Essays in European integration and economic inequalities

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An meine Eltern für ihre fortwährende Unterstützung

Abstract

The ongoing process of economic integration in Europe and beyond has already led to profound changes that are likely to manifest themselves further. Within Europe, formerly centrally planned economies have joined the European Union (EU) with the intention to ultimately introduce the common currency. On a more global scale, marginalised farmers in developing countries seek to become integrated in the world trading system to lift themselves out of poverty. However, issues surrounding economic inequalities are no longer exclusively confined to emerging economies. Indeed, awareness of income inequalities and their impact on the domestic economy is increasing among industrialised nations. This dissertation seeks to contribute to these topical debates in the form of three self-contained essays. The first essay is concerned with monetary integration in Europe. More specifically, we consider the EU member countries from Central and Eastern Europe (CEE) that seek to adopt the euro in the foreseeable future. Our analysis is based on a global VAR (GVAR) model to investigate to what extent central banks in CEE follow the European Central Bank's lead. We look in another core chapter at the economic implications of the Fair Trade (FT) movement. This is a fairly novel topic to the economics profession and we thus aim to provide intuitive insights. One of the key elements of our trade model is that FT generates and hinges upon economic inequalities. We combine these two aspects in the third core chapter. In particular, we analyse how monetary policy operates in an environment which is characterised by wage inequalities using a New Keynesian model that features heterogeneous labour. The third essay is motivated by the case of the United States, where, similar to many European countries, there is strong empirical evidence for rising internal economic divergence. Overall, the thesis not only combines and investigates topical issues, it moreover does so employing various techniques with the intention to also make contributions on the methodological level. We conclude the monograph by highlighting policy implications and by providing directions for future research.

Contents

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Writing a PhD dissertation is in many ways a solitary undertaking. It would be impossible to capture all the thoughts, hopes and (at times) worries associated with such a long-term project. That is why I feel even more fortunate about the invaluable support and guidance along the way by several.

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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Chapter 1

Introduction

1.1 Scope of analysis

Economic policymakers all over the world are confronted with a whole range of challenges these days. Economies in the eurozone, for example, are trying to address some of the structural issues that have become increasingly obvious in their monetary union. On a more global level, many countries need to deal with rising degrees of poverty and inequalities. Emerging economies seek to obtain a larger share of the pie that is being created and distributed through global trade, whilst industrialised nations such as the United Kingdom (UK) or the United States (U.S.) experience fractures within their societies caused by economic inequalities that have hitherto been largely unnoticed.

It is not clear at this stage what kind of answers will be formulated to these and other economic issues and how effective they might be. The approach taken thus far can succinctly be characterised as allowing for and fostering integration. The idea is that for instance integrated financial markets increase liquidity which amid lower capital costs should eventually foster efficiency and economic growth. Moreover, in a truly integrated monetary union that is characterised by synchronised business cycles, responses to monetary innovations should be transmitted in a more homogeneous fashion such that indeed "one size" should fit all members. On the real side, the opening up of borders for cross-border labour flows should allow for a more efficient matching process and thus allow for a gradual equalisation of international wages and lower unemployment.

Overall, there are – at least in theory – tangible benefits to a higher

degree of economic convergence and indeed European integration as well as globalisation (i.e. the integration and convergence of markets on a global level) are processes that have been evolving over several decades, if not centuries. In particular intra-European economic policies have been characterised by a strong desire to foster integration. The European Union (EU) of today is the result of a process that began more than half a century ago with the creation of the European Coal and Steel Community and that finally culminated via the creation of a single market in a monetary union. While political motives such as ensuring lasting peace and stability were important drivers of the European integration process, it would have most likely not sustained without a sufficient degree of economic performance and convergence (also see Pinder and Usherwood (2007) for a brief non-technical overview). Particularly the euro as common currency was thought to accelerate this process. The jury is still out, however, as to whether countries would not have been better off without a single monetary policy stance. Recent research suggests (see for example Deutsche Bundesbank (2011)) that imbalances in terms of trade persist which adds to the prevailing doubts concerning economic coherence in the eurozone at the current stage. But there is arguably also an extra-European dimension in that only a united Europe is likely to remain influential in a globalising world that is increasingly being shaped by emerging economies. Indeed, recent figures suggest that for example growth in EU outward foreign direct investment (FDI) in Russia rose by 82% and in Singapore by 54% (Eurostat, 2011b). Similarly, Brazil has become the EU's ninth most important global trading partner according to current data and more than one out ten goods as share of EU gross domestic product (GDP) are traded outside the union (Eurostat, 2011a).

Convergence processes such as European integration or more generally globalisation are of a rather long-term nature and it would be hard to argue that any of them have been "completed" – let alone that there would exist any such clearly definable end point to each of them. As such, policymakers face continuous challenges whose nature is bound to change over time. Economic integration has been considered a necessity in its own right throughout the Great Moderation. Financial, commodity and in part also labour markets have been liberalised and several formerly centrally planned economies from Central and Eastern Europe (CEE) have become full EU members. With the Crisis of 2008, however, the notion of integration has become more nuanced. Countries seek to find the right mix of policy regulation and coordination both in the monetary and real sphere. Alternative

forms of trade between the extremes of free markets and protectionism are becoming increasingly popular internationally. Moreover, distributional aspects are more and more being recognised and addressed. Imbalances both within and across countries are being assessed and policymakers have started to realise that their actions might have asymmetric effects across economic agents who differ in crucial characteristics.

This changing nature is reflected in the present monograph. The objective is to investigate some of the prevailing aspects pertaining to integration but also economic inequalities both on a European and global level. Integration and inequalities can occur on different markets (financial markets, labour markets, etc.) and on different levels (e.g. between or within countries) and it would be impossible to do justice to all of these aspects within the framework set by a doctoral dissertation. We shall therefore focus on three distinct aspects in particular:

1. the degree of integration of money markets between Central and Eastern European markets and the euro area

2. the impact of the Fair Trade movement in industrialised countries on the developing world

3. the effects of monetary policy in an environment that is characterised by economic inequalities

These topics form the backbone of the present monograph and are investigated in the following three core chapters in an essay-style manner. All of the core chapters are self-contained and seek to shed light on topical issues and economic debates. They intend to explore different aspects in an original way, using a variety of methodological approaches. It goes without saying that the investigation into each of these matters merits a further analysis on its own, and we shall therefore point out potential extensions in our concluding remarks in Chapter 5.

1.2 Overall theme and contribution

The overall theme that re-occurs throughout the core chapters is that of **European integration and economic inequalities**. European integration is hereby understood as a rather broad term that has both intra- and extra-European elements. The inner-EU part refers to internal integration

processes, where we in particular focus on monetary integration in the enlarging euro area. Extra-EU facets relate in this context to the links with the rest of the world (ROW). Those links exist both with the emerging as well as the industrialised part of the ROW. Convergence through global trade is becoming increasingly important for the EU as a whole as recent figures suggest (Eurostat, 2011a). Whilst openness is thought to be an important driver of integration, it is equally the case that socio-economic imbalances that have traditionally been more associated with Anglo-Saxon economies are more and more affecting the EU at its core (Goos and Manning, 2009). It might seem odd at first sight to consider aspects pertaining to integration and inequalities jointly in one study. However, the notion of asymmetries and imbalances as part of globalisation and European integration are becoming ever more apparent to economic policymakers (Smaghi, 2011). An important contribution with regards to contents and topic of this study is therefore to highlight the close relationship between inequalities and integration.

