κ^v an unitary cost. The accumulated capital is assumed to be used by firms with a lag, such as $\tilde{K}_t = K_{t-1}$. ϵ_t^A denotes a Total-Factor Productivity (TFP thereafter) shock and follows an AR(1) process such as:

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

⁴ 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 regarding the response of inflation to monetary shocks.

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

The problem (4.2.40) can be represented as a Bellman equation such as:

$$V(\Omega_t) = \max_{k_t, E_t^p, V_t} \left\{ Y_t - R_t^k k_t - W_t^p E_t^p h - \kappa^v V_t + \beta \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} V(\Omega_{t+1}) \right\} \quad (4.2.43)$$

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

$$\frac{\kappa^v}{q_t^p} = \beta_{t,t+1} \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} \lambda_{t+1}^{E_f} \quad (4.2.44)$$

$$\lambda_t^{E_f} = (1 - \alpha) \frac{Y_t}{E_t^p} - W_t^p h + (1 - \rho) \beta_{t,t+1} \frac{\lambda_{t+1}^{rio}}{\lambda_t^{rio}} \lambda_{t+1}^{E_f} \quad (4.2.45)$$

Equation (4.2.44) defines the value of a posted vacancy and (4.2.45) the value of a job for a producer.

Cost minimization subjects to equation (4.2.41) implies the following first order conditions:

$$R_t^k = \frac{\alpha Y_t}{K_t} mc_t \quad (4.2.46)$$

$$x_t = (1 - \alpha) mc_t \frac{Y_t}{E_t^p h} - W_t^p h, \quad (4.2.47)$$

where mc_t is the firms' marginal cost. Equation (4.2.46) characterizes the demand of capital by the producers and equation (4.2.47) defines the marginal cost of labor x_t .

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Intermediate firms, final goods firms and Calvo price-setting

There is a continuum j over $[0; 1]$ of intermediate firms that purchase the homogeneous goods from the producers at their marginal cost. Intermediate firms then transform the homogeneous goods on a continuum j of goods and sell them at the final goods firms.

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

$$Y_t = \left[\int_0^1 Y_{jt}^{\frac{\varepsilon-1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon-1}}, \quad (4.2.48)$$

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

$$Y_{jt} = \left(\frac{P_{jt}}{P_t} \right)^{-\varepsilon} Y_t, \quad (4.2.49)$$

with the following definition for the consumer price index P_t :

$$P_t = \left[\int_0^1 P_{jt}^{1-\varepsilon} dj \right]^{\frac{1}{1-\varepsilon}}, \quad (4.2.50)$$

where P_{jt} defines the price of good j in the period t .

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

An intermediate firm re-optimizes its price at period t seek to maximize its profit such as:

$$E_t \sum_{k=0}^{\infty} (\beta \theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} \left[\frac{P_{j,t}}{P_{t+s}} - mc_{t+s} \right] Y_{j,t+s}, \quad (4.2.51)$$

subject to the demand function expressed in equation (4.2.49). The first order condition yields:

$$P_{jt}^* = \frac{\varepsilon}{\varepsilon - 1} \frac{E_t \sum_{s=0}^{\infty} (\beta \theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} [mc_{t+s} P_{t+s}^\varepsilon Y_{t+s}]}{E_t \sum_{s=0}^{\infty} (\beta \theta_p)^s \frac{\lambda_{t+s}^{rio}}{\lambda_t^{rio}} [P_{t+s}^{\varepsilon-1} Y_{t+s}]} \quad (4.2.52)$$

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

$$P_t = [(1 - \theta_p) P_t^{*1-\varepsilon} + \theta_p P_{t-1}^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}. \quad (4.2.53)$$

Combination of equations (4.2.52) and (4.2.53) yield the New-Keynesian Phillips Curve.

4.2.4 Wage bargaining

The union utility corresponds to the mean of the surplus on employment of all its members. With μ being the share of non-Ricardian households, the union utility Y_t can be expressed as:

$$Y_t = (1 - \mu)[\lambda_t^{Eop} - \lambda_t^{So}] + \mu[\lambda_t^{Erp} - \lambda_t^{Sr}] \quad (4.2.54)$$

The surplus for a Ricardian household to stay employed following the wage bargaining is given by:

$$\begin{aligned} \lambda_t^{Eop} - \lambda_t^{So} = & (1 - \tau_t^w) \lambda_t^{rio} W_t^p h - \lambda_t^{rio} b + \frac{(1 - h - s)^{1-\zeta} - (1 - s)^{1-\zeta}}{1 - \zeta} \\ & + \beta E_t [(1 - p_t)(1 - \rho)(\lambda_{t+1}^{Eop} - \lambda_{t+1}^{So}) - p_t^g (1 - \rho)(\lambda_{t+1}^{Eog} - \lambda_{t+1}^{So})] \end{aligned} \quad (4.2.55)$$

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and similarly for the non-Ricardian workers:

$$\lambda_t^{Erp} - \lambda_t^{Sr} = (1 - \tau_t^w) \lambda_t^{rir} W_t^p h - \lambda_t^{rir} b + \frac{(1 - h - s)^{1-\zeta} - (1 - s)^{1-\zeta}}{1 - \zeta} + \beta E_t [(1 - p_t)(1 - \rho)(\lambda_{t+1}^{Erp} - \lambda_{t+1}^{So}) - p_t^g(1 - \rho)(\lambda_{t+1}^{Erg} - \lambda_{t+1}^{Sr})] \quad (4.2.56)$$

Nash product and efficient bargaining

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

$$\mathcal{N}_t = Y_t^\eta [\lambda_t^{Ef}]^{1-\eta}, \quad (4.2.57)$$

where η denotes the union bargaining power.

In the case of efficient bargaining, firms and union jointly determine the real wage but not the hours worked since I assume them as exogenous.

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

$$\eta \frac{\partial Y_t}{\partial W_t^p} \lambda_t^{Ef} = (1 - \eta) \frac{-\partial \lambda_t^{Ef}}{\partial W_t^p} Y_t \quad (4.2.58)$$

After several calculation steps (fully described in appendix 4.6.2), I obtain this rule for the private real wage (net of the income tax):

$$(1 - \tau_t^w) W_t^p h = \eta(1 - \alpha)(1 - \tau_t^w) \frac{Y_t}{E_t^p} + (1 - \eta) \left[b + \frac{(1 - s)^{1-\zeta} - (1 - h - s)^{1-\zeta}}{(1 - \zeta)(\mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio})} \right] + \eta(1 - \rho) E_t \left\{ \beta_{t,t+1} [1 - (1 - p_t^p)(1 - \tau_{t+1}^w) \tilde{\Lambda}_{t+1}] \lambda_{t+1}^{Ef} \right\} + (1 - \eta)(1 - \rho) p_t^g \beta E_t [\Lambda_t (\lambda_{t+1}^{Erg} - \lambda_{t+1}^{Sr}) + (1 - \Lambda_t) (\lambda_{t+1}^{Eog} - \lambda_{t+1}^{So})], \quad (4.2.59)$$

with $\Lambda_t = \frac{\mu \lambda_t^{rir}}{\mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio}}$ the relative part of non-Ricardian consumers in the

consumer pool and $\tilde{\Lambda}_t = \frac{\mu\lambda_t^{rir} + (1-\mu)\lambda_t^{rio}}{\mu\lambda_{t-1}^{rir} + (1-\mu)\lambda_{t-1}^{rio}}$.

4.2.5 Monetary and fiscal policies

Each period, the monetary authority sets the nominal interest rate according to the following standard Taylor rule:

$$\frac{R_t}{R_s} = \left(\frac{R_{t-1}}{R_s}\right)^{\alpha^r} \left(\frac{Y_t}{Y_s}\right)^{\alpha^y} \left(\frac{\pi_t}{\pi_s}\right)^{\alpha^\pi} \quad (4.2.60)$$

with R_s , Y_s and π_s the nominal interest rate, output and inflation at the steady state, respectively. α^r is 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.

Each period, the budget constraint each period for the government is given by:

$$\frac{B_{t+1}}{r_t} - B_t = C^g + bS_tW_t^gE_t^g h - [\tau_t^c C_t + \tau_t^w (W_t^p E_t^p h)] \quad (4.2.61)$$

The debt in GDP share Ψ_t is given by:

$$\Psi_t = \frac{B_t}{Y_t P_t}. \quad (4.2.62)$$

I assume that VAT responds to public debt according to the following rule:

$$\frac{\tau_t^c}{\tau_s^c} = \left(\frac{\tau_{t-1}^c}{\tau_s^c}\right)^{\rho^{\tau^c}} \left(\frac{\Psi_t}{\Psi_s}\right)^{\rho^\Psi}, \quad (4.2.63)$$

where α^{τ^c} is the constant VAT AR(1) coefficient and where α^B denotes the the degree of reaction of VAT to a variation of public debt. τ_s^c and Ψ_s denote the level of VAT and of public debt in GDP share at the steady state, respectively.

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

$$\frac{W_t^g}{W_s^g} = \left(\frac{W_{t-1}^g}{W_s^g} \right)^{\rho^g} \exp(\zeta_t^{Wg}) \quad (4.2.64)$$

and

$$\frac{V_t^g}{V_s^g} = \left(\frac{V_{t-1}^g}{V_s^g} \right)^{\rho^g} \exp(\zeta_t^{Vg}) \quad (4.2.65)$$

where ρ^g denotes the duration of the shocks. The terms ζ_t^{Wg} and ζ_t^{Vg} are the white noises associated with the shocks. One can notice that I assume a purely exogenous dynamic of the public wage. In Afonso and Gomes (2014) for instance, the dynamic of the public wage is partly endogenous and function of the dynamic of the real wage. In order to analyze the effects of a rise in public wage everything else equal, I assume a purely exogenous level of public wage.

4.2.6 Aggregation and market clearing

The market clearing condition can be expressed as:

$$Y_t = C_t + I_t + C^g \quad (4.2.66)$$

Finally, the following set of equations aggregate the labor market variables:

$$E_t^{tot} = E_t^p + E_t^g, \quad (4.2.67)$$

$$E_t^g = (1 - \mu)E_t^{og} + \mu E_t^{rg}, \quad (4.2.68)$$

$$E_t^p = (1 - \mu)E_t^{op} + \mu E_t^{rp}, \quad (4.2.69)$$

$$S_t = S_t^o + S_t^r \quad (4.2.70)$$

$$\theta_t = \theta_t^p + \theta_t^g \quad (4.2.71)$$

4.3 Calibration and strategy

Table (4.1) present the baseline calibration of the model and (4.2) displays the targeted values.

The time discount factor β is set to 0.997, which corresponds to an average annual interest rate of 3%. According to Chetty et al. (2013) and Peterman (2012), I set $-\zeta$ to 1/3 in order to match the macro estimates of the Frisch elasticity of labor supply. Following Smets and Wouters (2003) among others, I set the value of the risk aversion coefficient to $\sigma_c = 2$. $h = 0.33$. The value of the fixed cost of labor market participation is set to $s = 7.5\%$ of the time endowment. This value is halfway between Burnside and Eichenbaum's (1996) value and Ravn's (2005) value which are equal to 5% and 9.9% of the time endowment, respectively. The degree of habit formation in consumption is set to $H = 0.85$. Finally, I consider a share of non-Ricardian households $\mu = 0.3$, following Coenen and Straub (2005) for instance.

The Taylor rule's parameters are set at the following usual values: $\alpha^y = 0.5$, $\alpha^\pi = 1.5$ and $\alpha^r = 0.8$.

The share of the public sector *pubshare* is equal to 0,19. The parameters values for the tax rule are set following Forni et al. (2009) who estimate a New Keynesian model for the Euro Area with a rich fiscal block. Accordingly, I set $\rho^{\tau^c} = 0.96$ and $\rho^\Omega = 0.04$. Following Stähler and Thomas (2012) and Afonso and Gomes (2014), the elasticity of matches to unemployment in the public sector is set to $\varphi^s = 0.3$ while 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, I set a bargaining power equal to the elasticity of matches to unemployment in the private sector.

Regarding the production side, I set the elasticity of substitution between differentiated goods at $\varepsilon = 7$, which yields an optimal markup of around 17%. The depreciation rate of capital is set to $\delta^k = 0.025$. Finally, the share of capital in the production function is set to a standard value of $\alpha = 0.3$.

Following Michaillat (2014), I assume that the two different states of the business cycle are represented by two different values of unemployment at the steady-state. While Michaillat (2014) choosed to represent this difference of state by imposing different values of real wage, I choose to use directly different values of unemployment. Indeed, economic downturns are represented by a high level of unemployment while economic upturns are represented by a low level of unemployment. This low unemployment rate state consists in $U_s = 6\%$ while the labor market in bad times is represented by $U_s = 12\%$.

The whole economy, and in particular the labor market, changes across the different values of unemployment at the steady state. More precisely, I have $\frac{\partial E_s^{tot}}{\partial U_s} > 0$, $\frac{\partial \theta_s}{\partial U_s} < 0$, $\frac{\partial E_s^i}{\partial U_s} > 0$, $\frac{\partial p_s^i}{\partial U_s} < 0$ and $\frac{\partial q_s^i}{\partial U_s} > 0$.⁵ Therefore, at the steady state, a rise in unemployment yields a rise in total employment, a decrease in labor market tightness explained by a decrease in the probability for a worker to find a job and an increase in the probability for a firm to fill its job.

4.4 Results

4.4.1 *The effects of fiscal policy on the labor market and output over the business cycle*

For all simulations in this chapter I use the Adjemian et al.'s (2011) Dynare program. The algorithm used by Dynare for the second order approximation of my model is very close to the one developed in Schmitt-Grohé and Uribe (2004). In addition, simulations are carried out by using the pruning method, in order to avoid triggering polynomials of increasing degrees when simulating the model.⁶

For the two shocks considered, I 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 I will see throughout this section, these results are driven by two main elements: a wider pool of job seekers

⁵ Computations are presented in Appendix 4.6.1.

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

Tab. 4.1: Baseline calibration

<u>Preferences</u>		
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
<u>Production</u>		
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
<u>Monetary Policy</u>		
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
<u>Fiscal Policy</u>		
ρ^g	0.6	Duration of the fiscal policy shock
ρ^{τ^c}	0.96	VAT AR coefficient
ρ^Ω	0.04	Response coefficient to the debt in GDP share
<u>Labor market and wage bargaining</u>		
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
$pubshare$	0.19	Share of the public sector in the whole economy

and the crucial role of the wage dynamic.

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Tab. 4.2: Targeted Values

π_s	1	Inflation
p_s	1	Prices
Y_s	1	Output
C_s^g	0.2	Public Consumption
b	$0.3Y_s$	Unemployment benefit
τ^c	0.20	VAT
τ_s^w	0.16	Income 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
Ψ_s	$0.6Y_s$	Debt target

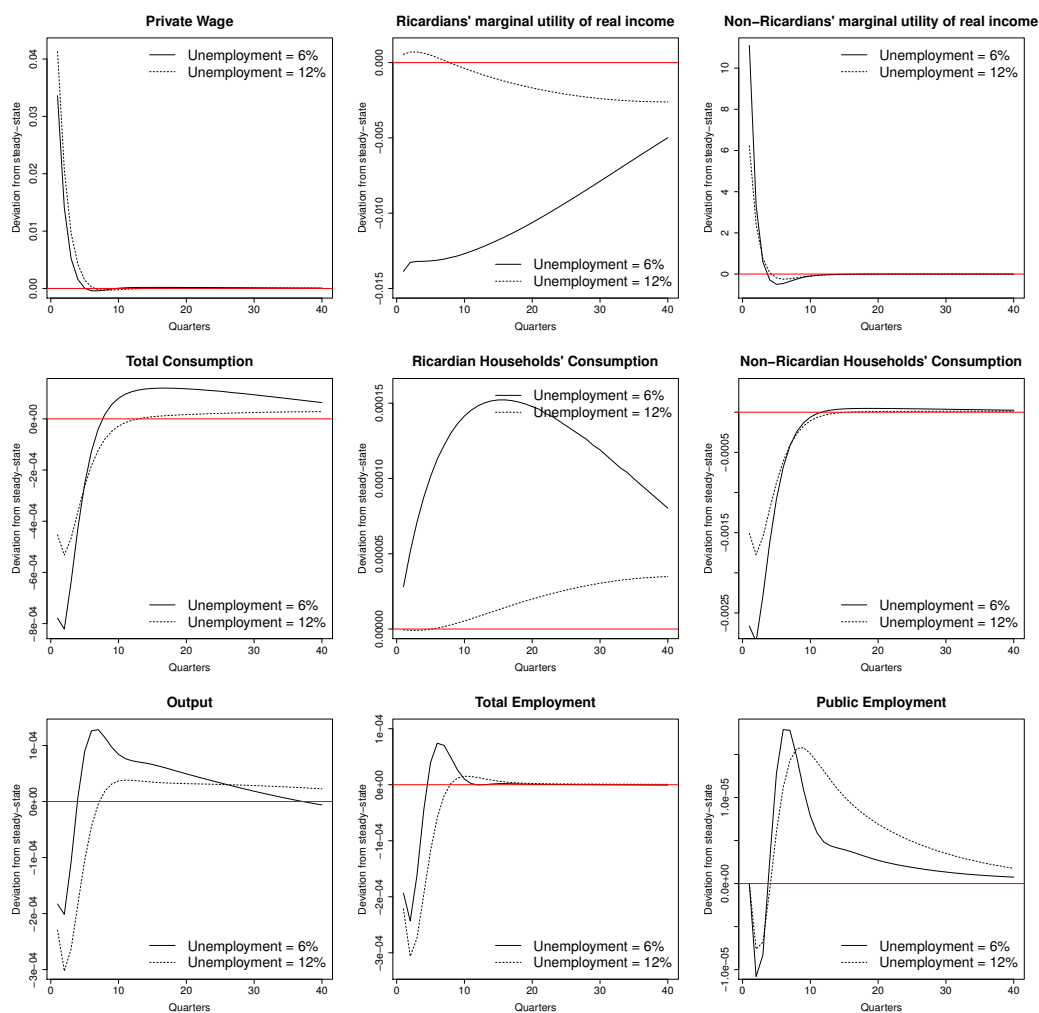
The effects of a cut in public-sector wage:

Impulse response functions for a cut of 1% in public-sector wage are displayed in Figures 4.1 and 4.2. A first observation is that the response of the economy greatly differs according to the steady-state unemployment rate. Before explaining these non-linear effects, let us focus on the general effects of a cut in the public-sector wage.

A drop in the public-sector wage triggers an automatic decrease in consumption of the non-Ricardian households. This effect is amplified by a decrease in total employment and is not compensated by the increase in the private sector wage. This negative effect on demand produced a decline in output in short run. On the contrary, consumption of Ricardian households tends to increase, regardless of steady-state unemployment. This increase in Ricardian's consumption is driven by two main transmission channels. First, the cut in public-sector wage puts a downward pressure on the real interest rate (especially in the case of $U_s = 12\%$), which triggers a positive wealth effect for this class of households. Second, and this is only valid for $U_s = 6\%$, VAT decreases following the decline in debt, so that it puts additional upward pressures on consumption of Ricardian households. Despite the rise in consumption of Ricardian households, total consumption and output decrease in the short run.