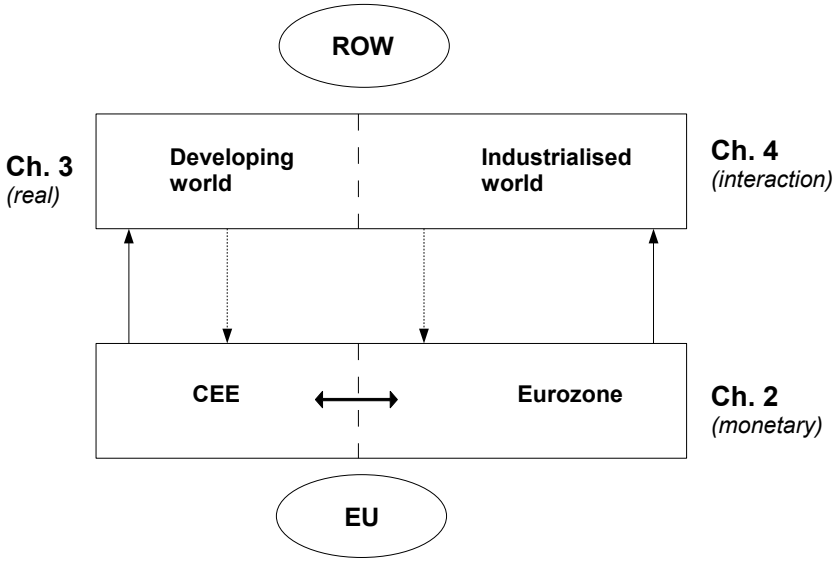

Figure 1.1: Links between core chapters

Figure 1.1 illustrates the emphasis of each of the core chapters as part of the overall theme. On a most general level, the dissertation considers the interplay between two blocs: the EU and the ROW. The EU itself is

split in Chapter 2 into eurozone and non-eurozone countries (more specifically countries from CEE). This Chapter analyses the degree of monetary integration between these two components. Chapter 3 considers the growing link between the EU as a whole (especially including the UK) and the developing world through the Fair Trade (FT) movement. This Chapter is thus purely concerned with real factors. In the final core chapter, Chapter 4, we investigate the interplay between monetary and real factors. In particular, we consider the conduct of monetary policy in an environment that is characterised by economic inequalities. This particular study is motivated by the case of the US, where economic inequalities are rather pronounced. However, there is also a link going back from the industrialised part of the ROW to the EU (as indicated by the arrows in the Figure) to reflect the increasing evidence for socio-economic imbalances in countries such as the UK or Germany.

Whilst Chapter 2 considers integration, the FT chapter also highlights problems with inequalities which indeed can arise through integration. Economic inequalities are here stated in terms of real wage inequalities. The scope is gradually widened in the final core chapter, in which we re-introduce monetary policy into the analysis and allow for additional forms of economic inequalities (in terms of consumption and wealth). In contrast to the trade chapter, however, the economy is closed and we consider a segmented domestic labour market that is characterised by heterogeneous input factors.

When referring to the notion of economic inequalities, it is important to stress that those are conceptualised here in terms of relative measures. This is done by considering aggregates (i.e. FT vs. non-FT sector or skilled vs. unskilled labour) which has the methodological advantage of increased theoretical transparency and tractability. In more empirical settings, of course, one would like to measure inequalities in terms of distributions.[1] Indeed, different policy implications arise depending on the specific percentiles considered of the, say, income distribution as we illustrate in Section 4.2.

As the OECD (2012) notes (also see this report for further references and stylised facts), economic inequalities are no longer confined to developing countries. The comparatively weak growth performance of industrialised economies over the last few years, particularly in the EU, has been accompanied by growing social problems (such as dual labour markets or rising youth unemployment in many European countries). It is thus not so much the level of inequalities but the rate at which those are increasing that

[1]However, also in many descriptive studies single aggregate measures, most notably the well-known Gini coefficient, prevail.

poses challenges to policymakers. Inequality in the EU as a whole has risen because income convergence among EU countries has not offset growing income inequality within countries (Fredriksen, 2012). Regardless of whether one considers emerging or industrialised economies, however, the overriding policy implications are the same: Boost the accumulation of human capital and make educational outcomes less dependent on social background. Those factors combined with a reduction of dualism and an enhanced integration of immigrants describe a set of policies that could potentially lead to an increase of GDP per capita and may reduce income inequality in the long run (Koske et al., 2012).

Clearly, questions pertaining to European integration but also more generally economic inequalities have received increased attention lately. We address some of these issues in three self-contained chapters. Whilst the essays can be read independently from each other, they are centred around a common theme. Taken together, all core chapters seek to analyse and to raise awareness for topical economic issues and are hence likely to spur further research.

1.3 Research questions and motivation

Since all core chapters stand on their own feet and have their own distinct institutional background, we provide extensive background information as part of the individual pieces. We nevertheless want to highlight in this Section the main motivation for each of the essays in turn and raise the research questions we seek to answer.

Chapter 2 is set very much in the tone of the EU Eastern enlargement which – at least several years ago – was regarded as a milestone in the process of European integration. Transition economies from CEE were and are, unlike countries such as the UK or Denmark, required by the Treaty on European Community to eventually join the European Economic and Monetary Union (EMU). Given their relatively small economic weight and close links with the euro area, those economies may be considered as being rather keen to become part of EMU soon. If this was the case, signs of integration should become apparent over a longer time horizon. Indeed, there are a number of studies (Dickinson and Mullineux (2001); Schadler et al. (2005)) that analyse the convergence of banking sectors and exchange rates in the formerly centrally planned economies, highlighting their challenges in the gradual transition phase towards the euro area. Building on Kadow (2011),

we develop in this Chapter the so-called Euro Dominance Hypothesis (EDH) to test for monetary integration in the enlarging eurozone.

The EDH seeks to translate the well-known German Dominance Hypothesis (GDH) into today's institutional environment. The GDH claimed that German Bundesbank policies were transmitted into other European Monetary System (EMS) interest rates during the pre-euro area. The issue of German monetary leadership in the EMS has been investigated empirically by several authors (Fratianni and von Hagen (1990); MacDonald and Taylor (1991) amongst others) – overall with inconclusive empirical evidence, however. The lack of a clear-cut picture probably also arose because of the limitations of econometric advancement at that time. Particularly the notion of cointegration was not well established and often not tested for at all. Moreover, the institutional environment has changed. The original notion of German Dominance referred to the alleged contradiction between the symmetry of monetary policy adjustments the EMS had been designed for and the claim that the Bundesbank was dictating its monetary policy to other members' central banks. With the creation of the European Central Bank (ECB), however, the eurozone as monetary system by definition became symmetric if we are willing to abstract from internal governance issues. We therefore seek to offer in this Chapter an upgrade to the GDH on both the methodological as well as the institutional level. We reformulate the GDH in terms of the current eurozone and non-eurozone countries that are on the brink of joining. Using cointegration techniques, we analyse to what extent there is a co-movement of short-term interest rates between the euro area and the CEE countries and how those are affected by (global) monetary shocks.

Chapter 3 turns to the economic effects of the Fair Trade (FT) concept. This grassroots consumer movement has received relatively little attention in the economic literature thus far, which is rather surprising given its growing importance. According to latest figures, consumption of products certified by FT organisations more than doubled between 2000-2005 (Krier, 2005). Europe forms the centre of the movement and coffee, the first product to be FT-certified, its backbone (Hira and Ferrie, 2006). In a nutshell, the FT concept seeks to establish a direct relationship between ethically-minded end-consumers, who for altruistic reasons pay higher prices, and marginalised producers in developing countries. Whilst there are many aspects surrounding FT, we single out in this Chapter the economic effects of the so-called FT premium which we capture by a wage differential between FT and non-FT sector in the South. FT appeals to consumers in industri-

alised countries for several reasons; one being the empowerment it gives to consumers in the North to express political views (say, a lowering of trade barriers) directly through their shopping trolley. Buying FT products is thus in line with rational behaviour and, on a more general level, reflects Adam Smith's writings on the co-existence of benevolence and self-interest (Ashraf et al., 2005).

The Chapter intends to provide theoretical underpinnings to the FT concept. We augment the benchmark Ricardian trade model by the existence of FT. Our model features three goods (FT good, non-FT good and numeraire good), where the FT good is only produced in South and only consumed in North. Labour is homogeneous but the FT sector differs from the non-FT sector in the prevailing working conditions, which in the presence of rationing gives rise to inequalities. We moreover investigate the welfare implications of FT. Is the fair wage offered in the FT-sector indeed welfare-enhancing as commonly claimed by supporters of FT? We elaborate in particular on Leclair (2002)'s claim that this form of alternative trade only supports one set of producers at the expense of others. We deliberately strive to provide closed-form solutions for greater analytical tractability and intuition.

Chapter 4 considers the relationship between monetary policy and economic inequalities over the business cycle. It appears increasingly important in the light of the recent Crisis to understand distributional effects of monetary policy and this Chapter intends to make a first step in that direction. Given the potency of monetary policy to steer the macroeconomy and given the increasing degree of economic inequalities throughout the industrialised world, it seems natural to ask if monetary policy is a suitable as well as feasible tool to tackle those inequalities. Indeed, this argument lies at the heart of Rajan (2010)'s analysis of the root causes of the Crisis beyond the usual immediate drivers such as global imbalances, weak financial regulation and excessive risk-taking. He conjectures that fractures within the U.S. society caused by rising levels of economic inequalities have created increasing political pressure to provide a quick remedy for the poor without tackling the structural problems at its roots. Instead of redistributing income, Rajan (2010) argues, the emphasis was on low-income lending with the intention to boost consumption in the short run. The longer-term dynamics underlying rising income inequalities were thus countered by short-run measures and we ask what role monetary policy as rather blunt tool could possibly have in supporting those aims.

To formalise that argument, we extend the benchmark New Keynesian

(NK) model by the presence of heterogeneous labour and incomplete financial markets. Distinguishing two sets of households who differ ex-ante in their skill levels (skilled vs. unskilled) introduces the notion of relativities in key macroeconomic variables such as consumption, real wages and wealth. This distinction is in line with stylised facts for many major industrialised countries like the U.S. as reported by Goldin and Katz (2008) and Heathcote et al. (2010) amongst others. The conventional monetary policy design problem is thus augmented by the presence of relative variables that matter next to absolute magnitudes. A rise in the ratios provides a natural measure of increasing inequalities and we investigate how economic inequalities evolve over the business cycle in a rule-based environment. The general equilibrium perspective moreover permits analysing the optimal monetary policy response (from a welfare-theoretic point of view) in the presence of heterogeneous households. Our framework is able to address several research questions: Are there asymmetric effects across households in response to aggregate shocks? But also, is it desirable for a monetary authority to introduce asymmetries into the conduct of monetary policy (i.e. assigning relatively stronger importance to one set of household over the other) over the business cycle as means of mitigating the sufferings arising from economic inequalities? To the best of our knowledge, the issue of economic inequalities and its relationship to monetary policy has not been investigated from this angle thus far.

1.4 Methods of investigation

Reflecting the various angles from which we study the subject matter, the analysis in this thesis makes use of both empirical and theoretical methods, depending on the fit to the relevant research question. Whilst it is difficult to draw a clear line between microeconomic and macroeconomic theory, the methodological approach in this dissertation is clearly more biased towards the latter one. Thus, as should be expected from a thorough work on macroeconomic issues, the dissertation considers real as well as monetary aspects from both a short-run and long-run perspective, and the methods of investigation are chosen accordingly.

Table 1.1 provides an overview of the employed methodologies and shows how those can be allocated across the core chapters. As common in mainstream macroeconomic theory, we differentiate methods by their time span (short run vs. long run), time dimension (static vs. dynamic), the type of

equilibrium they refer to (reduced form vs. more structural and general equilibrium approaches), degree of uncertainty (deterministic vs. stochastic) and the overriding economic environment (closed vs. open system).

	Chapter 2	**Chapter 3**	**Chapter 4**
time span	long run	short run	short run
time dimension	dynamic	static	dynamic
equ. type	reduced form	general equ.	general equ.
degree of uncertainty	stochastic	deterministic	stochastic
economic environment	multi-country	two-country	closed economy

Table 1.1: Classification of methodologies

Chapter 2 adopts a dynamic time series perspective. We want to investigate convergence processes which from an economic perspective may be thought of as being described by a long-run equilibrium. The counterpart to the notion of long-run equilibria in econometrics can be found in the idea of cointegration and it is exactly this correspondence that has led to the popularity of cointegration techniques in economics. Loosely speaking, cointegration implies that non-stationary variables are linked through some long-run relationship that is stationary (for $I(1)$ series) in levels. Of course, it is per se not obvious why certain variables should be linked through an equilibrium relationship over time and any cointegration study that is typically framed in reduced form thus needs to be supported by a convincing economic storyline. Sims (1980) pioneered in the analysis of unrestricted and structural vector autoregressive (VAR) models which emphasise statistical fit over theoretical consistency. However, it has become common knowledge nowadays that first-differenced VAR specifications of $I(1)$ variables are mis-specified if there exists a cointegrating relationship between two or more of the series which led to the development of the cointegrated VAR (CVAR) (see Johansen (1995) in particular).

We test for monetary convergence between EMU and CEE countries using a rather novel global vector-error correcting modelling approach (Global VAR, or GVAR in short). GVAR modelling (Pesaran et al. (2004); Dees et al. (2007)) may be considered an attempt to unite more data-driven European approaches with the more theory-driven American view on econometrics in that some variables are considered as structurally exogenous based on theoretical considerations. This approach is therefore in particular suitable for small open economies such as those in CEE, where the exogeneity

assumption of foreign prices is plausible. Moreover, unlike conventional vector error-correcting systems, the GVAR procedure first considers country-specific models, before turning to the global system that comprises all countries jointly. This procedure allows for richer dynamic specifications and a more efficient analysis of macroeconomic data, particularly over short time periods as is the case for the EU Eastern enlargement.

Chapter 3 utilises static trade-theoretic arguments to analyse FT. More specifically, we augment the benchmark Ricardian trade model whose notion of comparative advantage and emphasis on relative technological differences arguably constitutes some of the most elementary yet powerful concepts as motivation for the study of international trade. International trade models may be considered the discipline's showcase for general equilibrium concepts and in particular the basic Ricardian model stands out in its elegance, merely requiring the most minimal set-up. After all, any economy can be characterised by its existing technology, factor endowments and household preferences. These components together with certain behavioural assumptions about economic agents describe a complete economic model that can be used to analyse a particular economic question. In the benchmark Ricardian trade model, there is one representative household in each of the two countries who inelastically supplies labour, the only input factor, to perfectly competitive firms. Based on the counterfactual idea of both countries opening up to perfectly free trade, specialisation patterns arise in line with the prevailing comparative advantage. As a result, general equilibrium outcomes are driven by households' preferences and firms' technologies, where a fictitious Walrasian auctioneer clears all markets at all times which allows for an endogenous determination of all prices.