Following this negative short-run effect on private activity, private employ-

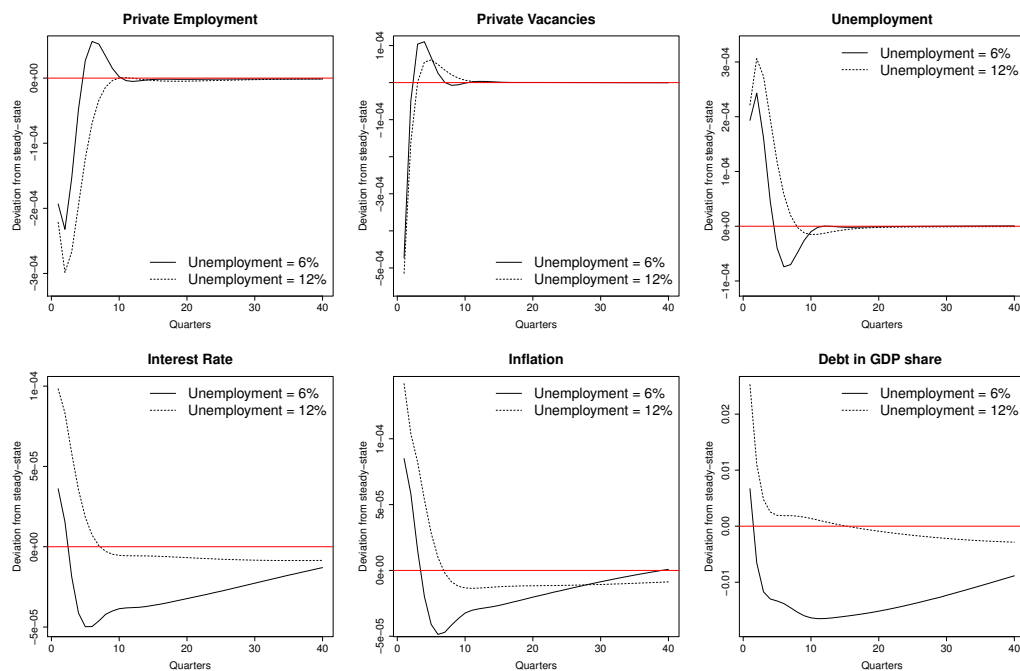
Fig. 4.1: Response to a cut of 1% in public sector wage I



ment tends to decrease. This fall in private employment positively affects the marginal productivity of labor and puts upward pressure on the private-sector wage for few periods. However, two additional effects tends to ease this dynamics on private wage. First, a decrease in public wage has a direct negative effect on the private-sector wage, as shown in equation (4.2.59). From the workers' point of view, the public sector becomes less attractive so that a part of the pool of the job seekers turns toward the private sector and will accept to work for a lower real wage. Second, a decrease in the public-sector wage diminishes the value to be unemployed, which puts additional downward pressures on the private-sector

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Fig. 4.2: Response to a cut of 1% in public sector wage II



wage. As a consequence, the private real wage increases but only for few periods.

As said previously, the effects of the cut in the public-sector wage are greatly influenced by the level of unemployment at the time of the shock. Before going into a detailed explanation, this restrictive fiscal policy has larger and sizable negative effects on employment and output during economic downturn than during economic upturn. As a consequence, while a reduction in public-sector wage decreases debt in GDP share in the case of $U_s = 6\%$, debt increases for about fifteen periods before being reduced in the more long run in the case of $U_s = 12\%$.

Impulse response functions show that the effects on private employment of the decline in public-sector wage are greater when the steady-state unemployment rate is large and that the real wage rises more sharply in this case. Closely to Michailat (2014), the larger the pool of job seekers at the steady-state, the larger the effects of a negative demand shock on employment. As a consequence and all things being equal, the negative fiscal policy shock induces a stronger fall in

private employment when unemployment is high at the time of the shock. This larger decrease in private employment induces a greater rise in the marginal productivity of labor: as a result, upward pressures on the private-sector wage are greater with $U_s = 12\%$.

This larger rise in the private real wage has contradictory effects on private consumption. First, despite a stronger degradation of private employment, consumption of non-Ricardian households is less reduced in this case. However, larger upward pressures on the real wage trigger a higher response of inflation in the case of $U_s = 12\%$. As a consequence, the real interest rate is significantly less reduced and its response is even slightly positive in the long-run. Therefore, the positive crowding-out effect of a fall in public wage on consumption of Ricardian households is diminished in a sizeable way. This effect on Ricardians' consumption prevails over the lower degradation of consumption of the non-Ricardian households so that the degradation of total private consumption is significantly lower when public wage is reduced in times of low unemployment. As a result, this restrictive fiscal policy has larger negative effects on output when it is implemented in periods of high unemployment.

A fall in public-sector wage allows to reduce importantly the debt in GDP share when $U_s = 6\%$. However, debt increases in the short-run before being reduced only slightly when $U_s = 12\%$.

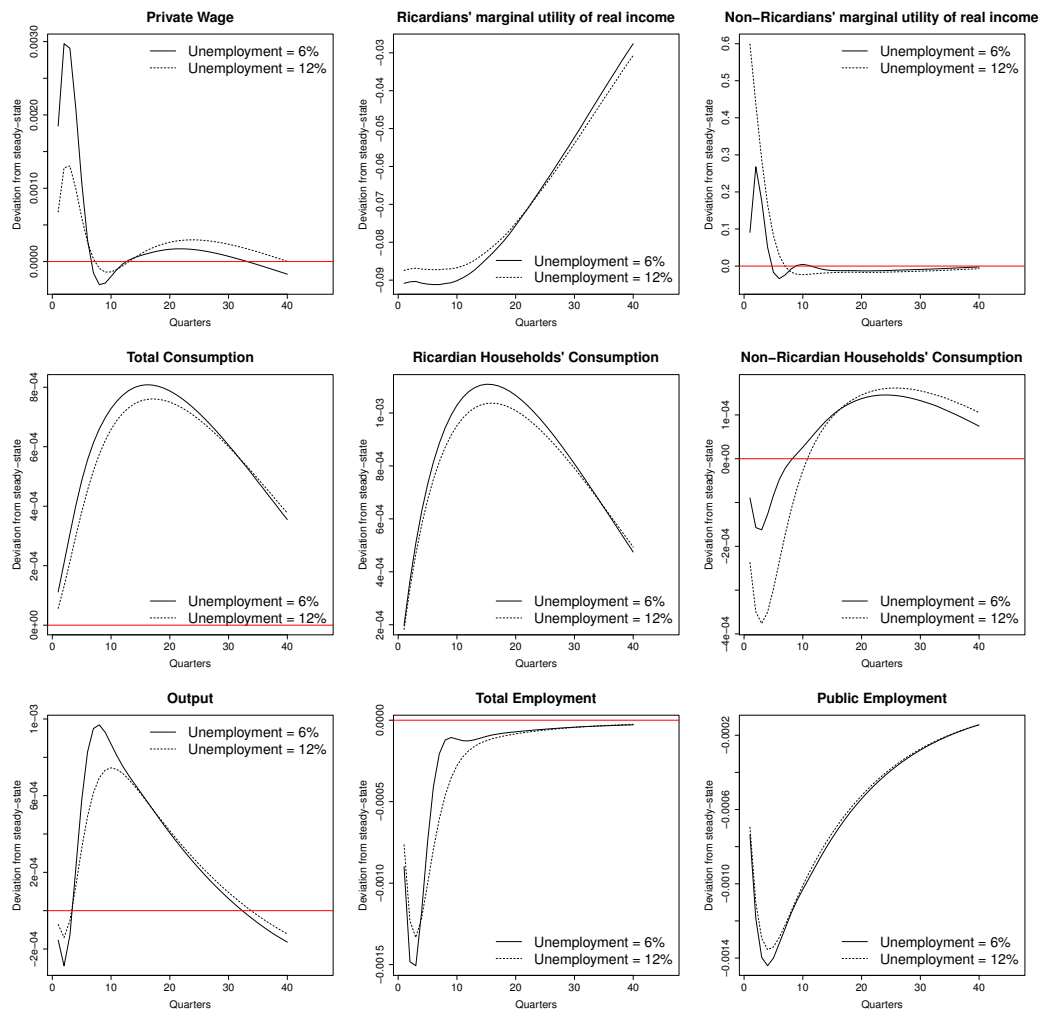
The effects of a cut in public vacancies

Before investigating the non-linear effects of this cut in public expenditure, let us describe the overall effects of a cut in public vacancies in this model. A first observation is that decreasing public employment triggers a positive response of output. As said previously, the implied negative output fiscal multiplier is due to the assumption of an unproductive public sector. To add public sector in total GDP would produce a decline in output. However, the present chapter does not focus on the size of the output fiscal multiplier but rather focuses on the impact of the initial unemployment rate on the size of the output fiscal multiplier. Response of output in this model has to be considered as the response of private

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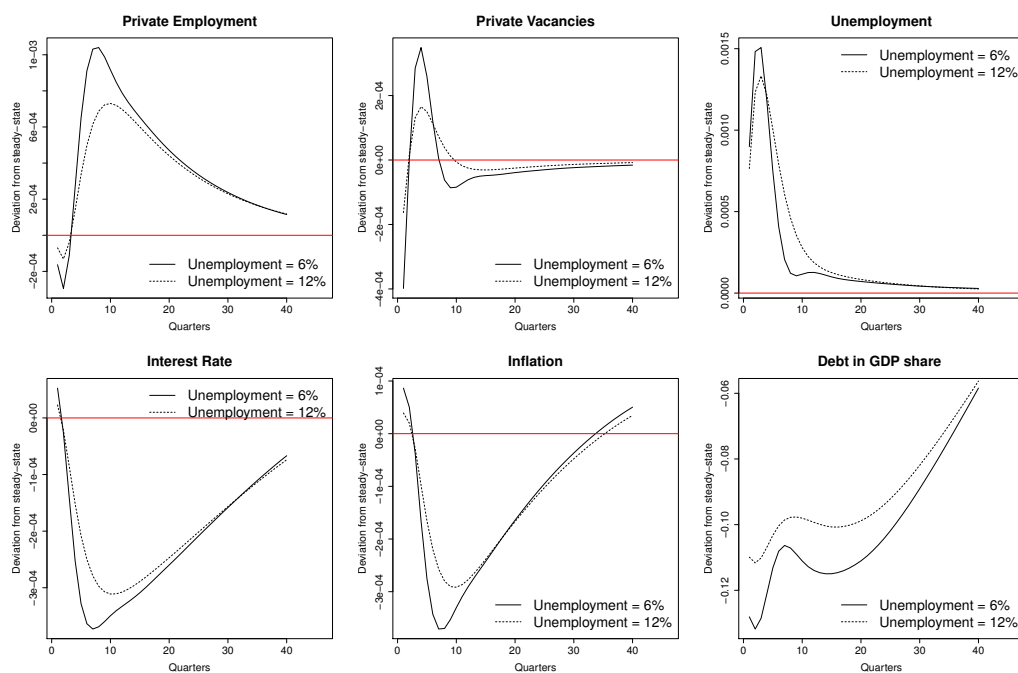
activity to changes in the fiscal stance. Impulse response functions for a cut of 1% in public-sector vacancies are displayed in Figures 4.3 and 4.4.

Fig. 4.3: Response to a cut of 1% in public vacancies I



A decrease in public-sector employment triggers an automatic positive crowding-out effect on the private-sector labor market. Following the contraction of public employment, the private sector takes advantage of a larger pool of job seekers so that the number of matches in this sector tends to increase. However, the response of total employment remains negative.

Fig. 4.4: Response to a cut of 1% in public vacancies II



Consumption of non-Ricardian households decreases following the drop in public employment. However, impulse response functions indicate that consumption of non-Ricardian households goes up in the medium run. Three elements drive this positive response. First, the rise in private employment offsets partly the fall in public employment. Second, the positive response of private activity and employment puts an upward pressure on private-sector real wage. Third, VAT falls following the decline in debt in GDP share. Overall, consumption of non-Ricardian households increases in the mid and long run.

Consumption of Ricardian households also reacts positively to the drop in public vacancies. Similarly to non-Ricardian households, the fall in VAT puts an upward pressure on consumption of Ricardian households. Moreover, the overall drop in prices and the implied decrease in the real interest rate boost Ricardian consumption. As said previously, a tightening of the public sector crowds in private activity.

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Impulse response functions indicate that, similarly to a cut in the public-sector wage, the response of output and employment is greater when the steady-state unemployment is high. The transmission channel at work is very close to the previous case. With a larger pool of job seekers, the positive crowding-out effect of a cut in public vacancies on the private-sector labor market is amplified. This mechanism is perfectly similar to what is demonstrated in Michailat (2014).

Consumption of non-Ricardian households is better (less negative) when the unemployment rate is low ($U_s = 6\%$) at the time of the shock. It can be explained by three reasons: when $U_s = 6\%$, the cut in public vacancies triggers a better response of total employment, a larger rise in the private-sector wage and a greater decline in VAT due to a lower fall in debt.

As said above, when the steady-state unemployment is low, the private-sector real wage increases more sharply. Similarly to the cut in public wage, the greater response of private employment when $U_s = 6\%$ generates a lower marginal productivity of labor than in the case of a high steady-state unemployment. As a consequence, prices and then the real interest rate are lower in this scenario. Hence, the response of consumption of non-Ricardian households is greater in the case of $U_s = 6\%$.

The combination of a better response of non-Ricardian households and of Ricardian households triggers a larger rise in output when the unemployment rate is low at the time of shock. As said previously, the cut in public employment enables a more sizeable decline in debt in GDP share in this case.

Overall remarks

To summarize the results, I attempt to show in this chapter that cuts in public-sector employment and salaries are more harmful in terms of output and total employment when unemployment is already large. The larger cost on total employment is similar to what highlights Michailat (2014) since the effect of the public sector to the private one is amplified by the presence of a larger pool of job

seekers at the steady-state.

Unlike Sims and Wolff (2013), it is also important to notice that the more positive response of consumption of the Ricardians is not due in my model to a higher marginal utility of consumption in economic downturns. The authors highlight this transmission channel for explaining different output fiscal multipliers over the business cycle. This is not the case in my 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:

$$C_s^o = \frac{C_s - \mu C_s^r}{1 - \mu}, \quad (4.4.1)$$

with 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 transmission channel highlighted in Sims and Wolff (2013) is not present in my model.

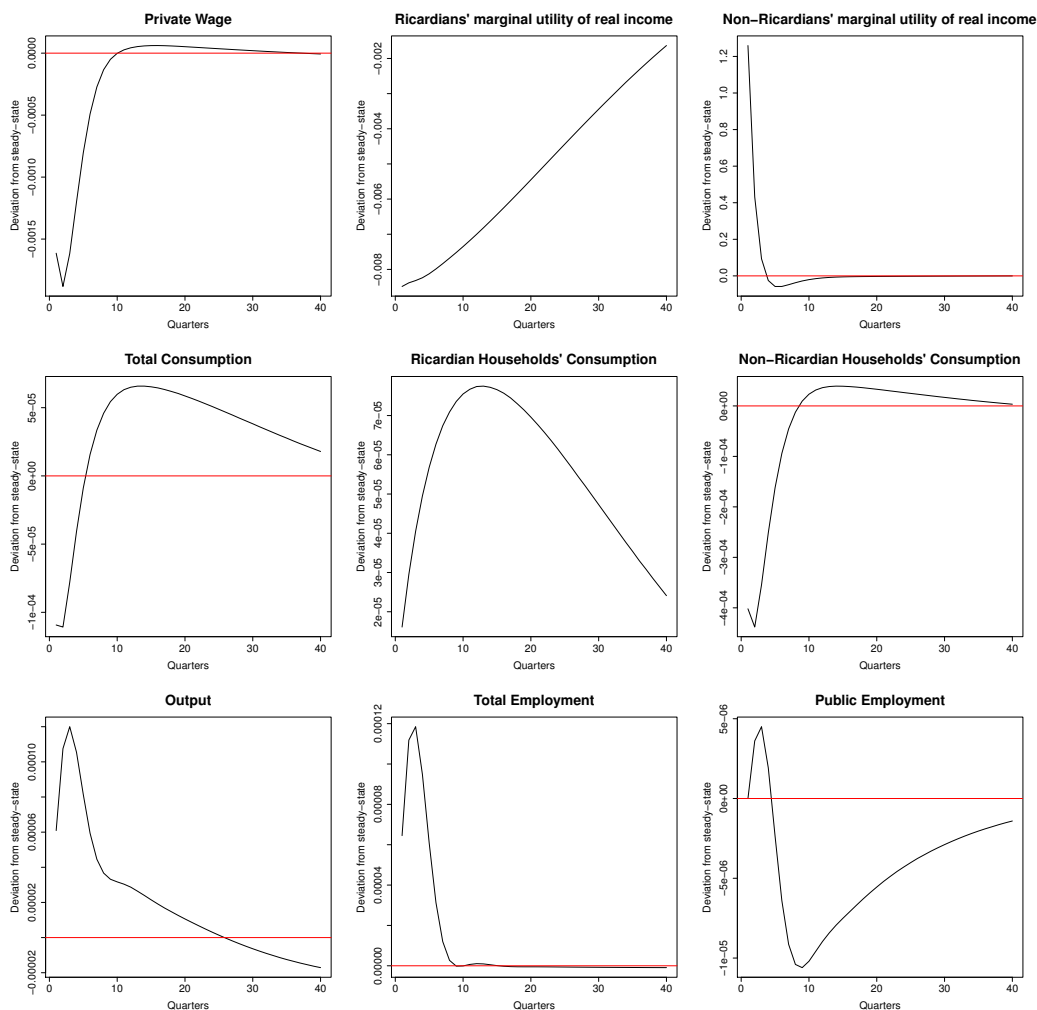
4.4.2 *On the importance of the composition of the fiscal adjustment*

Only few articles have recently investigated the effects of changes in public wage and one notable exception is Afonso and Gomes (2014). Results in this chapter regarding the response of the economy to a public wage shock are partly in opposition with those of Afonso and Gomes (2014). My model predicts a rise in the private-sector wage and a drop in employment following a cut in the public wage while Afonso and Gomes (2014) argue for an opposite dynamic. The

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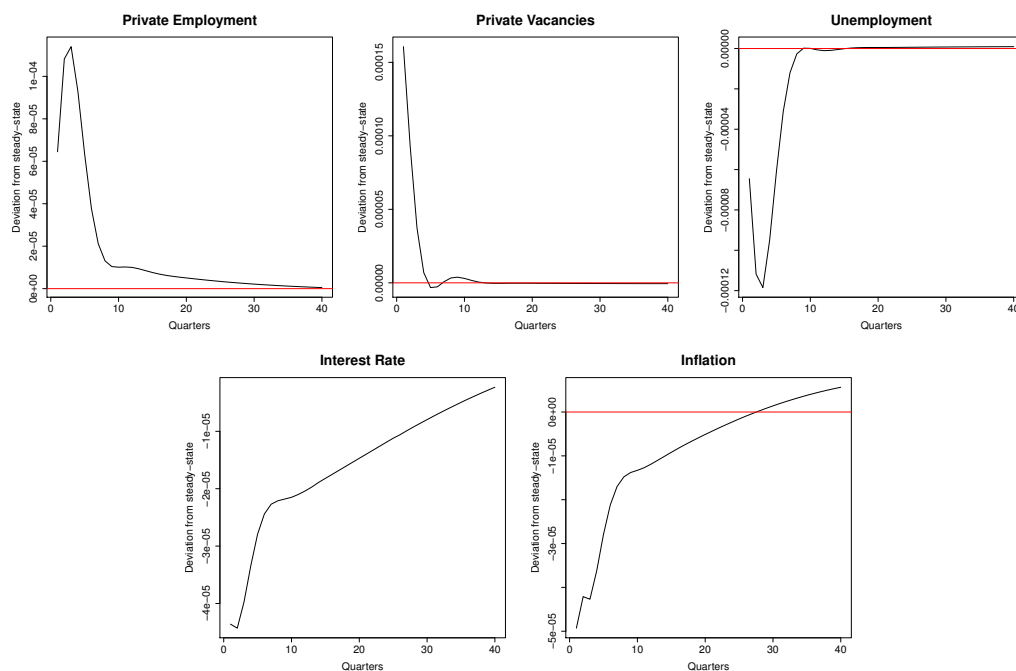
authors demonstrate that the private wage increases and that employment falls following a rise in public-sector wage. Impulse response functions are displayed in Figures 4.5 and 4.6.

Fig. 4.5: Response to a cut in public sector wage according to the composition of the fiscal adjustment I



First, a higher public wage increases the value of being unemployed, which is also included in my definition of the private-sector real wage. Secondly, their model generates a rise in marginal productivity of labor which creates upward pressures on private real wage. On the contrary, in my model a cut in the public wage trigger a unambiguous rise in the marginal productivity of labor thanks

Fig. 4.6: Response to a cut in public sector wage according to the composition of the fiscal adjustment II



to a positive effect on output and a fall in employment. This difference partly explains the different dynamic of the private-sector real wage produced by my model following a public wage shock. It is important to notice that this difference in the response of the marginal productivity of labor can be explained by the fact that the public sector is productive in Afonso and Gomes (2014) since labor in the public sector serves to produce public goods. As said previously, the public sector is not taken into account in my definition of GDP so that the positive response of output lies in rise in private activity.