Our FT model augments this benchmark setting in two dimensions. First, there are three goods, whereas the FT-good is produced only in developing South and exclusively consumed in developed North. This rations, given fixed expenditure shares, employment in the FT-sector. Second, those workers who are part of the FT sector are better off compared to the non-FT sectors. Thus, whilst there are other (more long-run) aspects of FT such as technology transfer or capacity building, we focus on the the economic implications of the so-called FT premium, which is arguably the best-known feature of FT to "FT laymen". By the FT premium we essentially refer to the social premium which the FT organisations offer to the certified farmers and their communities. This set-up permits investigating the impact of the increasingly popular FT movement in industrialised countries on FT-certified vis-à-vis non-certified producers in the developing world.

Whilst the FT Chapter is very much in the (neo)-classical spirit, the final core chapter, **Chapter 4**, is of the so-called NK type. This implies the presence of imperfect competition and price stickiness. NK models are typically seen as a monetary extension to the real business cycle (RBC) literature which considers dynamic economies subject to stochastic fluctuations and under endogenous household labour supply. These type of models currently constitute the mainstream approach to analysing macroeconomic policy effects and are typically categorised under the dynamic stochastic general equilibrium (DSGE) heading. It should be noted, however, that DSGE models cover wide-ranging aspects and several variants emphasising different features co-exist, showing further developments compared to the initial research stages as summarised in the contributions in the volume edited by Cooley (1995).

We extend in this Chapter the benchmark NK model (Clarida et al. (1999); Galí (2003)) that has evolved as the workhorse for monetary policy analysis to investigate the relationship between monetary policy and economic inequalities. In particular, we allow for the presence of heterogeneous labour differentiating between skilled vis-à-vis unskilled workers. Moreover, financial markets are incomplete and subject to transaction costs. DSGE models based on rational expectations have come under increased scrutiny lately (see Arestis and Sawyer (2008) for example) and the purposes they have been constructed for thus far might not have reflected more recent developments on both labour and financial markets. Nevertheless, DSGE approaches feature model-consistent behaviour (hereby more closely relating to aggregates) and have micro-foundations that add to the framework's consistency and allow for a transparent investigation of welfare effects. Our model does address some of the methodological shortcomings typically brought forward in that it relaxes the notion of a single representative household and features a form of financial frictions.

Depending on the models used, we employ different computational techniques. Relationships in chapter 2 are estimated using maximum likelihood. The FT model is solved with pen and paper. The NK economy is analysed using perturbation methods. Effects in the more theoretical models in Chapters 3 and 4 are quantified through calibration.

1.5 Thesis structure

The present monograph is structured as follows. This introductory chapter is followed by the main analysis in the form of the three self-contained core chapters. Chapter 2 investigates the EDH from a cointegration perspective. This work was presented at the SGPE conference in 2010. Chapter 3 turns to the economic effects of FT. The analysis was presented at the SGPE conference in 2011 and the 2011 EEA conference in Oslo. Chapter 4 analyses the link between monetary policy and economic inequalities. A previous version was presented at the Departmental PhD workshops in 2011. Finally, Chapter 5 provides an overall conclusion to the thesis, summarising and highlighting policy implications as well as providing directions for further research.

Chapter 2

Does the euro dominate Central and Eastern European money markets?

Chapter Summary

The so-called German Dominance Hypothesis (GDH) claimed that Bundesbank policies were transmitted into other European Monetary System (EMS) interest rates during the pre-euro era. We reformulate this hypothesis for the Central and Eastern European (CEE) countries that are on the verge of accessing the eurozone. We test this "Euro Dominance Hypothesis (EDH)" in a novel way using a global vector autoregressive (GVAR) approach that combines country-specific error correction models in a global system. We find that euro area monetary policies are transmitted into CEE money market rates which provides evidence for monetary integration between the eurozone and CEE countries. Our framework also allows for introducing global monetary shocks to provide at least tentative empirical evidence regarding the effects of the recent financial crisis on monetary integration in Europe.

2.1 Introduction

Long before the introduction of a single European currency, the notion of potential asymmetries within the European Monetary System (EMS) startled a debate both between academics and central bankers. The claim was that other members' central banks surrendered their monetary sovereignty to the German Bundesbank by mimicking German monetary policies with an eye towards keeping their domestic currency values stable vis-à-vis the Deutschmark (DM).

This so-called *German Dominance Hypothesis* (henceforth GDH) has received considerable attention in the empirical exchange rate literature. Whilst monetary economic theory provides arguments in favour of an asymmetric monetary system (Barro and Gordon (1983); Giavazzi and Pagano (1988)), conclusive and robust empirical evidence on the validity of the GDH is rather scant. The econometric approach used to test the GDH was typically based on short-run nominal money market rates and identified asymmetries in the EMS using Granger causality tests. The monetary system was considered asymmetric in the strict sense if there was evidence for unidirectional causality from German money market rates to the other EMS members (Uctum, 1999). Several authors (Katsimbris and Miller (1993); Hassapis et al. (1999)) added an extra-European dimension and tested how monetary innovations from the rest of the world (ROW), proxied by the US, were transmitted into the EMS. International asymmetry in this context implied that the ROW only affected the other EMS countries through its impact on German money market rates. German Dominance would then only be fulfilled if both forms of asymmetry could not be rejected simultaneously.

German monetary leadership in the EMS has been investigated empirically by a number of authors. Fratianni and von Hagen (1990), von Hagen and Fratianni (1990) and de Grauwe (1989), for example, find no statistical evidence for the notion of German Dominance (at least not in the strong form of unidirectional causality). Their results rather support the idea of multidirectional linkages within the EMS, attributing the Bundesbank an important, yet not dominant, role. Karfakis and Moschos (1990), on the other hand, fail to reject the GDH.[1] Using a bivariate set-up, they conclude that German interest rates Granger-cause other EMS members' rates.

We believe, however, that previous empirical results on the GDH should

[1] Giavazzi and Giovanni (1987) and MacDonald and Taylor (1991) are amongst others to support the idea of German Dominance as well.

be taken with a pinch of salt due to several limitations in the econometric methodology employed at that time. In particular, the notion of cointegration was not well established and often not tested for at all. Commonly used vector autoregressive (VAR) specifications in first differences are hence likely to yield biased estimates. Also, Granger causality tests suffer from a timing problem since they are unable to distinguish between the short run and the long run. These issues are addressed properly by Kirchgässner and Wolters (1993). They formulate and test the GDH in a multivariate cointegration framework and find evidence for German Dominance by imposing appropriate restrictions on loading coefficients and the cointegrating vector.

The original GDH debate was essentially couched in terms of the loss of monetary independence (a cost). The notion of German Dominance referred to the alleged contradiction between the symmetry of monetary policy adjustments the design of the EMS had intended and the claim that the Bundesbank was dictating its monetary policy to other members' central banks, hereby turning the EMS into a "Greater DM Area". In today's institutional environment of a still enlarging eurozone, however, the alternative notion of monetary integration (arguably a benefit) seems more appropriate.[2]

Indeed, the institutional environment in Europe has changed fundamentally since the earlier tests of the GDH with the creation of a European Economic Monetary Union (EMU) and the creation of the European Central Bank (ECB). Whereas the empirical evidence on German Dominance in the pre-euro era (and the loss of monetary autonomy of national central banks to the Bundesbank) remains a matter of debate, the ECB nowadays acts as the single legal body that is ultimately in charge of monetary policymaking for the whole euro area. The eurozone as monetary system is hence by definition symmetric, if we are willing to abstract from governance issues within the ECB. The question of greater cooperation of national central banks as opposed to following a hegemonic player no longer applies in the absence of the "$N-1$ problem".[3] For countries *outside* EMU, however, the case is not as clear cut. Whilst potential ECB leadership may be desirable from a convergence perspective, it may equally be problematic in the face of domestic or global shocks over a shorter horizon. This also raises the question of the transmission of EMU-wide shocks to those countries.

The main contribution of this Chapter consists in reformulating the GDH in terms of the current eurozone and non-eurozone countries that are

[2]Estonia was the latest country to introduce the euro in 2011.

[3]See Fratianni and von Hagen (1992) for a lucid discussion of the cooperative versus the disciplinary interpretation of the EMS.

on the brink of accession; that is, we introduce the so-called *Euro Dominance Hypothesis* (henceforth EDH). Our monetary convergence analysis focuses on the transitional economies from Central and Eastern Europe (CEE) for several reasons. First, the process of European integration received a fresh impetus with the eastern enlargement of the European Union (EU). This, in turn, revitalised research into issues such as the endogeneity of optimum currency areas, the potentially increasing heterogeneity in monetary policy transmission channels or the impact on movements of goods, capital and labour across borders.[4] Second, unlike countries such as the United Kingdom or Denmark, the Treaty on European Community requires newly-joining EU member states to eventually introduce the euro. Out of the original ten CEE member countries only Slovenia (in 2007), Slovakia (in 2009) and Estonia (in 2011) so far have complied with the Maastricht convergence criteria on a lasting basis which allowed them to introduce the euro. The CEE countries which yet need to become part of the euro area are in alphabetical order: Bulgaria, the Czech Republic, Hungary, Latvia, Lithuania, Poland and Romania.[5] European monetary integration is in this study defined as a gradual and dynamic process of interest rate convergence with the eurozone that culminates in the introduction of the euro as single currency. This implies that national central banks irrevocably fix their national currencies to the euro at some predetermined rate and hand over their monetary autonomy to the ECB. Although national central banks can still influence the decision making within the ECB, implementing monetary policies independently to stabilise the domestic economy will then no longer be possible.

The current situation of CEE countries outside the eurozone trying to bring their domestic monetary policy stance and currencies more in line with the ECB policies bears similarities with the EMS situation. In the 80's and 90's the DM and the Bundesbank were considered the major currency and, respectively, the "leading" central bank within the EMS. The DM was widely used outside Germany – particularly in CEE. About 30-40% of the currency in circulation was held abroad according to a Bundesbank study (Seitz, 1995). A similar degree of currency substitution for the euro can also be identified in some CEE economies (Dvorsky et al., 2008). Both the ECB and Bundesbank, moreover, share a similar constitution. The GDH was

[4]See for instance Angeloni et al. (2005) or de Grauwe and Mélitz (2005) for a further discussion.

[5]Given the time span considered, our analysis also includes Estonia as one of the entry candidates.

generally motivated by the credible low-inflation path of the Bundesbank, which the ECB intends to continue. Given these historical and institutional similarities, it seems natural to consider the euro and the ECB as a continuation of the DM and the Bundesbank, respectively, and to upgrade models developed for the analysis of interest rate linkages within EMS to today's environment.

Our testing framework not only offers an upgrade in the institutional dimension but also at the methodological level. While reduced form specifications such as the vector error correction model (VECM) employed by Kirchgässner and Wolters (1993) may be considered theory-averse, large-scale macroeconometric models are by their very nature computationally intense and are thus typically only developed by major policy institutions. We test for monetary convergence between EMU and non-EMU countries using a rather novel global vector-error correcting modelling approach (Global VAR; henceforth GVAR) due to Pesaran et al. (2004) and furthered by Dees et al. (2007).

GVAR modelling may be considered an attempt to unite more data-driven European approaches with the more theory-driven American take on econometrics.[6] In contrast to cointegrated systems as advanced, most notably, by Johansen (1995), some variables are treated as structurally exogenous based on theoretical considerations. This procedure allows for richer dynamic specifications and a more efficient analysis of macroeconomic data, particularly for relatively short time periods (Pesaran et al., 2000).

The GVAR approach seems to be particularly suitable for the case of small open economies, where it is plausible to assume that variables such as foreign prices are exogenous. Loosely speaking, variables are considered weakly exogenous in this context if they only affect domestic variables contemporaneously but are not affected by domestic deviations from the long-run equilibrium. Granger and Lin (1995) refer to weakly exogenous variables as *long-run forcing* in the presence of cointegration and as such this notion is very much different from *Granger causality* which commonly framed the empirical investigation of the GDH.

While the GDH suggested that the Bundesbank dominated monetary policies in the EMS, our version of the EDH implies that the ECB now takes up a similar role in the enlarging E(M)U. The GVAR approach allows for a coherent formulation of the EDH: it fully exploits the information set and at the same time reflects the structural underpinnings of monetary integration

[6] Also see Hoover et al. (2008) and the references therein for a discussion on this controversy.

in Europe. We also investigate to what extent the EDH testing results are sensitive to the prevailing exchange rate regime in the CEE countries. More specifically, it will be interesting to see whether the EDH not only applies to countries such as Bulgaria, Estonia or Lithuania which have adopted a unilateral currency board arrangement with the euro but also to explicit inflation targeters such as Poland or the Czech Republic.

The Chapter is structured as follows. Section 2.2 discusses and compares in more detail alternative ways of formulating the EDH. We present the data and test the EDH in Section 2.3. Section 2.4 investigates how the findings on Euro Dominance are affected by global shocks. Section 2.5 concludes.

2.2 Formulating the EDH

2.2.1 The EDH in terms of Granger causality

There are different ways of translating the concept of Euro Dominance into econometric terms. Early contributions to the German Dominance debate tended to be flawed essentially in two dimensions. First, the GDH was typically formulated in terms of so-called Granger causality tests without properly accounting for cointegration. Second, the GDH was usually tested within a restricted information set, looking only at pairs of countries at a time without considering multiple-equation systems. If the axiom of correct specification gave us reason to believe that the Data Generating Process (DGP) is indeed driven by bivariate systems, the standard unrestricted **VAR(p)** model of order p in first differences for a particular CEE country and EMU would look as follows:

$$\begin{bmatrix} \Delta R_{CEE,t} \\ \Delta R_{EMU,t} \end{bmatrix} = \boldsymbol{\Phi d_t} + \sum_{k=1}^{p-1} \begin{bmatrix} \pi_{11,k} & \pi_{12,k} \\ \pi_{21,k} & \pi_{22,k} \end{bmatrix} \begin{bmatrix} \Delta R_{CEE,t-k} \\ \Delta R_{EMU,t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_{CEE,t} \\ \varepsilon_{EMU,t} \end{bmatrix}, \quad (2.1)$$

where $\boldsymbol{\Phi d_t}$ represents a matrix of deterministic terms such as impulse dummies and a constant and $\boldsymbol{\varepsilon_t}$ is assumed to be i.i.d. – independent and identically distributed. This specification obviously neglects the possibility that integrated stochastic processes may be linked through a stationary linear relationship; but it would be straightforward to restrict (2.1) accordingly.

We shall ignore cointegration for now in line with the early literature on the GDH and formulate the EDH in terms of Granger causality tests (Granger, 1969). This simplifies testing for asymmetries considerably because Granger causality tests simply ask whether the knowledge of one series improves the forecast of the other without postulating any direct causal link.

Granger causality tests are thus purely a matter of precedence and information content. Unlike weak exogeneity tests which refer to parameters of interest, Granger (non-)causality is a property of the DGP, capturing a relationship between variables. If there was unidirectional causality, that is changes in euro area rates were affecting money markets in CEE, we should be able to reject the following null hypothesis

$$H_0 : \pi_{12,k} = 0 \tag{2.2}$$

against the alternative H_1 that at least one $\pi_{12,k} \neq 0$. Next to Euro Dependence, we could also test whether the ECB is acting independently of innovations arising in CEE by considering

$$H_0 : \pi_{21,k} = 0 \tag{2.3}$$

against the alternative that at least one $\pi_{12,k} \neq 0$. Accepting (2.3) and simultaneously rejecting (2.2) would establish evidence for Euro Dominance in what we may call a "strong form". This set of hypotheses could be easily investigated using Wald-type of tests based on an F-distribution (Lütkepohl, 1991).