Moreover, I differ from Afonso and Gomes (2014) since in my model the government is allowed to issue nominal debt each period and VAT is assumed to be adjusted to ensure public finance sustainability in the long run. In Afonso and Gomes (2014), the authors assume that the wage bill is entirely funded by the labor income tax, so that the budget is balanced each period. For comparison purposes, I modify the fiscal block such as the labor income tax is adjusted to maintain a balanced budget. The new budget constraint is then:

$$\tau^c(C_t^o + C_t^r) + \tau_t^w W_t^p E_t^p h + E_t^p W_t^p h = C^g + (1 - \tau_t^w)(W_t^g E_t^g h) + bS_t. \quad (4.4.2)$$

where τ^c is assumed to be constant. In this scenario, the labor income tax reacts contemporaneously to a cut in the public wage to ensure a balanced budget. As shown in Figures 4.5 and 4.6, my model reproduces similar results in this case. In the case of a negative shock on public wage, employment rises, unemployment falls and private real wage decreases. I emphasize that the composition of the fiscal adjustment can alter greatly the results. According to Afonso and Gomes (2014), the effects of a change in the labor income tax on the private-sector real wage is ambiguous. The authors argue that a rise in the labor income tax lowers the match surplus and then puts an upward pressure on the private real wage. On the contrary, the match surplus going to the worker is reduced, which tends to rise the private-sector wage. According to my simulations, a drop in the labor income tax reduces the private-sector wage through a large positive effect on the match surplus.

4.5 Conclusion

This chapter attempts to investigate the non-linear effects of fiscal policy over the business cycle with a focus on public-sector employment and salaries. The main result is that cuts in public employment and wages are more harmful in terms of output and employment in periods of high unemployment. Large cuts in government expenditure have been implemented in the Euro Area from 2010, a period of historically high unemployment. I argue, alongside numerous articles, for large contractionary effects of the austerity plans in the aftermath of the crisis. First, I show that cuts in the public-sector labor market have stronger negative effects on employment in periods of high unemployment rate. Second, contractionary effects on output are also magnified when unemployment is high at the time of the implementation of a restrictive fiscal policy. Likewise, the effectiveness of these austerity plans to reduce deficit and debt was weak because of a large cost on

economic activity.

4.6 Appendix

4.6.1 How are labor market variables impacted by unemployment at steady state ?

Given that $E_s^{tot} = 1 - U_s$ and $S_s = U_s + \rho E_s^{tot}$, I have

$$\begin{aligned} E_s^{tot} &= 1 - (\rho E_s^{tot} - S_s) \\ \Leftrightarrow E_s^{tot} &= \frac{1 + S_s}{1 + \rho} \end{aligned} \quad (4.6.1)$$

One can easily note that:

$$\frac{\partial E_s^{tot}}{\partial S_s} = \frac{1}{1 + \rho} > 0 \quad (4.6.2)$$

Moreover, by definition:

$$\frac{\partial \theta_s}{\partial S_s} = -\frac{V_s^p}{(S_s)^2} - \frac{V_s^g}{(S_s)^2} < 0 \quad (4.6.3)$$

$$(4.6.4)$$

From equation (4.2.3), I have:

$$\begin{aligned} E_s^p &= (1 - \rho)E_s^p + p_s^p(1 - \rho)S_s \\ \Leftrightarrow E_s^p &= \frac{(1 - \rho)p_s^p S_s}{\rho} \end{aligned} \quad (4.6.5)$$

From equations (4.2.5) and (4.2.6), I have:

$$p_s^p = \kappa_e^p (S_s)^{(\varphi^p - 1)} (V_s^p)^{(1 - \varphi^p)} \quad (4.6.6)$$

Given equation (4.6.6), I can define E_s^p as:

$$E_s^p = \left(\frac{1 - \rho}{\rho} \right) \kappa_e^p (S_s)^{\varphi^p} (V_s^p)^{(1 - \varphi^p)} \quad (4.6.7)$$

Thus, I have:

$$\frac{\partial E_s^p}{\partial S_s} = \left(\frac{1-\rho}{\rho} \right) \kappa_e^p \varphi^p (S_s)^{\varphi^p-1} (V_s^p)^{(1-\varphi^p)} > 0 \quad (4.6.8)$$

Similarly, one can define E_s^g and p_s^g as:

$$p_s^g = \kappa_e^g (S_s)^{(\varphi^g-1)} (V_s^g)^{(1-\varphi^g)} \quad (4.6.9)$$

and

$$E_s^g = \left(\frac{1-\rho}{\rho} \right) \kappa_e^g (S_s)^{\varphi^g} (V_s^g)^{(1-\varphi^g)}. \quad (4.6.10)$$

Thus, I have

$$\frac{\partial E_s^g}{\partial S_s} = \left(\frac{1-\rho}{\rho} \right) \kappa_e^g \varphi^g (S_s)^{\varphi^g-1} (V_s^g)^{(1-\varphi^g)} > 0 \quad (4.6.11)$$

Thanks to equation 4.6.6, one can note that

$$\frac{\partial p_s^p}{\partial S_s} = \kappa_e^p (\varphi^p - 1) (S_s)^{\varphi^p-2} (V_s^p)^{1-\varphi^p} < 0 \quad (4.6.12)$$

Thanks to equation 4.2.7, I can define the probability for a firm to find a worker at the steady state such as

$$q_s^p = \kappa_e^p \left(\frac{V_s^p}{S_s} \right)^{-\varphi^p} \quad (4.6.13)$$

Thus, I have

$$\frac{\partial q_s^p}{\partial S_s} = \kappa_e^p \varphi^p S_s^{\varphi^p-1} V_s^{p-\varphi^p} > 0 \quad (4.6.14)$$

Finally, accordingly to equation (4.2.62), nominal debt at the steady-state is

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equal to:

$$B_s = \Psi_s Y_s P_s. \quad (4.6.15)$$

4.6.2 Wage equation calculation

I start from the surplus' optimal sharing rule given by the equation (2.58). Knowing that:

$$\frac{\partial Y_t}{\partial W_t^p} = (1 - \mu)(1 - \tau_t^w)\lambda_t^{rio}h + \mu(1 - \tau_t^w)\lambda_t^{rir}h, \quad (4.6.16)$$

and

$$\frac{\partial Y_t^{E_f}}{\partial W_t^p} = -h, \quad (4.6.17)$$

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

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

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Moreover, since equation (2.58) yields:

$$\beta E_t[Y_{t+1}] = \frac{\eta}{(1-\eta)} E_t \left[\beta_{t,t+1} (1 - \tau_{t+1}^w) (\mu \lambda_{t+1}^{rir} + (1-\mu) \lambda_{t+1}^{rio}) \lambda_{t+1}^{Ef} \right],$$

I finally obtain:

$$\begin{aligned} & \Leftrightarrow (1 - \tau_w) (\mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio}) W_t^p h \\ & = \eta (1 - \tau_t^w) (\mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio}) \left[\frac{(1 - \alpha) Y_t}{E_t^p} + (1 - \rho) E_t [\beta_{t,t+1} \lambda_{t+1}^{Ef}] \right] \\ & \quad + (1 - \eta) \left[(\mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio}) b + \frac{(1 - s)^{1-\zeta} - (1 - h - s)^{1-\zeta}}{1 - \zeta} \right] \\ & \quad - \eta (1 - p_t^p) (1 - \rho) E_t \left[\beta_{t,t+1} (1 - \tau_{t+1}^w) (\mu \lambda_{t+1}^{rir} + (1 - \mu) \lambda_{t+1}^{rio}) \lambda_{t+1}^{Ef} \right] \\ & \quad + (1 - \eta) (1 - \rho) p_t^g \beta E_t [\mu (\lambda_{t+1}^{Erg} - \lambda_{t+1}^{Sr}) + (1 - \mu) (\lambda_{t+1}^{Eog} - \lambda_{t+1}^{So})] \\ \\ & (1 - \tau_t^w) W_t^p h = \eta (1 - \alpha) (1 - \tau_t^w) \frac{Y_t}{E_t^p} + (1 - \eta) \left[b + \frac{(1 - s)^{1-\zeta} - (1 - h - s)^{1-\zeta}}{(1 - \zeta) \mu \lambda_t^{rir} + (1 - \mu) \lambda_t^{rio}} \right] \\ & \quad + \eta (1 - \rho) E_t \left\{ \beta_{t,t+1} \left[1 - (1 - p_t^p) (1 - \tau_{t+1}^w) \tilde{\Lambda}_{t+1} \right] \lambda_{t+1}^{Ef} \right\} \\ & \quad + (1 - \eta) (1 - \rho) p_t^g \beta E_t [\Lambda_t (\lambda_{t+1}^{Erg} - \lambda_{t+1}^{Sr}) + (1 - \Lambda_t) (\lambda_{t+1}^{Eog} - \lambda_{t+1}^{So})] \end{aligned} \tag{4.6.18}$$

4.6.3 Steady-State calculations

Starting from the long-run targeted values described in table 4.2, I now describe the steady-state calculations. I first assume that $W_s^g = W_s^p$.

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

$$E_s^{tot} = 1 - U_s. \tag{4.6.19}$$

From equation (2.2), the number of job seekers in the economy as a whole is

equal to:

$$S_s = U_s + \rho E_s^{tot}. \quad (4.6.20)$$

By definition, assuming that *pubshare* is the size of the public sector on the labor market, I can define the value of public employment as

$$E_s^g = E_s^{tot} \times \text{pubshare}. \quad (4.6.21)$$

Then, from equations (4.6.21) and (2.67), I define the value of private employment at the steady state as:

$$E_s^p = E_s^{tot} - E_s^g. \quad (4.6.22)$$

By definition I have:

$$E_s^r = \mu E_s^{tot} \quad (4.6.23)$$

$$\text{and } E_s^o = (1 - \mu) E_s^{tot} \quad (4.6.24)$$

Thanks to equation (2.40), I can define

$$V_s^p = \rho \frac{E_s^p}{q_s^p} \quad (4.6.25)$$

and I assume similarly that

$$V_s^g = \rho \frac{E_s^g}{q_s^g}. \quad (4.6.26)$$

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) I are able to define the

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matching technology in each sector as:

$$\kappa_e^p = \frac{V_s^p q_s^p}{S_s^{\varphi^p} (V_s^p)^{1-\varphi^p}} \quad (4.6.27)$$

$$\kappa_e^g = \frac{V_s^g q_s^g}{S_s^{\varphi^g} (V_s^g)^{1-\varphi^g}} \quad (4.6.28)$$

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

$$M_s^p = \kappa_e^p S_s^{\varphi^p} (V_s^p)^{1-\varphi^p} \quad (4.6.29)$$

$$\text{and } M_s^g = \kappa_e^g S_s^{\varphi^g} (V_s^g)^{1-\varphi^g}. \quad (4.6.30)$$

Thanks to equations (4.6.20), (4.6.29) and (4.6.30), I can define the probability for a worker to find a job in each sector at the steady state as

$$p_s^p = \frac{M_s^p}{S_s} \quad (4.6.31)$$

$$\text{and } p_s^g = \frac{M_s^g}{S_s}. \quad (4.6.32)$$

According to equation (2.24) I have:

$$R_s^k = r_s + \delta^k - 1. \quad (4.6.33)$$

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

$$mc_s = \frac{\varepsilon}{\varepsilon - 1}. \quad (4.6.34)$$

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

$$x_s = (1 - \alpha) mc_s \left(\frac{Y_s}{E_s^p h} \right) - W_s^p h. \quad (4.6.35)$$

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:

$$Q_s = 1. \quad (4.6.36)$$

According to equation (2.46), I have:

$$k_s = \alpha m c_s \frac{Y_s}{R_s^k}, \quad (4.6.37)$$

while from aggregation I have:

$$k_s^o = \frac{k_s}{(1 - \mu)} \quad (4.6.38)$$

$$\text{and } I_s^o = \frac{I_s}{(1 - \mu)}. \quad (4.6.39)$$

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

$$\epsilon_s^a = \frac{Y_s}{k_s^\alpha (E_s^p h)^{1-\alpha}}. \quad (4.6.40)$$

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

$$C_s = Y_s - C^g - I_s. \quad (4.6.41)$$

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

$$\theta_s^p = \frac{V_s^p}{S_s} \quad (4.6.42)$$

$$\text{and } \theta_s^g = \frac{V_s^g}{S_s}. \quad (4.6.43)$$

Aggregation yields:

$$\theta_s = \theta_s^p + \theta_s^g. \quad (4.6.44)$$

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By construction, I have:

$$q_s^1 = \frac{\lambda_s^{rio} Y_s m c_s}{1 - \beta \theta^p \pi_s^{\epsilon-1}} \quad (4.6.45)$$

$$q_s^2 = \frac{\lambda_s^{rio} Y_s}{1 - \beta \theta^p \pi_s^{\epsilon-1}}, \quad (4.6.46)$$

and thanks to equation (2.52):

$$p_s^{opt} = \frac{\epsilon}{\epsilon - 1} \frac{q_s^1}{q_s^2}. \quad (4.6.47)$$

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

$$\lambda_s^{Ef} = \frac{1 - \alpha}{1 - (1 - \rho)\beta} \frac{Y_s}{E_s^p} - \frac{1}{1 - (1 - \rho)\beta} W_s^p h. \quad (4.6.48)$$

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

$$\kappa^v = \beta \left(\frac{(1 - \alpha) Y_s}{E_s^p} - W_s^p h + (1 - \rho) \beta \lambda_s^{Ef} \right) q_s^p. \quad (4.6.49)$$

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

$$Y_s = (1 - \mu)(\lambda_s^{Eop} - \lambda_s^{So}) + \mu(\lambda_s^{Erp} - \lambda_s^{Sr}). \quad (4.6.50)$$

Finally, by definition,

$$mpl_s = \frac{(1 - \alpha) Y_s}{E_s^p h}. \quad (4.6.51)$$

Marginal utility of real income in terms of non-Ricardian consumption

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

$$C_s^r = \{(1 - \tau_s^w)[E_s^r W_s^p h + (1 - E_s^r)b]\}^{1 + \tau_s^c} \quad (4.6.52)$$

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

$$C_s^o = \frac{C_s - \mu C_s^r}{1 - \mu} \quad (4.6.53)$$

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

$$\begin{aligned} \lambda_s^{rio} &= \frac{1 - \beta H}{1 + \tau_s^c} [(1 - H)C_s^o]^{-\sigma_c} \\ \Leftrightarrow \lambda_s^{rio} &= \frac{1 - \beta h}{1 + \tau_s^c} \left\{ (1 - H) \frac{1}{1 - \mu} \left\{ C_s - \frac{\mu}{1 + \tau_s^c} [(1 - \tau_s^w)E_s^r W_s^p h + (1 - E_s^r)b] \right\} \right\}^{-\sigma_c} \end{aligned} \quad (4.6.54)$$

$$\begin{aligned} \lambda_s^{rir} &= (1 - \beta H) [(1 - H)C_s^r]^{-\sigma_c} \\ \Leftrightarrow \lambda_s^{rir} &= \frac{1 - \beta H}{1 + \tau_s^c} \{(1 - H)\{(1 - \tau_s^w)[E_s^r W_s^p h + (1 - E_s^r)b]\}\}^{-\sigma_c} \end{aligned} \quad (4.6.55)$$

Workers' marginal utilities in terms of unemployment marginal utility

For Ricardian workers

$$\begin{aligned} \lambda_s^{E_{op}} &= (1 - \tau_s^w) \lambda_s^{rio} W_s^p h - \frac{1 - (1 - h - s)^{1 - \zeta}}{1 - \zeta} + (1 - \rho) \beta \lambda_s^{E_{op}} + \rho \beta \lambda_s^{S_o} \\ \Leftrightarrow [1 - (1 - \rho) \beta] \lambda_s^{E_{op}} &= (1 - \tau_s^w) \lambda_s^{rio} W_s^p h - \frac{1 - (1 - h - s)^{1 - \zeta}}{1 - \zeta} + \rho \beta \lambda_s^{S_o} \\ \Leftrightarrow \lambda_s^{E_{op}} &= \frac{1}{1 - (1 - \rho) \beta} \left[(1 - \tau_s^w) W_s^p h \lambda_s^{rio} - \frac{1 - (1 - h - s)^{1 - \zeta}}{(1 - \zeta)} + \rho \beta \lambda_s^{S_o} \right] \end{aligned} \quad (4.6.56)$$

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$$\begin{aligned}
\lambda_s^{E_{og}} &= (1 - \tau_s^w) \lambda_s^{rio} W_s^g h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} + (1 - \rho) \beta \lambda_s^{E_{og}} + \rho \beta \lambda_s^{S_o} \\
\Leftrightarrow [1 - (1 - \rho) \beta] \lambda_s^{E_{og}} &= (1 - \tau_s^w) \lambda_s^{rio} W_s^g h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} + \rho \beta \lambda_s^{S_o} \\
\Leftrightarrow \lambda_s^{E_{og}} &= \frac{1}{1 - (1 - \rho) \beta} \left[(1 - \tau_s^w) W_s^g h \lambda_s^{rio} - \frac{1 - (1 - h - s)^{1-\zeta}}{(1 - \zeta)} + \beta \rho \lambda_s^{S_o} \right] \\
\Leftrightarrow \lambda_s^{E_{og}} &= \frac{1}{1 - (1 - \rho) \beta} \left[(1 - \tau_s^w) W_s^p h \lambda_s^{rio} - \frac{1 - (1 - h - s)^{1-\zeta}}{(1 - \zeta)} + \beta \rho \lambda_s^{S_o} \right]
\end{aligned} \tag{4.6.57}$$

$$\begin{aligned}
\lambda_s^{S_o} &= b \lambda_s^{rio} - \frac{1 - (1 - s)^{1-\zeta}}{1 - \zeta} + (1 - p_s^p - p_s^g) \beta \lambda_s^{S_o} + \rho (p_s^p + p_s^g) \beta \lambda_s^{S_o} \\
&\quad + (1 - \rho) \beta [p_s^p \lambda_s^{E_{op}} + p_s^g \lambda_s^{E_{og}}] \\
\Leftrightarrow \lambda_s^{S_o} [1 - \beta + \beta(1 - \rho)(p_s^p + p_s^g)] &= b \lambda_s^{rio} - \frac{1 - (1 - s)^{1-\zeta}}{1 - \zeta} \\
&\quad + \frac{\beta(1 - \rho)(p_s^p + p_s^g)}{1 - \beta(1 - \rho)} \left[(1 - \tau_s^w) \lambda_s^{rio} W_s^p h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} + \beta \rho \lambda_s^{rio} \right] \\
\Leftrightarrow \lambda_s^{S_o} \left[1 - \beta + \beta(1 - \rho)(p_s^p + p_s^g) \left(1 - \frac{\beta \rho}{1 - \beta(1 - \rho)} \right) \right] &= b \lambda_s^{rio} - \frac{1 - (1 - s)^{1-\zeta}}{1 - \zeta} \\
&\quad + \frac{\beta(1 - \rho)(p_s^p + p_s^g)}{1 - \beta(1 - \rho)} \left[(1 - \tau_s^w) \lambda_s^{rio} W_s^p h - \frac{1 - (1 - h - s)^{1-\zeta}}{1 - \zeta} \right] \\
\Leftrightarrow \lambda_s^{S_o} &= \frac{b \lambda_s^{rio} - B_1^S + B_2^S W_s^p h \lambda_s^{rio}}{B_3^S}
\end{aligned} \tag{4.6.58}$$

with

$$\begin{aligned}
B_1^S &= \frac{1 - (1 - s)^{1-\zeta}}{1 - \zeta} + \frac{\beta(1 - \rho)(p_s^p + p_s^g)}{1 - (1 - \rho) \beta} \frac{1 - (1 - h - s)^{1-\zeta}}{(1 - \zeta)} \\
B_2^S &= \frac{\beta(1 - \rho)(p_s^p + p_s^g)}{1 - \beta(1 - \rho)} (1 - \tau_s^w) \\
B_3^S &= 1 - \beta + \beta(1 - \rho)(p_s^p + p_s^g) \left(1 - \frac{\beta \rho}{1 - \beta(1 - \rho)} \right)
\end{aligned}$$

For non-Ricardian workers In a similar way, I obtain:

$$\lambda_s^{Erp} = \frac{1}{1 - (1 - \rho)\beta} \left[(1 - \tau_s^w) W_s^p h \lambda_s^{rir} - \frac{1 - (1 - h - s)^{1-\zeta}}{(1 - \zeta)} + \beta \rho \lambda_s^{Srs} \right] \quad (4.6.59)$$

$$\lambda_s^{Erg} = \frac{1}{1 - (1 - \rho)\beta} \left[(1 - \tau_s^w) W_s^p h \lambda_s^{rir} - \frac{1 - (1 - h - s)^{1-\zeta}}{(1 - \zeta)} + \beta \rho \lambda_s^{Srs} \right] \quad (4.6.60)$$

$$\lambda_s^{Sr} = \frac{b \lambda_s^{rir} - B_1^S + B_2^S W_s^p h \lambda_s^{rir}}{B_3^S} \quad (4.6.61)$$

Chapter 5 | German fiscal and labor market reforms, the current account and macroeconomic imbalances in the Euro Area: a GVAR approach*

5.1 Introduction

Germany is nowadays the strongest economy in the Euro Area. Despite the crisis, the Germany economy is characterized by a quasi full employment and a large current account surplus.