Somewhat curiously, the literature tended to impose unidirectional causality only without considering multilateral relations.[7] There is, however, a more fundamental problem with formulating any form of dominance hypothesis in terms of Granger causality: Even when testing for cointegration and allowing for feedback relations, Granger causality tests suffer from a "timing problem" in that they fail to distinguish between short-run and long-run causality.[8] We would suspect, after all, that the presumed followers may want to deviate from the leader's decisions for some time, say reacting to domestic shocks, whilst at the same time maintaining a long-run path of convergence.

2.2.2 The EDH in terms of a VECM

Kirchgässner and Wolters (1993) were the first to properly account for cointegration by formulating the GDH in terms of a VECM which combines short-run deviations with long-run equilibrium co-movements in a multiple-equation setting. We could follow their approach and write in the presence

[7] von Hagen and Fratianni (1990) provide a more comprehensive framework which does account for international asymmetries and multilateral realtion with all hypotheses stated in terms of Granger causality tests, however.

[8] One solution to this would be resorting to causality tests in the frequency domain as for instance suggested by Breitung and Candelon (2006).

of cointegration the reduced form **VECM(p)** of order p for the N countries as

$$\boldsymbol{\Delta R_t} = \boldsymbol{\Phi d_t} + \boldsymbol{\alpha \beta' R_{t-1}} + \sum_{k=1}^{p-1} \boldsymbol{\Pi_k \Delta R_{t-k}} + \boldsymbol{\varepsilon_t}, \tag{2.4}$$

where $\boldsymbol{\varepsilon_t}$ is a N-dimensional zero mean white noise process with positive definite covariance matrix and $\boldsymbol{\Phi}$ includes deterministic terms such as dummies and $\boldsymbol{R_t}$ contains the domestic nominal interest rate series. The parameter matrices $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are of dimension $(N \times r)$ with r representing the number of cointegrating relations. This framework arguably is more flexible than (2.1) as it not only encompasses the unrestricted VAR but also allows for a coherent modelling of both short-run and long-run relations. Economically speaking, the latter ones may be understood as describing a long-run equilibrium and it is precisely this link between statistics and economic theory which makes error-correcting modelling appealing. It is well-known that the VECM is a restricted VAR in that it adds the cointegration space $\boldsymbol{\Gamma} = \boldsymbol{\alpha \beta'}$ which identifies the long-term integration process: $\boldsymbol{\beta}$ quantifies the cointegrating relations and $\boldsymbol{\alpha}$ contains the loading coefficients which attach weights to the long-run equilibrium relations. The short-run interest rate dynamics are described by $\boldsymbol{\Pi}$. The VECM is thus sometimes referred to as Cointegrated VAR (CVAR) and obviously nests the first-differenced VAR.

European monetary integration was earlier defined as a process that has both short-term and long-term aspects. We assume for the remainder that all CEE countries have the intention to join EMU over the long run, given the absence of an opt-out clause. A natural way to identify Euro Dominance is therefore to analyse convergence in terms of $\boldsymbol{\Gamma}$. In reference to Kirchgässner and Wolters (1993), the EDH may be thought of consisting of four hypotheses:

(I) CEE Dependence:
Interest rates are linked with the euro area in the long run. Provided these linkages really exist, central banks in CEE are influenced by the ECB's course over a longer horizon in their preparations for joining the euro.

(II) Euro Independence:
The ECB acts independently from the new member states' central banks. Interest rate decisions in CEE have no effect on the euro area and hence the entire adjustment towards equilibrium is driven by the transition economies.

(III) CEE Insularity:
There are no spill-over effects between CEE countries. The individual long-run relation with the euro zone is solely driven by the respective country (and potentially the euro area); other CEE economies do not affect this process.

(IV) Global Insularity:
Monetary innovations arising outside Europe have no direct impact on the equilibrium, but are only transmitted indirectly via the ECB.

We cannot reject the EDH in its strong form, if we find evidence for CEE Dependence and Euro Independence. As these conditions impose a rather hierarchical one-sided relationship, Condition (III) is meant to enrich the argument by allowing for feedback relations in a multivariate context, thus fully exploiting the information set. Condition (IV) adds a global dimension to the EDH, accounting for the increasing interlinkages across countries. With the US as proxy, we could moreover analyse whether global shocks such as the failure of major banks in the US hit CEE countries directly and whether this may have any bearing on the process of monetary integration in Europe.

We could roughly evaluate these conditions by reading off $\hat{\boldsymbol{\alpha}}$. While this allowed us to economise on degrees of freedom, we could also test the EDH formally by imposing appropriate exclusion restrictions on the estimated weighting matrix and employ standard likelihood-ratio tests.[9] Suppose $\boldsymbol{\alpha}$ is structured as follows: The euro area series, being the numeraire, is contained in the last row as all equilibrium relations are normalised accordingly. The eight CEE countries of interest are in the top rows, followed by the US series such that N is partitioned as follows: 0 in the subscript refers to the numeraire, the ECB, $i = 1, \ldots, 8$ are the CEE series and the final row is $9 = US$ in subscript. The cointegrating relations $r = 9$ for the case of a common stochastic trend are expressed in terms of the ECB and are in the j columns, where $j = 1, \ldots, 8, US$.

[9] Alternatively, if one was only interested in establishing long-run causality, one could also resort to parametric Granger-type conditions on the cointegrating relations. However, this testing procedure strongly relies on the existence of a common stochastic trend and suffers from size distortions in small samples as Rault (2000) shows using Monte Carlo experiments.

The set of hypotheses could then be tested as follows:[10]

$$H_0 : \alpha = \begin{pmatrix} 0 & \dots & 0 & \alpha_{1,US} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \alpha_{8,US} \\ \alpha_{US,1} & \dots & \alpha_{US,8} & \alpha_{US,US} \\ 0 & \dots & 0 & \alpha_{0,US} \end{pmatrix}. \tag{2.5}$$

CEE Dependence implies cointegration between the CEE series and EMU rates. Rejecting (2.5) provides evidence for the validity of this condition. Note that cointegration with US rates is neither necessary nor sufficient for CEE Dependence to hold as (2.5) suggests. Euro Dominance suggests in econometric terms weak exogenity of euro rates. Weak exogeneity of the euro zone with respect to a set of parameters of interest implies that we can condition on this variable without loss of information (Engle et al., 1983). For euro rates to dominate CEE rates, we would have to fail to reject:[11]

$$H_0 : \boldsymbol{\alpha_{0,i}} = \mathbf{0}. \tag{2.6}$$

$$H_0 : \alpha = \begin{pmatrix} \alpha_{1,1} & 0 & \dots & \alpha_{1,US} \\ 0 & \alpha_{2,2} & 0 & \alpha_{2,US} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \alpha_{8,8} \\ \alpha_{US,1} & \dots & \alpha_{US,8} & \alpha_{US,US} \\ \alpha_{0,1} & \dots & \alpha_{0,8} & \alpha_{0,US} \end{pmatrix} \tag{2.7}$$

Imposing restrictions as shown in (2.7) allows for testing for the evidence of multilateral relationships among CEE countries. Rejection provided evidence for spill-over effects and thus against CEE Insularity.