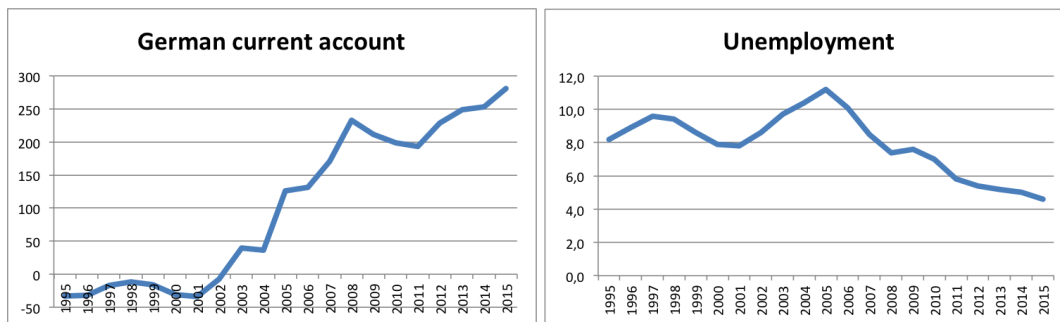
As shown in Figure 5.1, if Germany has strong economic performances since few years, it has not always been the case. At the beginning of the 2000's, Germany was even the *sick man* of Europe among others, with a rather high unemployment rate, weak GDP growth rates and a (small) current account deficit.¹ One major concern was that unemployment went up, was higher than the Eu-

⁰ This Chapter is based on an article co-written with Thierry Betti, titled "German fiscal and labor market reforms, the current account and macroeconomic imbalances in the Euro Area: a GVAR approach"

¹ See Dustmann et al. (2014).

ropean average and characterized by a strong rise in the number of long-term unemployed. A frequently asked question is then "Where the German miracle is coming from?". Indeed and as shown in Figure 1, the German current account became positive from 2002 and has increased continuously until now. Also, unemployment decreases from 2005 and the German economy is today at the full-employment. If Germany has certainly enjoyed the global upturn during the first half of the 2000's, many observers argue in favor of the beneficial effects of a set of reforms implemented in the mid-2000's called the "Hartz reforms".

Fig. 5.1: The German current account (US billions) and German unemployment rate (in pourcentage of the active population). Sources: *Worldbank, Eurostat*



Named after Peter Hartz, president of the *Kommission für moderne Dienstleistungen am Arbeitsmarkt*, literally "Commission for the modernization of the labor market", the Hartz reforms are a package of four different laws that have been implemented from January 2003 to January 2005 in Germany. The objectives of these reforms are clear: help Germany to face two main issues that are a high level of unemployment and a fall in labor force.²

A literature has investigated to what extent these reforms have participated to the strong economic performance of the German economy and to the sharp rise in the German current account. Moreover, some economists and policy-makers have claimed that these reforms have had harmful "beggar-thy-neighbor" effects for Germany's trade partners in the Euro Area and have participated greatly to the emergence of macroeconomic imbalances between Germany and the rest of

² See Amable and Françon (2014) for a detailed description of the Hartz reforms.

the Euro Area.

In this chapter, I aim at contributing to this literature by focusing on the open-economy effects of the fiscal reforms embedded in the Hartz reforms. Indeed, alongside deep reforms on the labor market, Germany has also implemented different fiscal reforms. First, Germany has continuously led fiscal devaluation. From 1999, the VAT rate has been increased significantly: +0.51% in 1999, +0.22% in 2000, +0.23% in 2001, +0.22% in 2002, +0.22% in 2003 and +1.45% in 2007. Contemporaneously, social contributions for both employers and employees have been decreased: a drop of 0.42% in 1999 followed by a decrease of 0.15% each year from 2000 to 2003.

Hartz IV (January 2005) focus on unemployed workers' rights. First, with *Arbeitslosengeld I*, the short-run unemployment benefit duration is reduced. Second, with *Arbeitslosengeld II*, the *Arbeitslosenhilfe*, an income related unemployment assistance for long-run unemployed workers, and the *Sozialhilfe*, a lump-sum social assistance, are merged: the unemployment assistance is abolished while the social assistance is increased, submitted to an active job search and turned into a means-tested minimum income subsidy. The Hartz reforms are completed by two minor laws that makes unfair dismissal procedure more flexible and that reduce unemployment benefits maximum duration from 32 to 18 months.

There exists different way to comprehend the Hartz reforms impact on Germany's economy. On one hand, the Hartz reforms globally reached the goal they targeted. Indeed, as reported by Bouvard et al. (2013), German employment moves from 64.9% in 2004 to 72.4% in 2012. This increase can be explained thanks to a rise in temporary jobs since this kind of employment has been multiplied by 2.7 between 2003 and 2011 while full-time and part-time employment increased between 2003 and 2011 by 2.4% and 33%, respectively. Moreover, between 2004 and 2011, the participation rate raised by 4.6% while the working age population fell by 1.3%. In particular, seniors' participation increased by more than 16.2 percentage points and women's participation by more than 6.0 percentage points. Finally, Jacobi and Kluve (2006), Klinger and Rothe (2010) and Hertweck and

Sigrist (2012) show that Hartz III in particular improved the German labor market matching efficiency. This yields a decrease in structural unemployment and a move in Beveridge curve. On the other hand, Bouvard et al. (2013) document that from 2004 to 2006, poverty rate moved from 4.8% to 7.5%. The Hartz reforms affected more unemployed workers than the rest of the German population since the poverty rate for this population moved from 41% in 2004 to 68% in 2010.

Another aspect of the Hartz reforms consequences that has to be considered is their impact on Germany's commercial partners. It is this approach that is adopted in this chapter. Indeed, it is sometimes argued that these reforms have participated to the emergence of macroeconomic imbalances.

The effects of the Hartz reforms on the rest of the Euro Area remains an unsolved puzzle. Indeed, from an international perspective, two main effects are opposed. On one side, the wage moderation that followed the Hartz reform reduced German labor costs and then increased its price competitiveness. In this case, the Hartz reforms could be interpreted not only as a structural German labor market reform but also as a *beggar-thy-neighbour* policy that could be partially responsible for Euro Area structural current account imbalances. On the other side, the Hartz reforms increased Germany's output and then German demands for the Rest of the Euro Area goods and services. In this perspective, the German labor market reforms could have yielded positive spillover effects.

In order to disentangle the different effects yielded by the Hartz reforms, a large theoretical literature has grown up. Among it, Dao (2013) built a two-countries DSGE model calibrated for Germany and the rest of the Euro-Area. The author shows the Hartz reforms yields a fall in labor costs that stimulates German output. In return, Germany's demand for European goods and services increases. *In fine*, the author shows that the Hartz reforms positively spill over into other European countries. Gadatsch et al. (2015) also use a two-country DSGE model but focus particularly on German current account. The authors theoretically show that the Hartz reforms strongly increased Germany's real net exports because of a reduction in labor costs. However, because of this same reduction in labor costs,

export prices reduction balances the increase in real net export. As a consequence, Germany's labor market would have a small but positive effect on the rest of Euro Area current account balance.

From an empirical point of views, fewer articles study the Hartz reforms spillover effects. Gadatsch et al. (2015) estimate that the reforms have a positive impact on the rest of Euro Area output about 0.2%. Kollmann et al. (2014) estimate that Germany's trade balance is impacted by three different channels: the saving rate, the demand from the rest of the Euro area and the Hartz reforms.

In this chapter I focus on the fiscal component of the Hartz reforms by estimating the effects of tax changes in Germany on the rest of the Euro Area. More specifically, I am interested in the impact of a rise in VAT and of cuts in social security contributions and unemployment benefits. For this purpose, I estimate a Global VAR model with quarterly data for the Euro Area over the period 1992-2011. Primarily presented in Pesaran et al. (2004), a global VAR is particularly suitable for my purposes since it allows for the modelling of international linkages between economies and for the analysis of spillover effects.

The contribution of this chapter is the following. First, only few articles use a global VAR model to investigate fiscal spillovers in a monetary union, with the notable exceptions of Hebous and Zimmermann (2013) and Ricci-Risquete and Ramajo-Hernández (2015). However, these two articles the authors do not focus on the effects of fiscal devaluation on the current accounts. Second, very few articles provide empirical evidence on the open-economy effects of unemployment benefits.

The rest of the chapter is organized as follows: the section (2) presents the econometric framework and the data set, the section (3) contains the results and a section (4) concludes.

5.2 Empirical section

5.2.1 Data description

I estimate a GVAR model for 8 Euro Area economies, namely Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain, from 1992Q1 to 2011Q4. This group of countries represents about 90% of Euro Area GDP. Variables included in the GVAR are real GDP, the consumer price index (CPI, hereinafter) inflation, the current account, the real effective exchange rate (REER, hereinafter), VAT receipts, the social contributions (paid both by employers and employees), unemployment benefits and the three-month ECB's nominal interest rate as a global variable in the model. Due to data unavailability, I exclude from the country-specific regressions social contributions and VAT for Spain and the unemployment benefits for Austria.

I use the *GVAR toolbox*³ to estimate and simulate the GVAR model and data for GDP and inflation are taken from the GVAR dataset. The GDP series are expressed in index and in log, in real terms and seasonally adjusted. The CPI is used to express GDP in real terms.

Data for the current accounts are taken from *Eurostat* and are expressed in percents of GDP. Data for the REER series are taken from the *IMF International Financial Statistics database* and are expressed in log. The three-month ECB's nominal interest rate serie is provided by the ECB database.

Data for VAT and social contributions are available at the quarterly frequency on the *Eurostat* database. Data are expressed in real terms by using the CPI series. The VAT series are directly available seasonally adjusted. However, data for social contributions are only available unadjusted and are manually seasonally adjusted.

Quarterly data for unemployment benefits are not available. Data are only

³ The GVAR toolbox is a program developed notably by Vanessa Smith. See Smith and Galesi (2014).

available at the annual frequency. I use the Chow-Lin method to disaggregate the annual series into the quarterly frequency. The quarterly proxy used to extrapolate quarterly series for the unemployment benefits is the seasonally adjusted number of unemployed persons.⁴

Cyclically-adjusted fiscal variables

One potential drawback of the GVAR modeling is that shocks cannot be interpreted as structural ones. Fiscal shocks in the present chapter then cannot be interpreted as exogenous changes in fiscal stances. Indeed, data for fiscal receipts and unemployment benefits are likely to contain an important automatic stabilizers component (*i.e.* the automatic response of fiscal receipts or of some types of government expenditure to the business cycle. For instance, a rise in unemployment triggers an automatic rise in the expenditure related to unemployment insurance for the government.).

In order to overcome this limit, I decide to transform the fiscal series by using cyclically-adjusted versions of these series. To drop the automatic component from these series, I use the following formula:

$$\tilde{X}_t = X_t \left(\frac{Y_t^p}{Y_t} \right)^\epsilon \quad (5.2.1)$$

where X_t is the initial fiscal variable, and \tilde{X}_t the cyclically-adjusted series. Y_t is actual GDP while Y_t^p denotes potential GDP.⁵ I use this measure of the output-gap to capture the business cycle component of the series. ϵ denotes the elasticity of the fiscal component to the output-gap.

The elasticity of unemployment benefits to the output-gap $\epsilon_{UNB/Y}$ can be determined such as:

$$\epsilon_{UNB/Y} = \epsilon_{UNB/U} * \epsilon_{U/Y} \quad (5.2.2)$$

⁴ See the Appendix (5.1) for a more detailed description of the Chow-Lin method.

⁵ Data for potential GDP for the eight countries are taken from the OECD main economic indicators database.

where $\epsilon_{UNB/U}$ defines the elasticity of unemployment benefits to unemployment and $\epsilon_{U/Y}$ the elasticity of unemployment to the output-gap. Guillemette et al. (2014) provide new estimates for the eight European economies I consider in this chapter. According to their estimates, I set $\epsilon_{UNB/U} = 1$ and $\epsilon_{U/Y}$ differs among economies, from -5.83 for Spain to -2.29 for Italy.

I use also estimates from Guillemette et al. (2014) for the elasticity of social contributions to the output-gap. This elasticity also varies among countries, from 0.58 for Italy to 0.72 for Spain.

Finally, for the elasticity of VAT receipts to the output-gap, I use the elasticity of indirect tax receipts to the output-gap. Since two thirds of indirect tax receipts are VAT receipts, this elasticity seems to be an acceptable proxy. Always following Guillemette et al. (2014), I set an elasticity equals to 1 for each economy.

Variables are introduced such as:

$$\left\{ \begin{array}{l} y_{it} = \ln(GDP_{it}/CPI_{it}) \\ p_{it} = \Delta \ln(CPI_{it}) \\ r_{it} = 0.25 \ln(1 + R_{it}/100) \\ ca_{it} = \ln(CURRENTACCOUNT_{it}) \\ vat_{it} = \ln(VAT_{it}) \\ spc_{it} = \ln(TSP_{it}) \\ unb_{it} = \ln(UNB_{it}) \end{array} \right.$$

5.2.2 The GVAR model

Country-specific VARX* models

To investigate the effects of fiscal reforms in Germany on the rest of the Euro Area, a GVAR approach is particularly tractable since it enables to model the trade linkages between economies of the union so that this is a suitable economic modeling to capture potential spillovers of such fiscal shocks on economic partners of the union. The GVAR model was primarily presented in Pesaran et al. (2004) and I

follow the latter article by using a standard version of this model.

The GVAR methodology contains basically two steps. First, I estimate for each country a *country-specific* VARX* model, which contains the domestic- and foreign-specific variables but also the global exogenous variables. Once each VARX* model is estimated, country-specific equations are combined by using a weight matrix and then the GVAR model is solved. In this section I describe the VARX* model for a particular country i and then I present the global VAR model.

Let assume that the Euro Area is composed of $N + 1$ economies with $i = 0, 1, \dots, N$. The country-specific VARX*(p,q) for the country i is given by:

$$x_{it} = \alpha_i + \beta_{it} + \phi_{i1}x_{it-1} + \dots + \phi_{ip}x_{it-p} + \psi_{i0}x_{it}^* + \psi_{i1}x_{it-1}^* + \dots + \psi_{iq}x_{it-q}^* + u_{it} \quad (5.2.3)$$

where x_{it} is the vector of country-specific variables and x_{it}^* denotes the vector of foreign variables for the country i . α_i is a vector of intercepts and β_{it} is a deterministic time trend. The terms $\phi_{i1}, \dots, \phi_{ip}$ denote the matrix associated to lagged domestic variables and the terms $\psi_{i0}, \dots, \psi_{iq}$ are the coefficients matrix associated to the current and lagged foreign-specific variables. u_{it} denotes the vector of residuals of the country-specific equations. I assume that residuals are serially uncorrelated such as $u_{it} \text{ i.i.d.}(0, \Sigma_{ii})$ with Σ_{ii} a non-singular covariance matrix. However, as in Pesaran et al. (2004), a cross-country correlation among residuals is allowed.

The Global VAR model and its resolution

Cointegration relationships are found in the different VARX* (see table (5.2)). Thus, the VARX* are estimated under their vector error correction form (VECMX*). Domestic and foreign variables, x_{it} and x_{it}^* respectively are merged into the $(k_i + k_i^*) \times 1$ vector

$$z_{it} = (x'_{it}, x'^{*}_{it})'. \quad (5.2.4)$$

It allows to rewrite the country-specific models defined by equation (5.2.3)

such as:

$$A_{i0}z_{it} = a_{i0} + a_{it}t + B_i z_{i,t-1} + \varepsilon_{it}, \quad (5.2.5)$$

with $A_{ik} = (I_{ki} - \Lambda_{i0})$, $B_i = (\Phi_i, \Lambda_{i1})$, Φ_i a matrix of coefficients associated to lagged domestic variables, Λ_{i0} and Λ_{i1} matrix of coefficients related to contemporaneous and lagged foreign variables, respectively.

A global vector is then built in order to collect all the country-specific variables together such as $x_t = (x_{0t}, x'_{1t}, \dots, x'_{Nt})'$ where $k = \sum_{i=0}^N k_i$. Moreover, I define the $(k_i + k_i^*) \times k$ link matrix W_i of fixed country specific weights such as

$$z_{it} = W_i x_t, \quad i = 0, 1, 2, \dots, N. \quad (5.2.6)$$

W_i allows us to rewrite the country-specific models in terms of the global vector such as

$$A_i W_i x_t = a_{i0} + a_{i1}t + B_i W_i x_{t-1} + \varepsilon_{it}. \quad (5.2.7)$$

When each country model are stacked up, it yields the (full-system) GVAR model so that

$$Gx_t = a_0 + a_1t + Hx_{t-1} + \varepsilon_t \quad (5.2.8)$$

where

$$a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \vdots \\ a_{N0} \end{pmatrix}, \quad a_1 = \begin{pmatrix} a_{01} \\ a_{10} \\ \vdots \\ a_{N1} \end{pmatrix}, \quad \varepsilon_t = \begin{pmatrix} \varepsilon_{0t} \\ \varepsilon_{1t} \\ \vdots \\ \varepsilon_{Nt} \end{pmatrix}, \quad (5.2.9)$$

$$G = \begin{pmatrix} A_0W_0 \\ A_1W_1 \\ \vdots \\ A_NW_N \end{pmatrix}, \quad H = \begin{pmatrix} B_0W_0 \\ B_1W_1 \\ \vdots \\ B_NW_N \end{pmatrix} \quad (5.2.10)$$

The solution of the GVAR model in its reduced form is obtained by pre-multiplying equation (5.2.8) by G^{-1} :

$$x_t = G^{-1}a_0 + G^{-1}Hx_{t-1} + G^{-1}\varepsilon_t. \quad (5.2.11)$$

One crucial hypothesis in the GVAR modeling is that the foreign variables x_t^* but also the global variable in the country-specific equations are assumed to be weakly exogenous. The different economies are then considered as *small economies*. This hypothesis is necessary to validate the full-estimation of the model.⁶

First, to test the weak exogeneity hypothesis, I use Akaike's information criterion to select the order of the weak exogeneity regressions. Then, F-tests are used to conclude on the rejection of the null hypothesis, namely the fact that the foreign variable can be considered as weakly exogenous. Results indicate that the weak exogeneity hypothesis cannot be rejected for 63 variables over the 72 foreign variables. Notably, the F-tests indicate that the null hypothesis can be rejected for the ECB's interest rate in the case of Germany. As a consequence, I consider the ECB's interest rate as endogenous in the regression of Germany.

Also, to validate the estimation of the full system of the country-specific equations, the stability of the global model implies that the eigenvalues of the H matrix must be under or equal to one. Also, each country-specific foreign variable weight must be small enough and the idiosyncratic shocks must be weakly cross-dependent.⁷ Equation (5.2.11) can be solved recursively forward in order to compute impulse response functions.

⁶ See Dees et al. (2007) for a more detailed discussion on the hypothesis of weak exogeneity.

⁷ According to Chudik et al. (2011), this assumption implies that the idiosyncratic shocks weighted average at a given point of time must converge to its expectation in quadratic mean.

The weight matrix

One advantage of the GVAR methodology is to include in each domestic model foreign variables as aggregated. This model allows to limit the number of parameters to be estimated and to avoid problems related to the well-known “*curse of dimensionality*”. For instance, the foreign-specific variable for GDP y_{it}^* in the model of the country i is computed as:

$$y_{it}^* = \sum_{j=0}^N \omega_{ij} x_{jt} \quad , \quad \sum_{j=0}^N \omega_{ij} = 1 \quad (5.2.12)$$

where ω_{ij} denotes the trade weight between the domestic economy i and the country j . I use fixed (and not time-varying) trade weights that are computed as the sum of imports and exports between two economies, such as:

$$\omega_{ij} = IMPORTS_{ij} + EXPORTS_{ij} \quad (5.2.13)$$

Trade weights are computed over the period 2004-2006. Consequently, trade weights correspond to means of values for the years 2004/2005/2006. All data for imports and exports are considered in *Purchasing Power Parity*. Computations lead to the following trade matrix:

Tab. 5.1: Weight matrix

	AUT	BEL	FIN	FRA	DEU	ITA	NLD	ESP
AUT	0,000	0,014	0,132	0,019	0,034	0,020	0,061	0,200
BEL	0,039	0,000	0,161	0,075	0,088	0,188	0,084	0,305
FIN	0,648	0,338	0,000	0,288	0,423	0,335	0,351	0,212
FRA	0,032	0,049	0,091	0,000	0,059	0,163	0,130	0,068
DEU	0,008	0,010	0,022	0,010	0,000	0,009	0,012	0,011
ITA	0,070	0,260	0,224	0,333	0,118	0,000	0,265	0,147
NLD	0,144	0,081	0,158	0,183	0,096	0,175	0,000	0,058
ESP	0,058	0,249	0,212	0,091	0,181	0,110	0,097	0,000

List of countries: Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Germany (DEU), Italy (ITA), the Netherlands (NLD) and Spain (ESP).

5.2.3 Statistical properties of the dataset and data transformations

One important step before the estimation of the country-specific VARX* models is to choose the appropriate transformations of the set of variables. Following Pesaran et al. (2004) or Dees et al. (2007), this is usual in a GVAR framework to consider the variables introduced in the VARX* models as integrated of order one. In this way, I can extract long-run relations from the data and interpret these relations as cointegrating ones. To test it formally, I use a traditional unit root test, namely the Augmented Dickey Fuller (ADF) test. Before running the ADF tests for each variable, I have to select the lag order in the regressions. To do so, I use the Akaike information criterion (AIC)⁸. According to the results of the tests, unit root tests are performed on regressions with 2 lags.

I first run the ADF unit root tests with data in level. I add for this case a time trend and an intercept. The null hypothesis cannot be rejected in all cases so that I conclude that all the variables are integrated of order one. Then, ADF unit root tests are performed with data in first difference. Results are that data are integrated of order one, except inflation that are integrated of order 2.⁹

The order of each individual country VARX* (p_i, q_i) models, where p_i denotes the number of lags of the domestic variables and q_i defines the number of lags of foreign variables. I select the values for p_i and q_i by using the Akaike Information Criterion.

The selected order for each country-specific VARX* model is presented in Table 5.2. Expect for France, a VARX*(2,1) is preferred by the AIC. For France, a VARX*(1,1) is preferred. Then, the cointegration analysis is done for each

⁸ The AIC is a measure of the quality of a model. In order to improve the maximum likelihood estimation, one can be tented to increase the number of parameters in a model. Thus, AIC provides a way to choose between different models: it says that the best model would be the one that maximize the likelihood function with as few parameters as possible. In the case of GVAR, the AIC focuses on the number of lags for all the different variables. Indeed, to increase the size of the number of lagged times for each variable automatically increases the number of parameters in the model. Finally, the best model will be the one with the lowest AIC score.

⁹ For saving space, I do not display the results of the different ADF tests. However, the results can be send upon request.

5.3 The effects of fiscal and labor market reforms in Germany on output and the current account

Tab. 5.2: Country-specific models order and cointegrating relations

Country	VARX*(p_i, q_i)		Cointegrating relations
	p_i	q_i	
AUT	2	1	2
BEL	2	1	2
FIN	2	1	2
FRA	1	1	2
DEU	2	1	2
ITA	2	1	2
NLD	2	1	2
ESP	2	1	2

country-specific VARX* and for each specific model. The results are displayed in the last column of Table 5.2. Cointegrating relationships can be interpreted as a measure of long-term relationships among domestic variables and/or between foreign and domestic variables.

5.3 The effects of fiscal and labor market reforms in Germany on output and the current account

5.3.1 Contemporaneous effects of foreign variables on their domestic counterparts

Table 5.3 presents the estimation of the contemporaneous effects of foreign variables on their domestic counterparts. These coefficients are known as "*impact elasticities*". Following Ricci-Risquete and Ramajo-Hernández (2015), I present the Newey-West's heteroscedasticity-consistent variance estimator. The interpretation of these coefficients is quite simple. For instance, an increase of 1% in foreign real output in a specific quarter triggers an increase of 0.9% in Austria during this same quarter. As a result, Spain seems to be the country that is the less impacted by foreign real output. In turn, Germany is strongly impacted by variations of foreign output.

Another interesting feature is that unemployment benefits in a specific coun-

try are only weakly affected by a variation in other countries unemployment benefits. Germany is the exception with an impact elasticity equals to 1.74. Regarding the rest of the euro zone, the impact elasticities are spread between 0.41 and 0. In turn, VAT is more correlated one another. Regarding VAT, impact elasticities are spread between 1.99 and 0.21. However, the situation of the social contribution is more disparate: Austria, Italy and the Netherlands display high elasticities in absolute values, spread between 0.55 and 0.81, while Belgium, Finland, France and Germany display only weak elasticities, between 0.03 and 0.5 in absolute value.

Finally, in contrast with Dees et al. (2007) but in accordance with Ricci-Risquete and Ramajo-Hernández (2015), I find that in the short run prices in the entire Euro Area are affected by variations in foreign prices. Except for Finland (0.29) and Italy (0.38), impact elasticities are spread between 0.51 with Austria and 1.2 with Belgium. As a global result, it seems clear that European countries display high contemporaneous interaction each others.

5.3 The effects of fiscal and labor market reforms in Germany on output and the current account

Tab. 5.3: Contemporaneous effects of foreign variables on their domestic counterparts

Country	y	p	ca	reer	vat	SC	ub
AUT	0.9 (5.73)	0.51 (6.31)	0.04 (1.84)	0.82 (4.79)	0.21 (3.51)	0.55 (2.79)	-
BEL	0.81 (6.96)	1.2 (11.21)	0.26 (1.25)	0.82 (4.2)	1.11 (15.94)	0.17 (2.3)	0.05 (1.01)
FIN	0.82 (2.46)	0.29 (1.74)	0.98 (2.41)	-0.24 (-1.04)	0.85 (10.81)	0.5 (1.82)	0.06 (0.8)
FRA	0.65 (10.58)	0.81 (7.27)	0.33 (2.39)	1.08 (10.34)	0.63 (9.42)	0.22 (1.89)	0 (0.04)
DEU	0.84 (4.11)	0.94 (6.62)	1.16 (3.54)	1.08 (15.32)	0.25 (6.28)	-0.03 (-0.4)	1.74 (5.35)
ITA	0.82 (4.21)	0.38 (4.71)	0.63 (4.44)	-2.17 (-3)	0.67 (5.98)	-0.61 (-1.51)	0.24 (3.43)
NLD	0.67 (5.52)	0.54 (5.98)	-0.13 (-0.5)	1.21 (8.5)	1.99 (16.29)	0.81 (1.07)	0.41 (5.53)
ESP	0.43 (4.66)	0.78 (7.19)	0.19 (1.12)	0.62 (2.88)	-	-	0.07 (0.74)

Newey-West *t*-ratios are given in square brackets. Newey-West standard errors are used to correct serial correlation of errors terms over time.

5.3.2 Dynamic analysis

In order to analyze the effects of the three different fiscal shock on the German economy, I use the Generalized Impulse Response Functions (GIRFs) proposed by Koop et al. (1996) and Pesaran and Shin (1998) and provided by the L. Vanessa Smith's GVAR Toolbox. As highlighted by Ricci-Risquete and Ramajo-Hernández (2015), GIRFs are different from Sims (1980)'s orthogonalized impulse response functions (OIRs) in two different ways: they are invariant to the way countries and variables are ordered in the GVAR model and they do not provide any information about causality. This last characteristic makes it impossible to interpret the different shocks as structural. However, GIRFs are still interesting for my concerns since they display enough information about spillover dynamics.

Germany's reaction to its own fiscal policies

The GIRFs that present the reaction of Germany to the different fiscal devaluation policies are displayed in Appendices 5.5.2.

First, in order to replicate Hartz IV reforms and to investigate the consequence of the merge between the *Arbeitslosenhilfe* and the *Sozialhilfe* that globally yields a decrease in replacement rate, I simulate a cut in unemployment benefits in German economy. This cut yields a decrease in German output, in contradiction with Gadatsch et al. (2015). Indeed, thanks to a two-country DSGE model, the authors show that the decrease in replacement rate yields a decrease in real wage and an increase in employment. In a model with both Ricardian and *hand-to-mouth* households, the loss in real income is fully compensated by the reduction in unemployment. As a consequence, the German consumption increase and push the entire economy. Here, I show that the decrease in net income is actually not entirely compensated by the increase in employment since *in fine* output decreases in the aftermath of the shock. However, as in Gadatsch et al. (2015), the decrease in unemployment benefits triggers a decrease in consumer price index. Finally, as in Gadatsch et al. (2015), the German price fall reduces the value of German export and yields a decrease in German current account.

5.3 The effects of fiscal and labor market reforms in Germany on output and the current account

Second, between 2001 and 2005, Germany decreases social contributions in order to boost price and costs competitiveness. In order to stabilize public finance and to fund this cut in corporate tax, an increase in VAT is implemented in 2007. In order to simulate this so-called Social VAT, I shock successively a negative shock in social contributions and a positive one in VAT in Germany and compare the different dynamics thus generated. As expected, the increase in VAT yields a decrease in German output as the decrease in social contributions triggers an increase in this variable. However, the global effect of these two different shocks on German output is ambiguous and very sensitive to the bootstrapping exercise. A main result of my analysis concerns the reaction of German current account. Indeed, globally, my model suggests that fiscal devaluation increases strongly and durably the German current account. Rather than the cut in unemployment benefits, the Social VAT is responsible for a great part of the increase in current account experimented in Germany after 2006, as documented earlier in the chapter.

Concerning the reaction of the rest of the Euro area, I focus on two particular variables: output and current account. The response of the specific country current account is qualified. First, Finland plays the Euro area exception since the Finnish current account is the only one to be positive after the decrease in German unemployment benefits. Concerning Belgium and France, their current account increase in the aftermath of the shock. However, after few quarters, they clearly become negative. Finally, Austrian, Dutch and Spanish current account is instantaneously negative. Regarding output reaction, the tendency is obvious since all countries experiment a weak increase in their GDP in the middle and the long run. In the short run, only Italy, the Netherlands and Spain know a frail decrease or an inertia in output. Finally, as a general remark, the amplitude of the output response is weak. Even for Germany, the increase in output is far below 1% after the decrease in German unemployment benefits.

5.3.3 The Rest of the Euro Area reaction to the German fiscal devaluation

Concerning the reaction of the rest of the Euro area, I focus in particular on two variables: output and current account. As a first result, the response of cut in Ger-

man unemployment benefits yields a negative answer for all the European countries present in my model. Indeed, the fall in German output spillovers the rest of the Euro Area. The response peak for Belgium, France, Spain and the Netherlands is around 0.5% while it is around 0.8% for Italy and around 1% for the Netherlands. In that point of view, this policy cannot be considered as a *beggar-thy-neighbour* one since the fall in European countries is shared by Germany. The response of the specific country current account is qualified. First, Finland plays the Euro area exception since the Finnish current account is the only one to be negative after the decrease in German unemployment benefits. Concerning Austria, Belgium, France, Italy and Spain, these countries see their current account increase in the aftermath of the shock. Finally, the Netherlands' response to the German shock is slightly positive.

The decrease in social contribution paid by German employers yields an unequivocal answer in the European countries since it increases the output in these countries. Belgium and the Netherlands know a slighted decrease in the aftermath of the shock but after few quarters the activity in these two countries. Regarding the current account reaction, the situation is dual. Austria and the Netherlands experiment an increase in their current account, just as Germany. However, this increase is realized at the costs of a clear decrease of the current account in Belgium, France, Italy and Spain and a weak decrease in Finnish one.

In reaction to the increase in German VAT, France, the Netherlands and Spain's current accounts follow Germany's one since they rise afterwards. Once again, this rise is possible only because the current account of the others countries fall. It is clearly the case for Austria, Finland and Italy while the response of Belgium current account is quite weak. Finally, the negative answer of the German output to the increase in VAT directly translates into the rest of the Euro area except for Austria that knows a little growth after the shock to finally see its activity decrease after few quarterly.

5.4 Concluding Remarks

The consequence of the fiscal and labor market reforms in Germany for the rest of the Euro Area are a puzzle for both economists and policy makers. For the latter, the question is to know if these reforms have to be individually implemented in their economy. For economists, it both to identify if these reforms are responsible for the incredible increase in German current account and if they are at the roots of spillover effects, whether positive or negative, into the rest of the Euro area. To participate to this debate and to provide some answer, I build in this chapter a *Global Var* model in order to estimate country-specific models and to simulate the German policy that have implemented during the last decade.

I estimate country-specific VARX models for European countries and in particular for Germany from 1992Q1 to 2011. I pay a particular attention to the effect of cut in unemployment benefit and to the Social VAT implementation. My contribution can be summed up as follows: from the dynamic analysis of the model, I show than any policy that contribute to boost German output also contribute to stimulate the rest of the European economy. Especially, the Social VAT tends to increase both Germany and the resto of the Euro Area GDP. In turn, the cut in unemployment benefit implemented with Hartz IV reform negatively impacted the European economies. This result stands out from the theoretical literature. This can be explained by the fact that I choose to focus on a particular reform and not on Hartz reforms as a whole. In that, I am able to highlight the particular effect of Hart IV reform. Another important result emphasized by my model is that the impact of German fiscal devaluation on European current account is not homogenous. In contrast with a great part of the theoretical literature, I show that the Social VAT improve Germany's current account at the cost of a share of other European country one.

5.5 Appendices

5.5.1 The Unemployment Benefits Temporal Disaggregation using the Chow-Lin Method: Statistics

Since quarterly data regarding unemployment benefits are not available, I use the Chow and Lin (1971) method for temporal disaggregation and further developed by Fernández (1981) and Litterman (1983). This method consists in using a statistical relationship between a low frequency data and a related high frequency indicator in order to build a higher frequency proxy of the first data. While it is possible to use multivariate regression, I choose in my case to use only the number of unemployed workers found in the Eurostat database in each specific country in order to approximate the quarterly dynamic of unemployment benefits in this country. Regression coefficients are then estimated between the two variables at the low frequency level since data are available for both variables. These regressions are composed by two elements: the estimated quarterly values and a correction that is present for possible inconsistency problems.

To analyze the dynamic property of the different GVAR models, I investigate successively different fiscal reforms in Germany: a negative inunemployment benefit (in order to simulate the Hartz IV reform), a positive shock in VAT and a negative shock in employers' social contribution.

Tab. 5.4: Belgium

Residuals:	Min	1Q	Median	3Q	Max
	-3463,1	-2560,7	-1026,5	929,9	3554,6
Coefficients:	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	1358.1608	884.8547	1.535	0.1422	
Unem.rate.Belgium	1.8190	0.7484	2.430	0.0258 *	

Signif. codes: 0'***'; 0.001'***'; 0.01'**'; 0.05 ' ', 0.1'; ' 1

Tab. 5.5: Finland

Residuals:				
Min	1Q	Median	3Q	Max
-507,3	-408,21	-243,27	69,75	691,67
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	104.424	111.886	0.933	0.363
Unem.rate.Finland	2.233	0.260	8.590	$8.77e^{-08***}$

Signif. codes: 0'***'; 0.001'***'; 0.01'***'; 0.05 '.', 0.1'; ' 1

Tab. 5.6: France

Residuals:				
Min	1Q	Median	3Q	Max
-8574.3	-7069.9	-398.9	5313.4	7456.5
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1585.426	2000.362	0.793	0.43835
Unem.rate.France	1.637	0.566	2.893	0.00969**

Signif. codes: 0'***'; 0.001'***'; 0.01'***'; 0.05 '.', 0.1'; ' 1

Tab. 5.7: Germany

Residuals:				
Min	1Q	Median	3Q	Max
-5079.1	-3115.9	-1300.8	568.9	10145.9
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-420.8439	1530.4977	-0.275	0.786
Unem.rate.Germany	2.3081	0.4415	5.227	$5.69e^{-05***}$

Signif. codes: 0'***'; 0.001'***'; 0.01'***'; 0.05 '.', 0.1'; ' 1

Tab. 5.8: Italy

Residuals:				
Min	1Q	Median	3Q	Max
-4602.8	-4166.2	-2823.0	551.4	4626.8
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-254.3399	1208.8531	-0.210	0.8357
Unem.rate.Italy	0.9492	0.4192	2.264	0.0361*

Signif. codes: 0'***'; 0.001'***'; 0.01'**'; 0.05'.'. 0.1'; ' 1

Tab. 5.9: The Netherlands

Residuals:				
Min	1Q	Median	3Q	Max
-996.06	-329.99	-171.48	14.22	1510.89
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	737.8448	223.7525	3.298	0.004**
Unem.rate.Netherlands	2.7065	0.5091	5.316	4.71e ⁻⁰⁵ ***

Signif. codes: 0'***'; 0.001'***'; 0.01'**'; 0.05'.'. 0.1'; ' 1

Tab. 5.10: Spain

Residuals:				
Min	1Q	Median	3Q	Max
-5184	-3136	-1383	2322	5892
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-204.3169	757.5410	-0.270	0.79
Unem.rate.Spain	1.2217	0.1751	6.977	1.62e ⁻⁰⁶ ***