Compared to (2.7), world insularity imposes an even stronger idea

$$H_0 : \alpha = \begin{pmatrix} \alpha_{1,1} & \dots & \alpha_{1,8} & 0 \\ \alpha_{2,1} & \dots & \alpha_{2,8} & 0 \\ \vdots & \vdots & \vdots & \vdots \\ \alpha_{8,1} & \dots & \alpha_{8,8} & 0 \\ 0 & \dots & 0 & \alpha_{US,US} \\ \alpha_{0,1} & \dots & \alpha_{0,8} & \alpha_{0,US} \end{pmatrix}, \tag{2.8}$$

[10] Here and in the following it is understood that the H_0 is tested against the H_1 describing the unrestricted system.

[11] Although we are particularly interested in the long-run parameters, rejecting (2.6) implied that weak exogeneity could be ruled out in the short run as well (Urbain, 1992).

where (2.8) suggests that US rates are not only predetermined with respect to CEE rates but also that CEE countries are not responsive at all to any innovations arising from the rest of the world. In a way, the existence of Global Insularity would imply that the process of European integration dominates any potential global imbalances.

Thus, the notion of CEE Dependence implies that CEE interest rates and euro rates cointegrate, whereas Euro Independence additionally requires evidence for weak exogeneity of the euro area with respect to the CEE markets. We would be unable to reject the EDH in its strong form if we found evidence for the first two conditions, which would identify euro rates as the common stochastic trend. The notion of CEE Insularity might be considered to enrich the argument by allowing for feedback relations in a multivariate context. The other insularity condition lifts the EDH to a global level, thereby accounting for the increasing interlinkages across countries and allowing for feedback with the ROW. Apart from the latter aspect of global linkages, theses hypotheses have been investigated by Kadow (2011) in a multiple-equation cointegration setting. While his emphasis is more on the role of the evolving banking sectors, he finds evidence for multilateral links both across CEE economies and with the eurozone.

Even though the VECM approach allows us to formulate the EDH in a consistent manner, economically meaningful normalisations of the cointegrating vector would crucially hinge on the existence of a common stochastic trend. Indeed, the preceding discussion would be of limited use without having established econometric evidence for this common stochastic trend. Cointegration tests for large N but a relatively short time dimension – as is the case for the CEE transition economies – may be prone to size distortions, however. The most natural way of dealing with this "curse of dimensionality" appears to be to first investigate interest rate linkages on a domestic level, before analysing all series in a combined system. This is the essence of GVAR modelling we discuss next.

2.2.3 The EDH in terms of a GVAR

Our proposed approach in formulating and testing the EDH is mainly empirical in nature but it also has some structural underpinnings which we briefly want to mention. Suppose there are two blocs of countries (CEE and EMU), both of which have their own independent central banks. EMU is a large economy and adopts a common monetary policy stance, whereas CEE consists of several somewhat more disjoint small open economies.

Monetary policymakers in CEE are as a consequence slightly more heterogeneous in their choice of operating procedures, yet they share the common overall objective of ultimately becoming part of EMU.

We may conceptualise the situation in CEE by means of the following policy rule:

$$\boldsymbol{R_{it}} = \boldsymbol{G(L)z_t},$$

where $\boldsymbol{R_{it}}$ represents the vector of policy instruments in a particular CEE country (typically short-term interest rates or foreign reserves), $\boldsymbol{G(L)}$ is a vector polynomial in the lag operator L and $\boldsymbol{z_t}$ contains policy-relevant endogenous and exogenous variables, including short-term interest rates in EMU.[12] Specifying some sort of reaction function, however, might not only be limited by data availability and reliability but would also lead us to exclusively centre the analysis around short-run central bank behaviour. Our proposed error-correcting specification is richer: it captures short-run deviations but models interest rate convergence in the context of a long-run equilibrium.

Table 2.1 gives an overview of the prevailing monetary policy regime as of the end of 2009. As can be seen, CEE central banks have moved towards the extremes of the spectrum of possible exchange rate arrangements over the last decade. The Bank of Latvia, for example, has pegged the lat tightly to the euro, only allowing for much smaller fluctuations than stipulated in the Exchange Rate Mechanism II (ERM II), which essentially replaced the former EMS. Other national central banks announce explicit inflation targets and allow their exchange rates to float more freely. The Maastricht criteria of stable nominal exchange rates with low and stable inflation rates describe the relevant benchmarks for monetary convergence and the stabilising effects on the bilateral exchange rate from inflation targeting, or active exchange rate fixing, are apparent from market data.[13] Table 2.1 thus provides important institutional background for the remainder as it facilitates comparisons of the transmission of shocks of inflation targeting with exchange rate targeting countries in CEE.

Whilst the GVAR model can easily be generalised, we confine ourselves in line with the structural underpinnings and reported descriptive and anec-

[12]Obviously, if euro area interest rates would not matter to the policy rule in CEE the corresponding parameter value g_i in the parameter vector $\boldsymbol{g}$ was just zero. Other variables which may be part of $\boldsymbol{z_t}$ are output gaps or exchange rate differentials between the two blocs.

[13]See Figure A.1. A notable exception may be the Hungarian forint which has been subject to speculative attacks over the recent past.

dotal evidence to short-term nominal interest rates. This allows for a more transparent mapping to the VECM approach for testing the GDH (a crucial methodological contribution of our paper).

	monetary policy framework
Bulgaria	CBA[a]
Czech Rep.	floating; inflation targeting
Estonia	CBA[a]; ERM II[b]
Hungary	floating[c]; inflation targeting
Latvia	hard peg[d]; ERM II[b]
Lithuania	CBA[a]; ERM II[b]
Poland	floating; inflation targeting
Romania	floating; inflation targeting

Table 2.1: Overview of monetary policy frameworks in CEE (December 2009). Sources: Public information by the ECB and national central banks in CEE. *a*: unilateral currency board arrangement with the euro; *b*: membership in the ERM II; *c*: replaced exchange rate intervention band against the euro in 2008; *d*: replaced peg to SDR basket of currencies in 2005.

Nominal interest rates also seem to be the most reliable measure of monetary convergence for the enlarged euro area. Coricelli et al. (2006) study the transmission of monetary policies in CEE and find empirical evidence for a complete passthrough from key domestic monetary policy rates to short-term money market rates. Indeed, the CEE banking industry has undergone substantial reforms towards market-based structures during the 90's. In contrast to bond, equity and derivative markets, the financial sector currently matches EMU standards and can no longer be considered "underdeveloped".[14] Previously state-owned banks were privatised to establish a so-called two-tier banking system, consisting of an independent central bank and several private commercial banks. The process of market liberalisation led to the removal of interest rate ceilings on credits and lowered entry barriers for private domestic and foreign banks. Accounting standards, commercial and bankruptcy law as well as banking supervisory and regulatory procedures were put in place to meet the changed market structures (Dickinson and Mullineux, 2001).

Given the state of development of the financial sector in CEE, convergence of monetary policies may therefore be best identified on the domestic money markets. If national central banks outside the eurozone mimicked

[14]See Schadler et al. (2005) for more detailed evidence.

the ECB's path, it may be conjectured that this is reflected there, i.e. CEE and EMU interbank rates are expected to be cointegrated. GVAR modelling (Pesaran et al. (2004), Dees et al. (2007)) initially tests for cointegration in country-specific systems, before combining all error-correcting terms in a global model. One may thus view the proposed framework as an attempt to consolidate the different approaches used during the EMS period to examine the GDH (i.e. considering both single- and multiple-equation systems). This two-stage approach offers an alternative, more structural, way of investigating the EDH.