Signif. codes: 0'***'; 0.001'***'; 0.01'**'; 0.05'.'. 0.1'; ' 1

5.5.2 Germany's reaction to the fiscal devaluation policies

Fig. 5.2: Cut in unemployment benefits

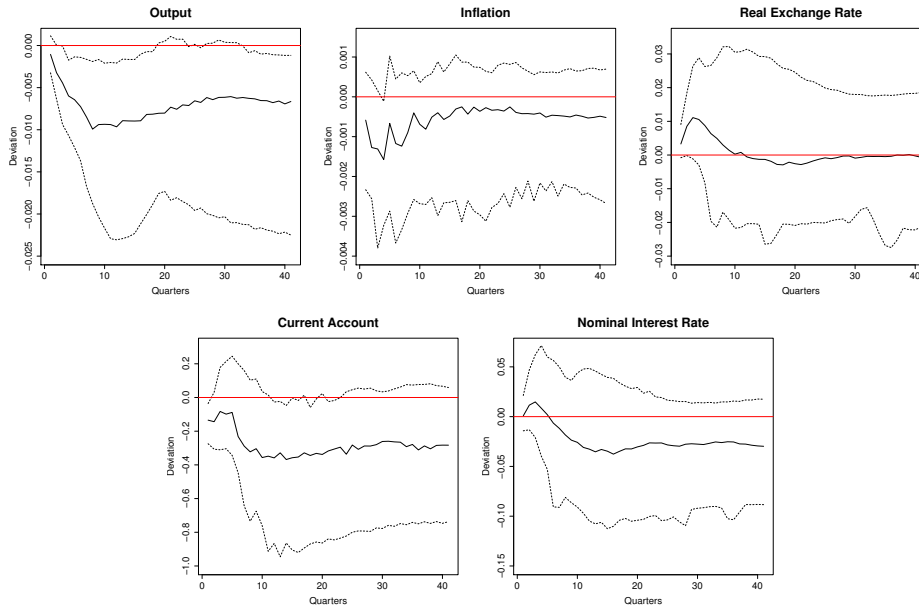


Fig. 5.3: Cut in Social Contributions

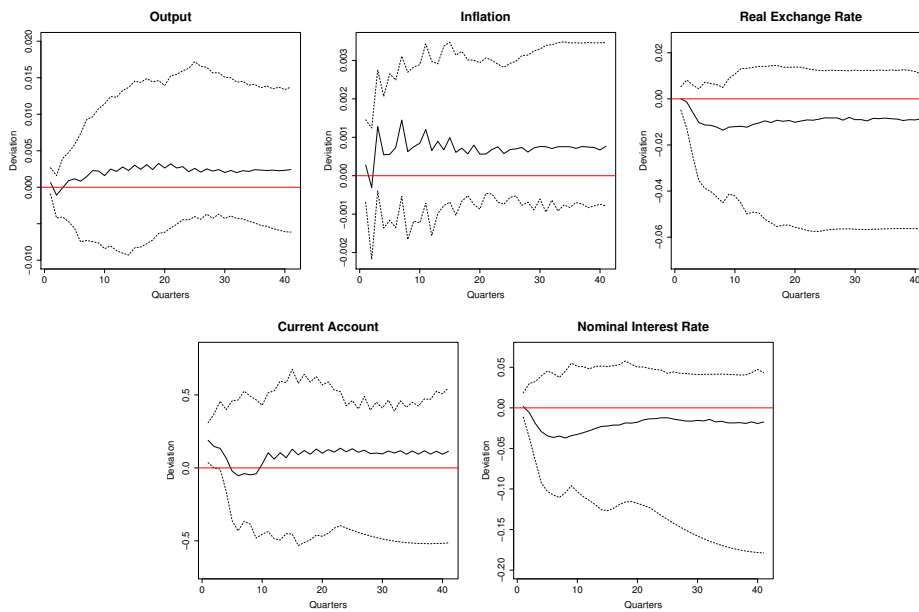
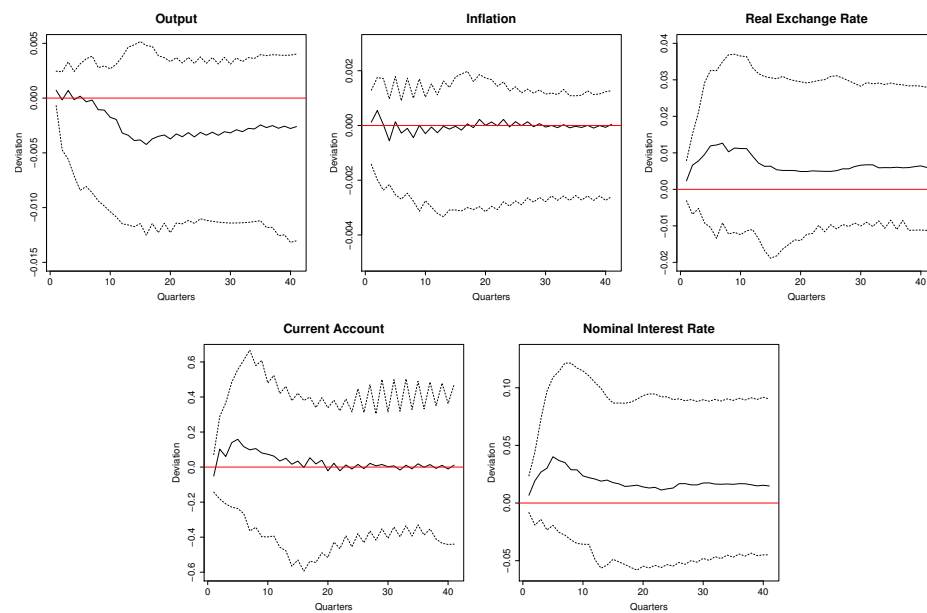


Fig. 5.4: Increase in VAT



5.5.3 Generalized Impulse-Response Functions to a German cut in unemployment benefits

Fig. 5.5: Austria

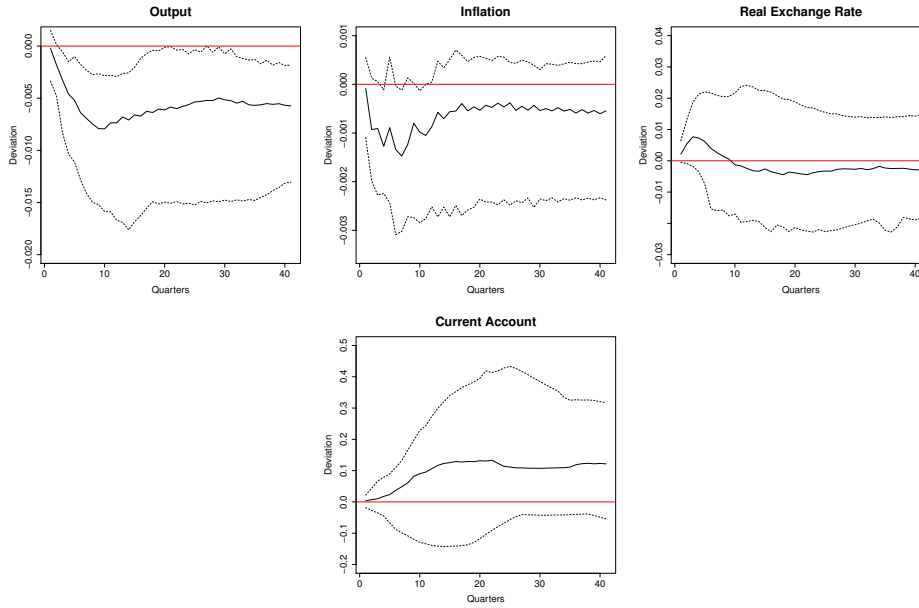


Fig. 5.6: Belgium

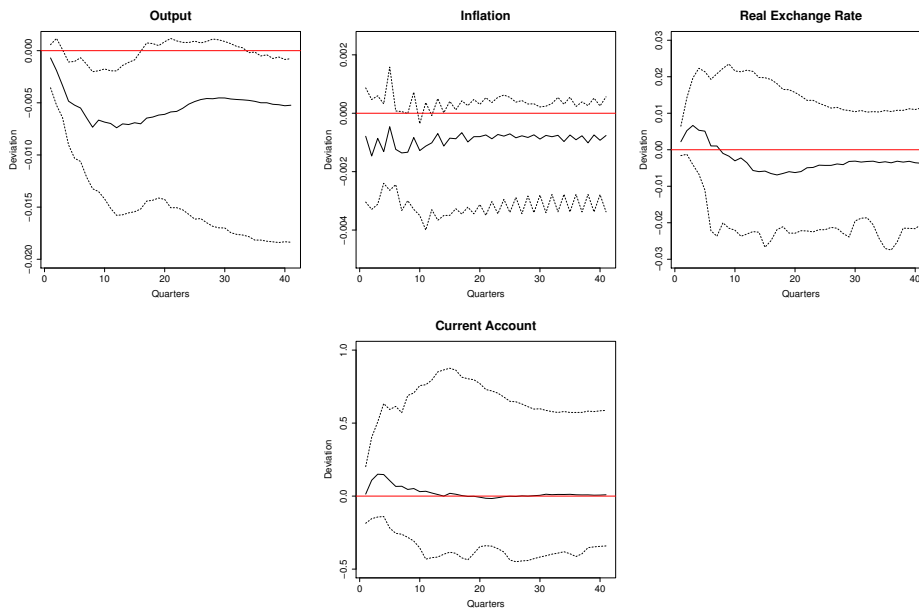


Fig. 5.7: Finland

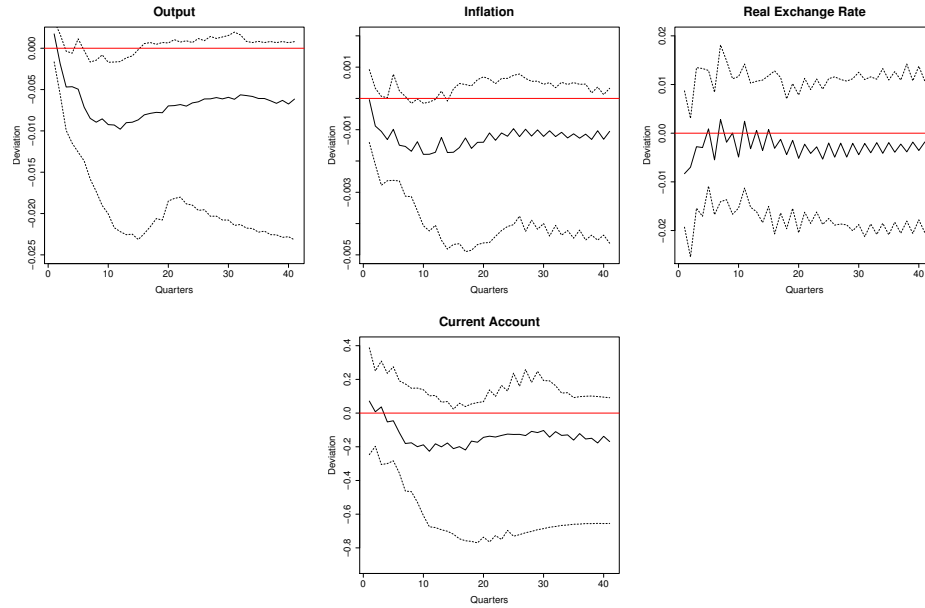


Fig. 5.8: France

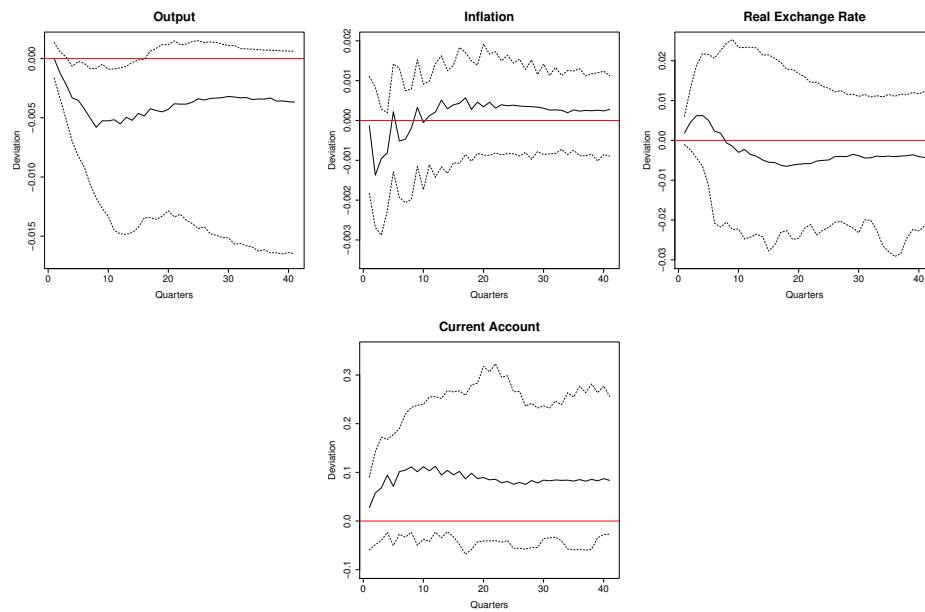


Fig. 5.9: Italy

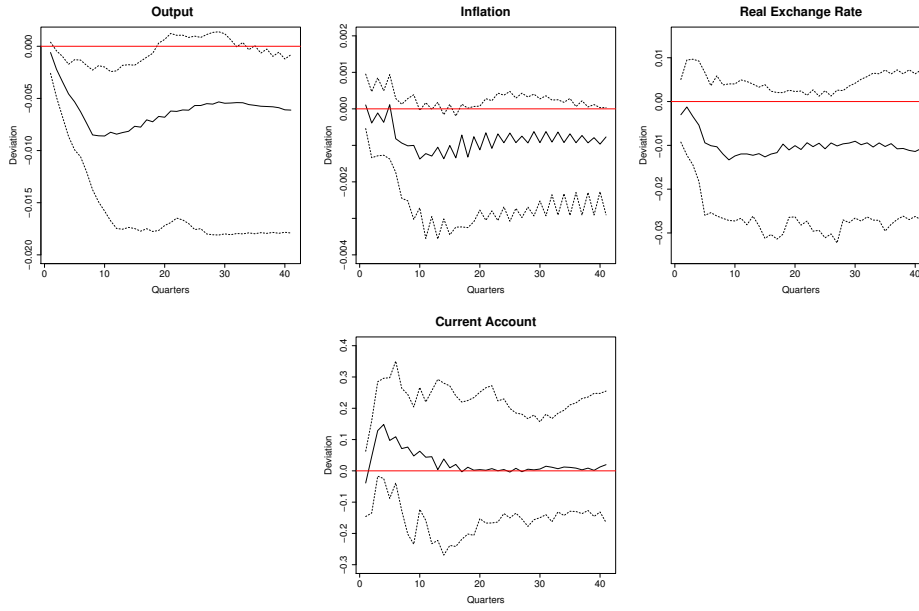


Fig. 5.10: The Netherlands

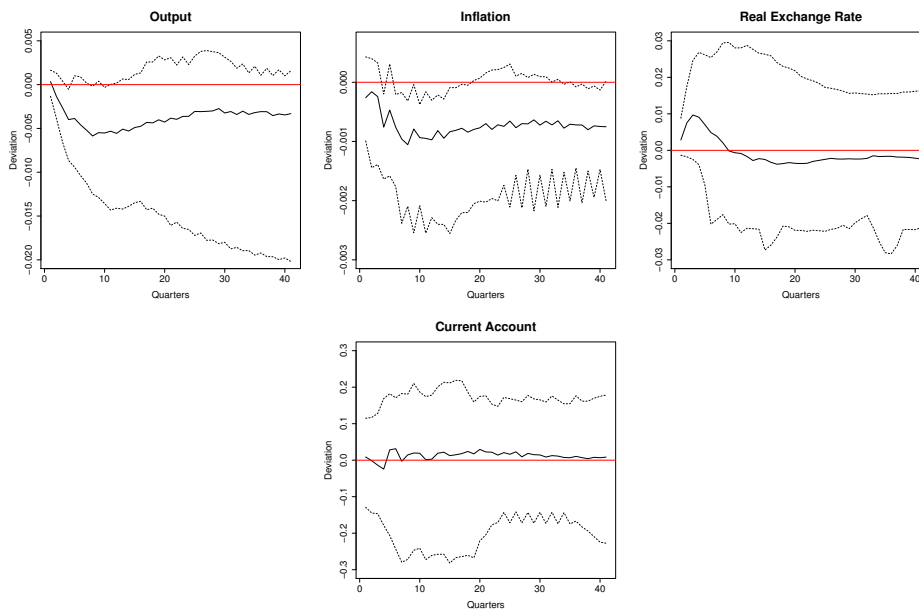
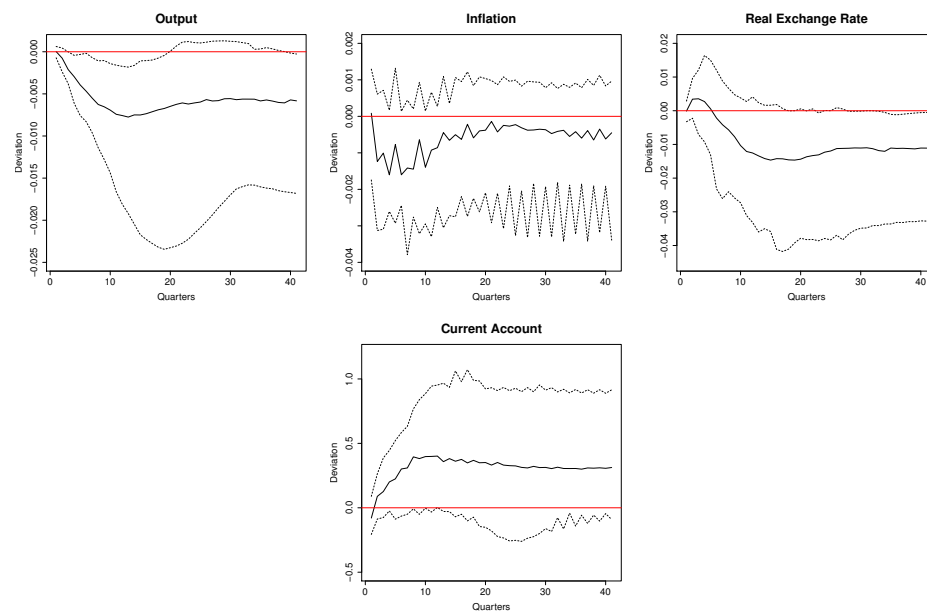


Fig. 5.11: Spain



5.5.4 Impulse-response functions to a Germain cut in Social Contributions

Fig. 5.12: Austria

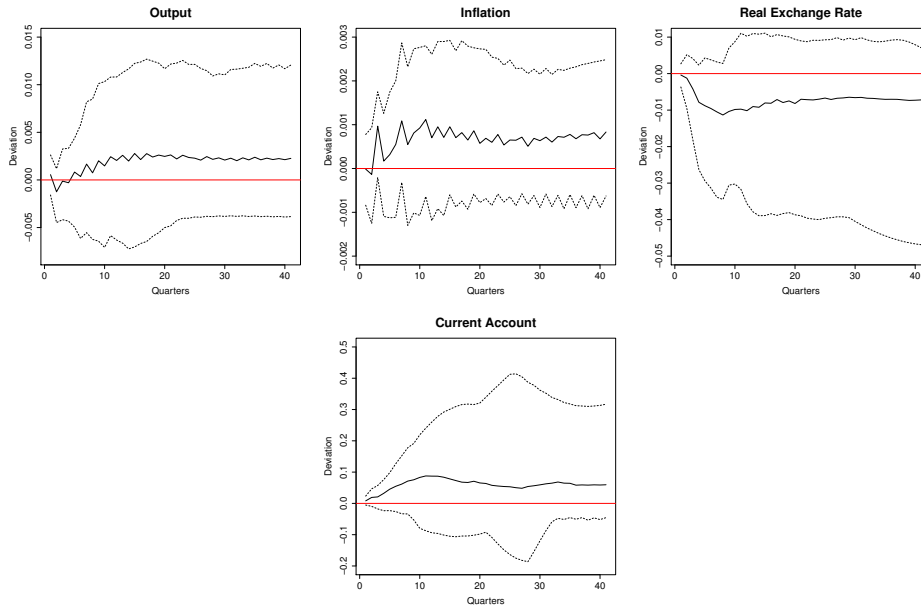


Fig. 5.13: Belgium

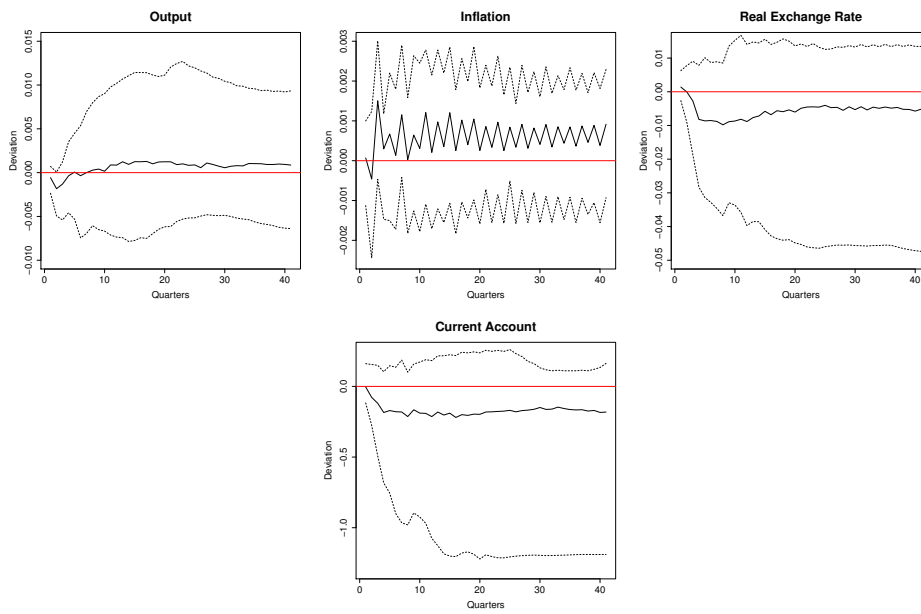


Fig. 5.14: Finland

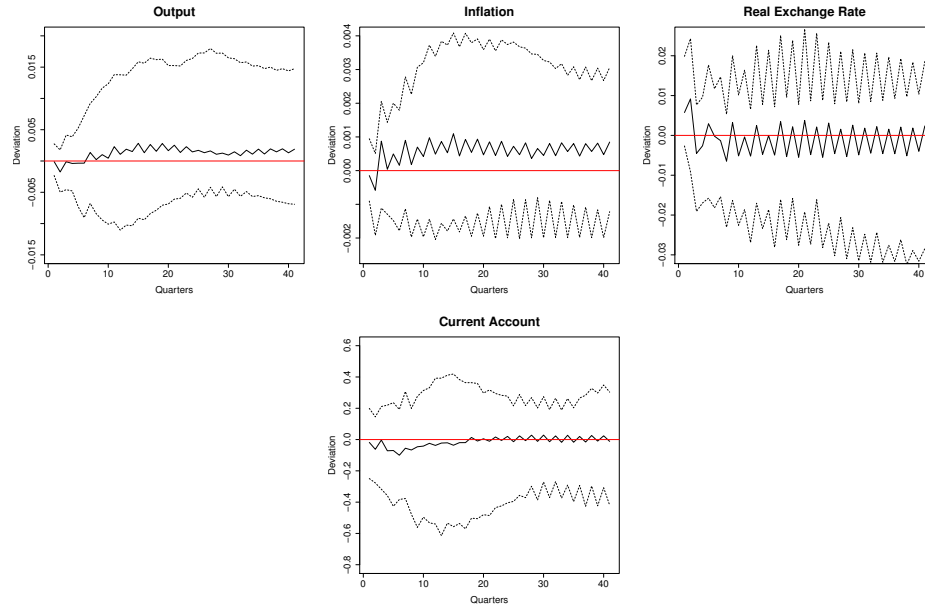


Fig. 5.15: France

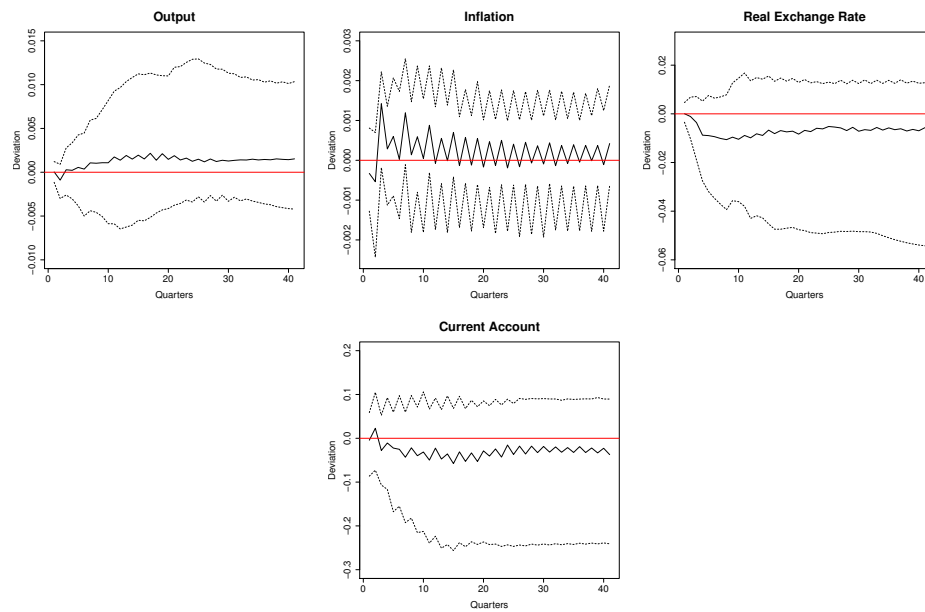


Fig. 5.16: Italy

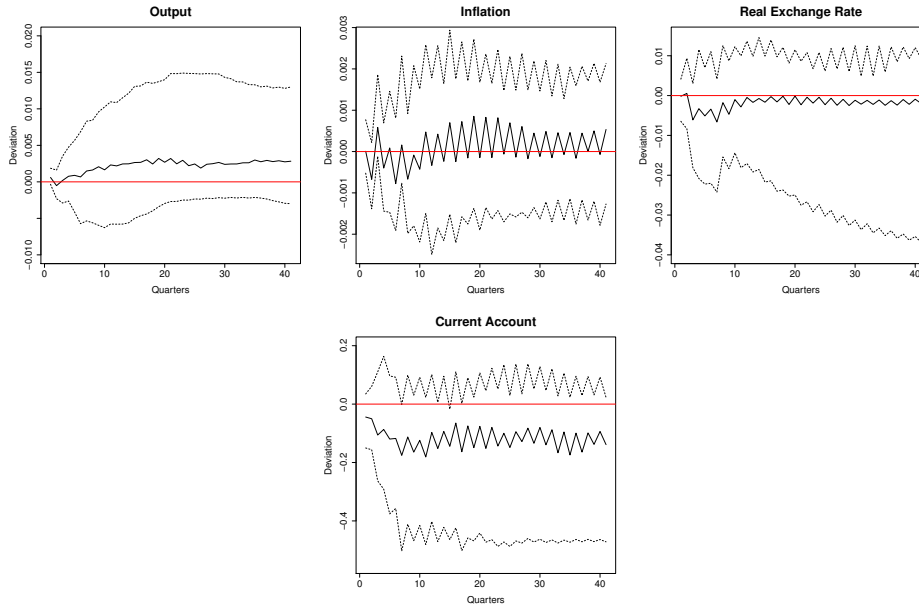


Fig. 5.17: The Netherlands

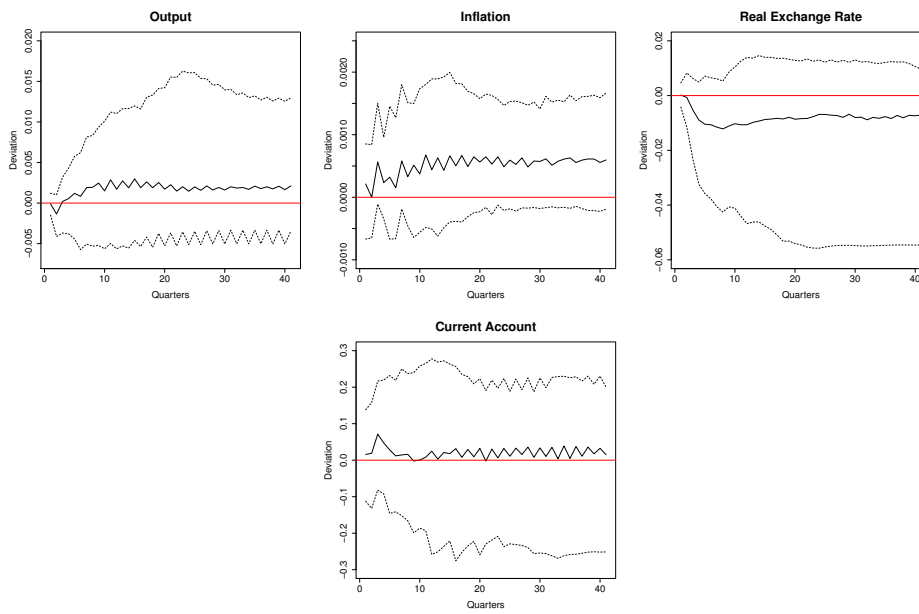
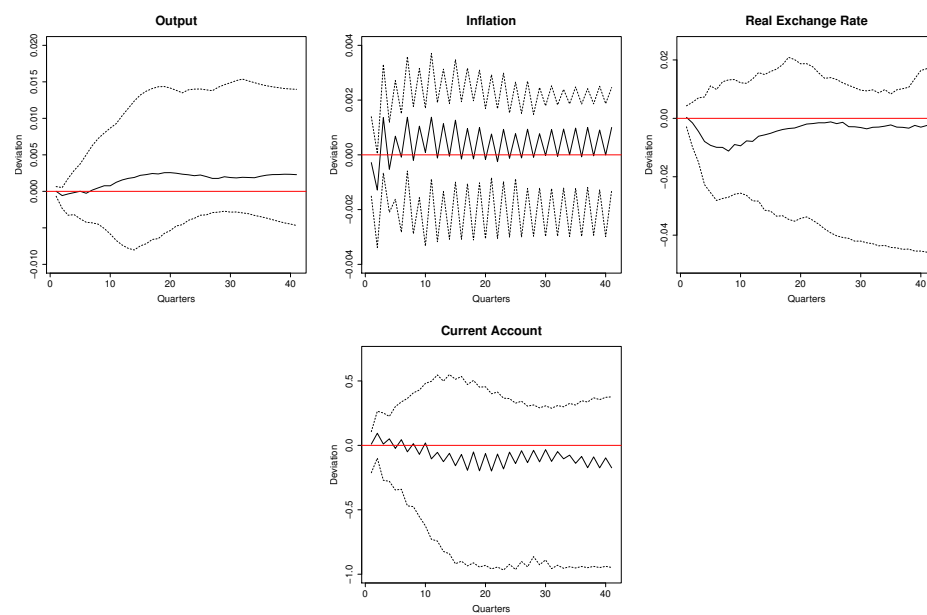


Fig. 5.18: Spain



5.5.5 Impulse-response functions to an increase in German VAT

Fig. 5.19: Austria

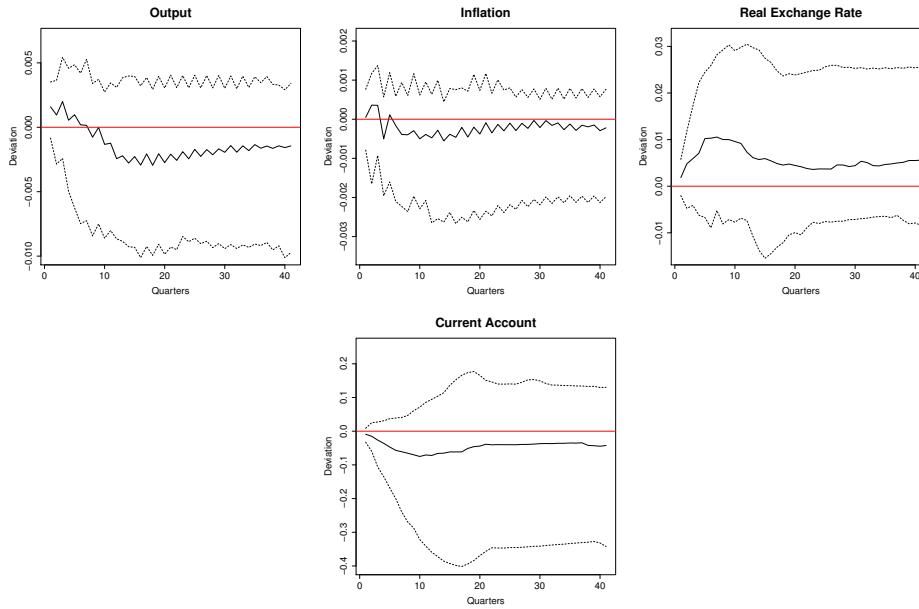


Fig. 5.20: Belgium

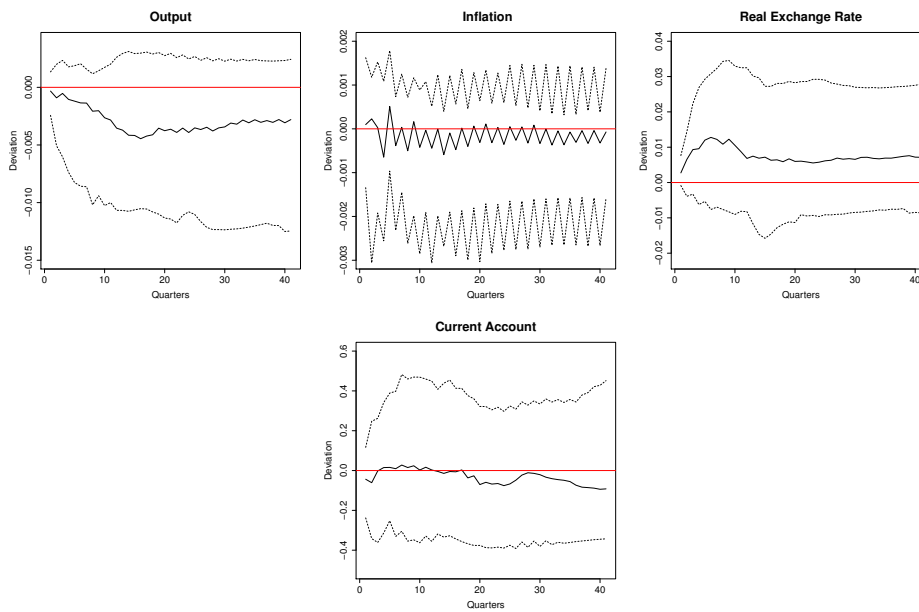


Fig. 5.21: Finland

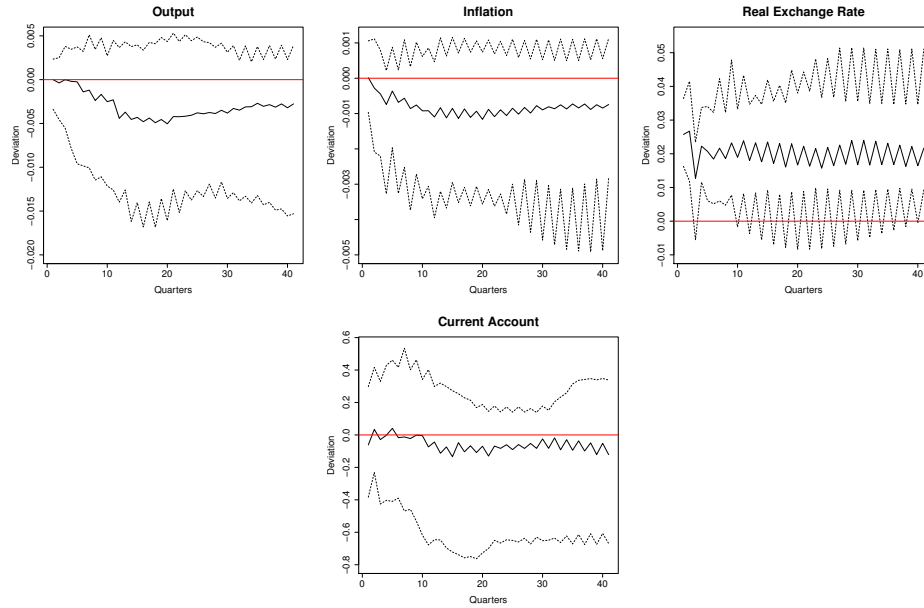


Fig. 5.22: France

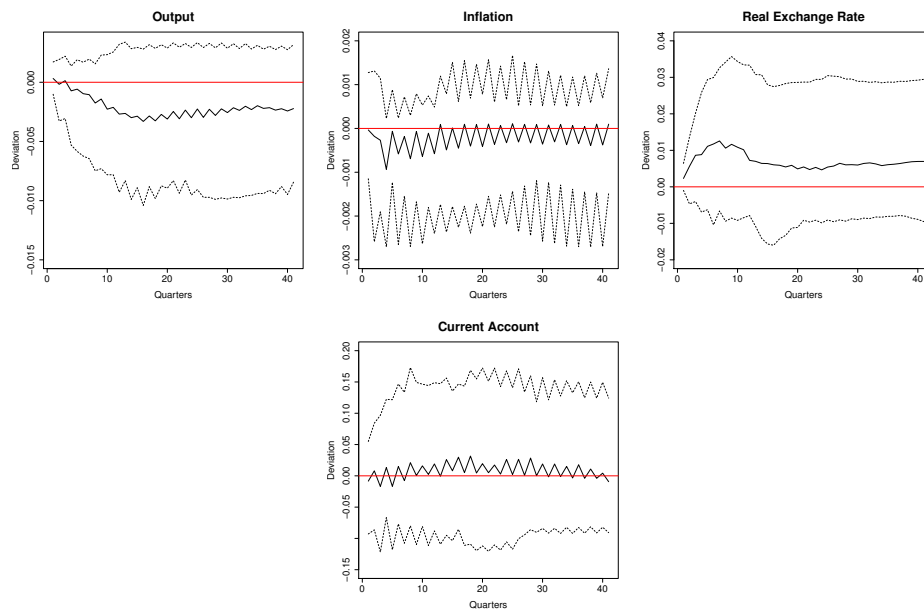


Fig. 5.23: Italy

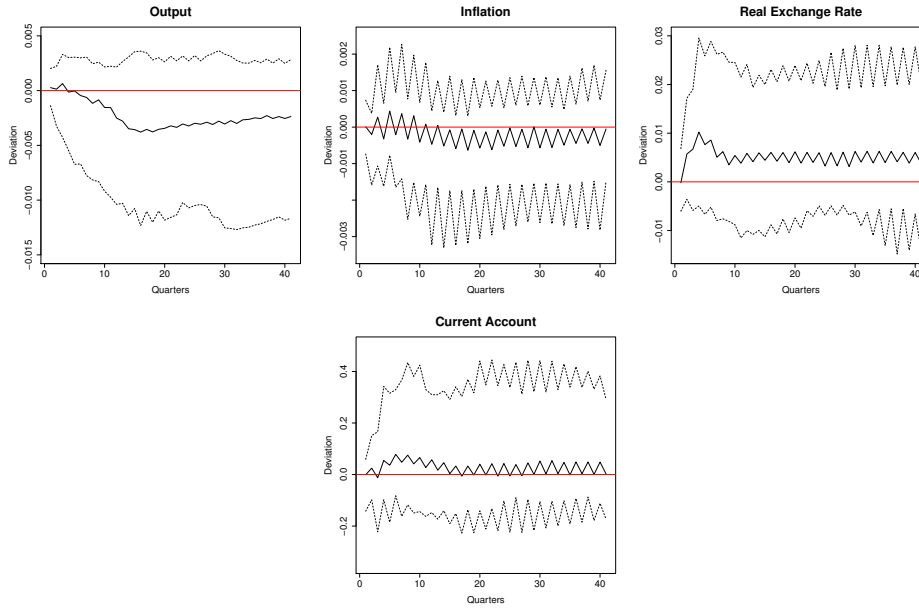


Fig. 5.24: The Netherlands

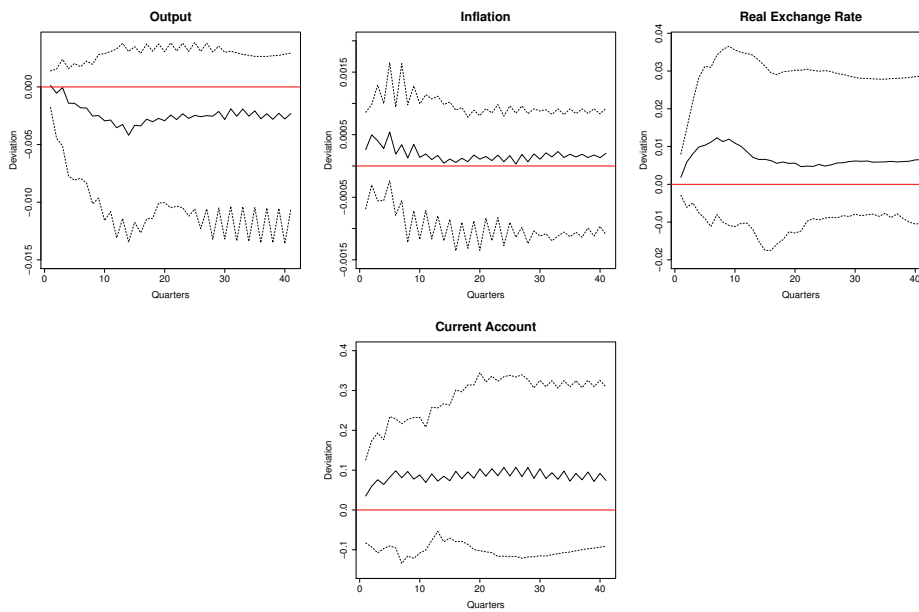
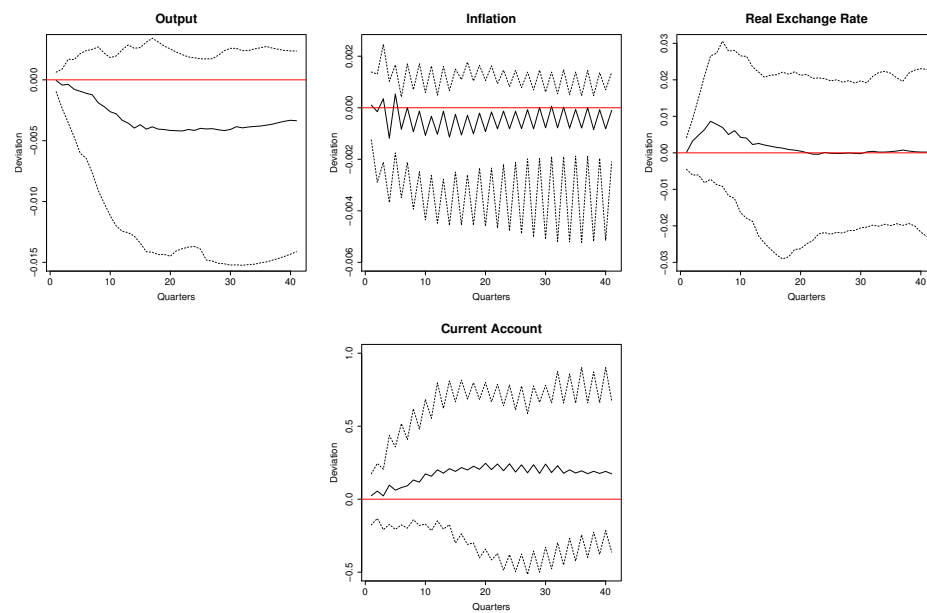


Fig. 5.25: Spain



Chapter 6 | General Conclusions

This dissertation contributes to a better understanding of the interaction between the labor market and the monetary and fiscal policies. These contributions are fourfold and have been developed throughout Chapter 2, 3, 4 and 5.

Chapter 2 and 3 focused on the analysis of inflation persistence and its connections to the labor market in a theoretical perspective. In particular, the impact of firing costs on the inflation dynamic have been stressed. In order to do so, I developed two medium-scale DSGE models with a search and matching labor market following Trigari (2006). In particular, Calvo (1983) price setting is introduced in order to derive the New Keynesian Phillips Curve. Wages are negotiated in a right-to-manage bargaining framework in order to link the real wage to the marginal costs. In this way, wage dynamic translates into marginal costs and *in fine* into inflation ones.

In Chapter 2, mandatory firing costs are supposed to be constant and set exogenously. I demonstrate that these firing costs directly affect the wage dynamics in two different ways. First, as a standard result, firing costs positively impact existing matches wage while they negatively affect new hires wage. Second, firing costs influence on wage dynamic depends on economic agents' behavior. Indeed, since firms and workers cannot negotiate the level of firing costs, they will influence the relative weight given to firing costs into wage dynamic. Firms grant firing costs a weight that is negatively correlated to their profits after an increase in real wage. Thus, when firms' activity increase, firing costs weight into wage dynamics decreases because workers tend to be not laid-off. In turn, workers give to firing costs a weight that is positively correlated to their gain linked to

an increase in real wage. Consequently, in order to fully enjoy the gain linked to an increase in real wage, workers increase the importance of firing costs in wage dynamic and reinforce this way their protection. Firms and workers' behaviors have an opposite effect on wage rigidity: firms' behavior tends to increase it while workers' one tends to reduce it. This opposition reduces the influence of firing costs on the inflation persistence. As a global result, the introduction of these mandatory lump-sum firing costs only weakly increase inflation persistence in the New Keynesian framework.

Chapter 3 extends the results stressed in Chapter 2 and introduces bargained severance pay into a New Keynesian model. In this model, severance pays are introduced following Garibaldi and Violante (2005). This is done for two distinct reasons: first, in order to match firing costs modelling to the empirical evidence as stressed by Garibaldi and Violante (2002, 2005) and Fella (2007); second, in a theoretical perspective, in order to allow firms and workers to directly influence the level of firing costs. I compare four models in order to clearly disentangle the different effects of severance pays on wage dynamic. Indeed, severance pays have the particular property to represent a temporary new income from workers, paid by firms. However, I show that this particularity is not responsible for inflation persistence. Moreover, since severance pays can be optimally negotiated at each period, workers can reduce their influence on wage dynamic. In this, a mechanism *à la* Lazear is present in the model. This mechanism can be interpreted as a contribution system that makes workers partially paying for their own protection. Thus, every increase in real wage triggers an increase in workers' will to be protected and so an increase in their job protection contribution. *In fine*, negotiated severance pays introduce a new dynamic in real wage that increases its inertia. However, this inertia is not strong enough to increase inflation persistence by itself. That is why the wage channel has to be introduced. It implies that right-to-manage bargaining seems to be more realistic in terms of wage and price dynamics. Finally, when severance pays and right-to-manage bargaining are merged, New Keynesian models are able to endogenously generate a degree of inflation persistence that is consistent with empirical evidences.

Chapter 4 investigates the non-linear effect of fiscal policy over the business cycle. It aims to explain why fiscal policy is more efficient during economic downturn than during economic upturn. Austerity policies are simulated in order to replicate the economic policies that have been implemented in Europe after the sovereign debt crisis. To do so, I build a large scale DSGE model with several elements that are able to account for such a difference of effectiveness. First, Ricardian and hand-to-mouth households are introduced into the model in order to incorporate both savers and Keynesian consumers. Second, two sectors (a public and a private one) are assumed in order to study the relationship between private and public sectors wage. Moreover, it allows to study the effect of cut in public sector wage on the private sector. Third, two states of the economy are supposed: a "good" state when unemployment is low and a "bad" one when unemployment is high. This triggers two different economies that will react differently to fiscal policy shocks. Finally, two different kinds of shocks are simulated: a cut in public sector wage and a cut in public vacancies. These two shocks have not been selected randomly since they represent the two main policies that have been implemented in Europe to reduce the sovereign debt. Thus, attention have been paid on unemployment, output and public debt reactions to these shocks. The main results can be summed up as follows: both public sector wage and public vacancies cuts trigger a larger decrease in total employment during economic downturn. This greater response of total employment will translate into a smaller response of real wage driven by a larger response of marginal productivity of labor that brakes real wage falls. In return, inflation will be smaller and monetary policy will react consequently. Because the presence of Ricardian household, public policy triggers smaller crowding out effects on private consumption during economic downturn. As a result, in the short run, output decrease is smaller during economic downturn and austerity policy is less efficient in reducing sovereign debt in this situation.

Chapter 5 focuses on the fiscal and labor market reforms that have been implemented during the first decade of the 20th century in Germany. In particular, attention is paid on Hartz IV reform and the implementation of a Social VAT that can be defined as a joint decrease in social contributions and an increase in VAT.

The question raised in this chapter is to identify empirically if such policies had a positive or negative spillover effects on the rest of the Euro Area and if they can at least partly account for the great improvement known by Germany in terms of current account. To answer this question, a *Global VAR* model has been built. Three main results can be displayed. First, the two different policies do not have the same effect on German economy. The cut in unemployment benefits reduces German output while the Social VAT has a more ambiguous effect on German activity. The first effect can be theoretically explained by a loss in income for workers, since the decrease in unemployment benefits played downward pressures on real wage, that was not compensated by the increase in employment. The second effect is due to opposite effect of the increase of VAT and the decrease in social contribution on output. The second main result of the model is that Germany appears to be a driving force in Europe since the effect of the two policies directly translate into the rest of the Euro area activity: the decrease in German activity induced by both the cut in unemployment benefit and the increase in German VAT is turned into a global decrease in Euro Area output while the increase in German output stimulates the entire zone. Finally, the Social VAT in particular greatly increases German current account at a cost of asymmetrical degradation in European current account.

To briefly conclude this dissertation, I will present the direction that will take my future research.

With my co-author, Thierry Betti, we attempt to improve the model used in Chapter 4 in several different ways. First, we aim to introduce an endogenous labor market participation in order to account for issues that have been at the roots of the Hartz reforms in Germany, for instance. This also would allow us to investigate which labor market reforms would be the most able to encourage workers to enter or re-enter the labor market. Such an improvement could be done in the spirit of Ravn (2005) and Brückner and Pappa (2012). Moreover, the public sector is under-estimated in this model. A productive public sector could greatly impact the size of the fiscal multipliers and amplify the difference in terms of fiscal policy efficiency along the business cycle. As in Straub and Tchakarov (2007),

both productive public spending and public capital can be introduced in a DSGE model.

Regarding Chapter 5 and still in a work with Thierry Betti, a larger set of countries can be introduced in order to extend the analysis and to pay a greater attention on core-periphery structure inside the Euro Area. Moreover, structural shocks will be introduced using a Cholesky decomposition in order to clearly identify the different shocks in the GVAR model. Moreover, using this literature, and with Audrey-Rose Meynard, we attend to investigate the spillover effect of European aid on African Union.

In order to investigate the effect of a single monetary policy on a monetary union with different labor markets, a natural extension of the model used in chapter 2 and 3 would be to include it in a two-country DSGE models. In this framework, alternative monetary policies could be studied in order to evaluate which one is the most able to reduce the impact of the structural differences in inflation persistence linked to the domestic labor market differences.

Another research field linked to these Chapters concerns directly the severance pays. Indeed, if ? propose a new framework to study severance pays and show that there exists an optimal level for non-mandatory severance pay, a great issue remains: why rational economical agents, and in particular firms, would freely choose to include severance pay in their contract, as it appears in the empirical evidence? Indeed, workers can have access to the financial market to help them smoothing their consumption even in case of unemployment spell. Then, the intuition shared by a part of the literature but that still have to be demonstrated is that it could be a manner for firms to build a long-run relationship with their workers and to encouraged them to invest into firm-specific human capital. This investment is totally lost for workers in case of lay-off and could be partly repayed by firms in this case. Thus, both firms and workers are better off when including severance pays in their contract.

Résumé Général

Le but de la thèse est d'analyser l'effet du marché du travail tel qu'il est représenté par les modèles d'appariement en macroéconomie. Plus précisément, la première partie de la thèse (chapitre 1 et 2) est consacrée à l'étude de l'impact des institutions du marché du travail sur la persistance de l'inflation. La deuxième partie de la thèse (chapitre 3) étudie comment le marché du travail peut rendre compte de différents multiplicateurs budgétaires en fonction de la position de l'économie sur le cycle économique. Enfin, la dernière partie de la thèse (chapitre 4) étudie d'un point de vue empirique l'effet des réformes du marché du travail allemand sur le reste de la zone euro en utilisant une approche GVAR.

Le chapitre 1 considère l'impact des coûts de licenciement, modélisés comme des coûts administratifs, sur la persistance de l'inflation. Pour ce faire, un modèle EGDS nouveau keynésien avec un marché du travail à la Mortensen et Pissarides (1994). Ce modèle est très proche de celui développé par Trigari (2006), notamment en ce qui concerne la modélisation du marché du travail et la négociation salariale. Le principal résultat de ce premier chapitre est que les coûts de licenciement influent positivement la persistance de l'inflation. Cependant, cette influence est globalement faible du fait de revendication contradictoire entre les entreprises et les travailleurs sur la manière dont les derniers doivent être protégés.

Le chapitre 2 étend le chapitre 1 et introduit dans un modèle EGDS nouveau keynésien un aspect oublié des coûts de licenciement : les indemnités de licenciement. Garibaldi et Violante (2002, 2005) et Fella (2007) montrent que les coûts de licenciement sont significatifs d'un point de vue quantitatif et qu'ils ont également un impact différent sur le marché du travail que les coûts de licenciement standards. En suivant Garibaldi et Violante (2005), les indemnités de licenciement

sont supposées être négociées efficacement entre les entreprises et les travailleurs dans un cadre d'équilibre général. En conséquence, lorsque les salaires sont négociés dans un cadre de droit de gérer, les indemnités de licenciement augmentent considérablement la persistance de l'inflation. En effet, la négociation des indemnités de départ introduit une nouvelle source de rigidité des salaires dans le modèle nouveau keynésien qui se transforme directement en persistance de l'inflation en raison de la négociation de type droit de gérer et du fait de la présence du canal du salaire qui en résulte.

Le chapitre 3 se concentre sur la taille des multiplicateurs budgétaires au cours du cycle économique. L'impact des dépenses publiques sur la production et le chômage en temps normal a déjà été étudié par Monacelli, Perotti et Trigari (2010), entre autres. Cependant, comme l'ont souligné Auerbach et Gorodnichenko (2012) et Creel, Heyer et Plane. (2011), le multiplicateur budgétaire est plus important en période de ralentissement économique que pendant la reprise économique. Seuls quelques articles cherchent à expliquer ce phénomène d'un point de vue théorique. Parmi eux, Sims et Wolf (2013) montrent qu'une utilité marginale plus élevée de la consommation pendant la récession peut être une bonne raison explicative. Michailat (2014) montre qu'un plus grand pool de demandeurs d'emploi en période de ralentissement économique peut expliquer un effet plus important de la politique budgétaire sur le chômage. Une autre approche est présentée dans ce chapitre : gr à un modèle EGDS résolu en utilisant une approximation de second ordre, il est démontré que la réaction des salaires réels est plus grande au cours du ralentissement économique et peut expliquer pourquoi les effets de la politique budgétaire sur la production et sur le chômage sont également plus importants.

Enfin, le chapitre 4 se concentre sur les retombées des réformes Hartz sur le reste de la zone euro. Ce chapitre examine principalement l'effet de Hartz IV et la diminution de l'aide au chômage sur la production et le chômage de la zone euro. Une approche VAR globale est utilisée afin de démêler les différentes interdépendances internationales. Les données macroéconomiques concernent l'Autriche, la Belgique, la Finlande, la France, l'Allemagne, l'Italie, les Pays-Bas et vont de 1992T1 à 2011T4. De plus, comme les données trimestrielles sur les prestations de chômage ne sont pas disponibles, la méthode de Chow-Lin est

utilisée pour désagréger les données annuelles en données trimestrielles. Comme résultat global, il est démontré que les réformes allemandes du marché du travail produisent un effet de débordement négatif sur le reste de la zone européenne. Cela s'explique par le fait que même si les réformes de Hartz ont réduit le chômage allemand et ont stimulé la participation au marché du travail, l'effet sur le revenu des personnes sans emploi a dégradé la situation économique allemande. Par ailleurs, la hausse de la compétitivité liée à la baisse des coûts du travail n'a eu que peu d'impact sur la balance commerciale allemande. In fine, cela a entraîné une baisse de la demande globale allemande et donc une baisse de la demande pour le reste des biens de la zone euro.

General Abstract

The aim of the thesis is to analyze the effect of search and matching labor market in macroeconomics. More precisely, the first part of the thesis (Chapter 1 and 2) is dedicated to the study of the impact of labor market institutions on inflation persistence. The second part of the thesis (Chapter 3) studies how the search and matching labor market can account for different fiscal multipliers over the business cycle. Finally, the last part of the thesis (Chapter 4) studies from an empirical perspective the effect of the German labor market on the rest of the Euro area using a GVAR approach.

Chapter 1 considers the impact of firing costs, modeled as administrative costs, on inflation persistence. In order to do so, a New Keynesian DSGE model with a search and matching labor is build. This model is really close to the one develop in Trigari (2006), especially regarding to the labor market modelling and the wage bargaining. The main result of this first chapter is that firing cost positively affect inflation persistence. However, the influence of firing costs on inflation dynamic is globally weak. Chapter 2 extends chapter 1 and introduces into a New Keynesian DSGE model a forgotten aspect of firing costs: severance pay. Whether from Lazear (1990), it is known that severance pay effects on labor market dynamics can be avoid during wage bargaining, Garibaldi and Violante (2002, 2005) and Fella (2007) show that this firing costs elements is significant from a quantitative perspective but also has a different impact on labor market than standard firing costs. Following Garibaldi and Violante (2005), severance pays are supposed to be efficiently negotiated between firms and workers in a general equilibrium framework. As a result, when wages are negotiated in a right-to-manage framework, severance pay dramatically increases inflation per-

sistence. Indeed, severance pay negotiation introduces a new source of wage rigidity into New Keynesian model that is directly turned into inflation persistence because of the right-to-manage bargaining.

Chapter 3 focus on the size of fiscal multipliers over the business cycle. The impact of public spending on output and unemployment in normal time have already been studied, by Monacelli, Perotti and Trigari (2010), among other. However, as it has been highlighted by Auerbach and Gorodnichenko (2012) and Creel, Heyer and Plane. (2011), fiscal multiplier is greater during economic downturn than during economic upturn. Only few papers aim to explain this phenomenon from a theoretical perspective. Among them, Sims and Wolf (2013) show that a higher marginal utility of consumption during recession can be a reason. Michailat (2014) shows that a larger job seekers pool during economic downturn can explain a higher unemployment fiscal multipliers. Another approach is presented in this chapter: thanks to a large-scale DSGE model solved using second order approximation, it is shown that real wage reaction is greater during economic downturn and can explain why both output and unemployment fiscal multipliers are also larger.

Finally, Chapter 4 focus on the spillover effects of the German Hartz reforms on the rest of the Euro area. Principally, this chapter consider the effect of Hartz IV and the decrease in unemployment assistance on Euro area's output and unemployment. A Global VAR approach is used in order to disentangle the different international interdependences. Macroeconomic data concern Austria, Belgium, Finland, France, Germany, Italy, Netherlands and Spain from 1992Q1 to 2011Q4. Moreover, since quarterly data for unemployment benefits are unavailable, the Chow-Lin method is used to disaggregate annual data into quarterly ones. As a global result, it is shown that German labor market reforms yield a positive spillover effect on the rest of the European Area. It can be explained by the fact that, even if German labor market costs fall and German price competitiveness increases, the Hartz reforms decreases German unemployment and labor market participations. It yields an increase in aggregate German demand and so an increase in demand for the rest of Euro area goods.

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Essais sur le marché du travail en macroéconomie

Résumé

Cette thèse contribue à la littérature théorique et empirique concernant le marché du travail en macroéconomie. La partie théorique a deux thèmes majeurs : l'analyse des conséquences des coûts de licenciements sur la persistance de l'inflation et celle de l'effet de la politique budgétaire sur le marché travail en fonction du cycle économique. La partie empirique étudie les conséquences des réformes du marché travail allemands sur les partenaires commerciaux de l'Allemagne. Le marché du travail peut-il influencer les performances de la politique monétaire ? Les conditions macroéconomiques peuvent-elles influencer les performances de la politique budgétaire ? Les réformes sur le marché du travail allemand peuvent-elles expliquer les performances de l'Allemagne en matière de commerce extérieur ?

Mots clefs : Marché du travail, Cycle des affaires, Politique budgétaire, Politique monétaire

Abstract

This thesis contributes to both theoretical and empirical aspects of the literature on the labor market in macroeconomics. On the theoretical side, I provide insights both on the impact of labor market institutions on monetary policy and on the efficiency of fiscal policy according to the business cycle position. On the empirical side, I discuss the spillover effects of the Germany's labor market reforms on its trade partners. How do labor markets institutions affect monetary policy? Has fiscal policy the same effect on labor market during economic downturns than during economic upturns? Can the German labor market and fiscal reforms account for Germany's new trading performances?

Key words: Labor Market, Business Cycle, Fiscal Policy, Monetary Policy