A crucial difference between the VECM and the GVAR model related to these structural underpinnings lies in the way weak exogeneity is introduced. Weak exogeneity is tested for in the VECM by imposing exclusion restrictions on the estimated parameters, whereas particular variables in the GVAR specification (typically foreign quantities) are treated as weakly exogenous from the outset. We could, of course, also condition on weakly exogenous variables in the VECM. As we shall see below, however, the GVAR allows for a coherent analysis of impulse responses within a global system and thus accounts for the interlinkages across the partial models.

Each country-specific error-correcting model contains both domestic and foreign variables. The latter ones are treated as long-run forcing in the sense of Granger and Lin (1995) without necessarily ruling out short-run feedback effects from the lagged variables. We conjecture euro rates to be (weakly) exogenous to CEE countries. We also introduce global influences, proxied by US interest rates. We have $N = 10$ countries, where EMU is the reference country. We thus adopt the following notation: euro rates are denoted by R_{0t} and dollar rates by R_t^*, respectively. We index CEE rates by $i = 1, \ldots, n$ with $n = 8$.

We model the EDH in terms of the GVAR as follows. We introduce two sets of $VARX^*(p_i, q_i)$ models for each country bloc, CEE and EMU, where p_i and q_i refer to the lag order of the domestic and the foreign rates, respectively. The CEE-system has the following representation

$$\boldsymbol{\Theta_i}(L, p_i)\boldsymbol{R}_{it} = \boldsymbol{a}_{i0} + \boldsymbol{\Lambda_i}(L, q_i)\boldsymbol{R}_{0t} + \boldsymbol{\varepsilon}_{it} \tag{2.9}$$

and for EMU we have

$$\Theta_0(L, p_i)R_{0t} = a_0 + \Lambda_0(L, q_i)R_t^* + \varepsilon_{0t}. \tag{2.10}$$

All idiosyncratic shocks $\boldsymbol{\varepsilon}_t$ are assumed to be i.i.d. Note that (2.9) and (2.10) are simply reduced form VAR models augmented by (weakly) exogenous foreign variables which nest standard unrestricted VAR processes,

if $\mathbf{\Lambda}(L, q_i) = \mathbf{0}$. The CEE model suggests that CEE countries are small open economies which take interest rates in the large economy – EMU – as exogenously given. US interest rates affect under the null CEE markets indirectly via EMU rates and are thus meant to proxy outside influences arising from the ROW.

The EDH can now be stated as a joint hypothesis consisting of three legs:

(I) CEE Dependence:
R_i and R_0 are cointegrated.

(II) Euro Independence:
R_0 is weakly exogenous to R_i.

(III) Global Independence:
R^* is weakly exogenous to R_0.

Loosely speaking, Condition (I) implies that CEE and EMU rates are linked over the long run. Provided these linkages really exist, it may be conjectured that central banks in CEE are influenced by the ECB's course over a longer horizon in their preparations for joining the euro. However, without establishing evidence for the idea of Euro Independence, we would believe in the notion of a linear combination between the series as common stochastic trend. Only if euro rates were weakly exogenous to CEE rates, we would be able to give some empirical justification for identifying the ECB as the dominant player in this long-run process. Clearly, given the institutional environment, this should be expected. It will therefore be interesting to see what role EMU plays in transmitting shocks to CEE markets and how results differ across countries. Next to relating the evidence to the prevailing official policy stance in CEE, we therefore also add Condition III which considers the role of US rates. Provided US rates can also be identified as the common stochastic trend in the EMU model, it follows that interest rate movements in our countries of interest, the CEE economies, have no effect on the ROW.

Our definition of the EDH implies several adjustments compared to the original GDH specification. In particular, we no longer conjecture any form of "insularity" (i.e. the absence of spill-over effects) which seems to be an awkward notion, given the size of the CEE countries and the degree of cooperation and coordination within the EU. The way we formulate the EDH rather reflects two developments the EU faces: globalisation and integration. Globalisation particularly refers to linkages outside Europe with

the ROW as captured by Condition (III). Integration is more related to intra EU issues, most notably the eastern enlargement of the E(M)U, which Conditions (I) and (II) examine. In a later step, in Section 2.4, we shall elaborate on the idea of globalisation and the impacts on the EU and fully exploit the GVAR approach by linking models (2.9) and (2.10).

2.3 Testing for Euro Dominance

2.3.1 Data

Our study is based on 3-month interbank rates obtained from Eurostat. Since Bernanke and Blinder (1992)'s seminal paper, short-term money market rates have become the commonly accepted proxy for modelling monetary policy behaviour and transmission in many economies. Amid our focus on long-term aspects of monetary convergence and given the noise and jumps present in daily interest rate movements, we opted for a monthly frequency. The dataset ranges from January 2000 to August 2009, roughly one year after Lehman Brothers declared bankruptcy. Accession negotiations with the CEE countries started already in the late 90's such that market expectations and interest rate differentials in line with the idea of uncovered interest rate parity are likely to reflect any signs of convergence early on.[15]

Figure 2.1 shows the CEE money market series in levels. Money market rates for the eurozone and the US are added for the sake of comparison. The figure seems to suggest that short-term interest rates are indeed converging.[16] All interbank rates display a sharp increase towards the end of 2008 – a clear indication of the alleged credit crunch on global financial markets. Interestingly, past CEE interest rate fluctuations have often been much more severe than these spikes. Romania or Poland, for example, experienced interbank rates that were up to 10 times higher than their end-of-sample values.

Whilst Figure 2.1 is suggestive of a converging pattern, graphs on their own might be misleading and a more formal analysis is called for. Our proposed framework obviously requires variables to be integrated of order

[15]Ideally, one would like to initialise the data in 1999. We refrained from doing so due to a considerable amount of missing values for some countries in that period.

[16]We also report the individual series in Figures A.2 and (in differenced form) A.3 to account for the substantial initial spread between some CEE interest rates and euro rates.

1, $I(1)$, even though the GVAR approach is flexible enough to accommodate stationarity.

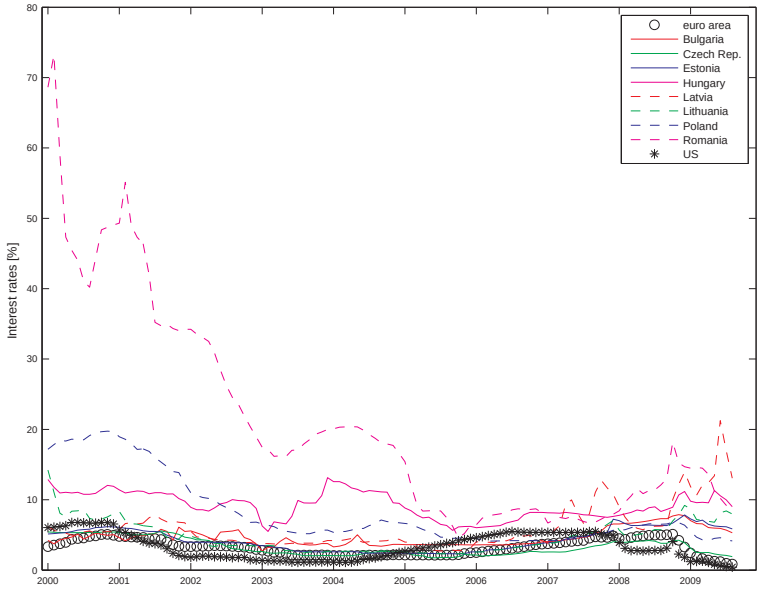

Figure 2.1: Monthly observations of 3-month money market rates. Source: Eurostat

We employ the standard augmented Dickey-Fuller (ADF) regressions to test for the presence of unit roots in the series:

$$\Delta R_t = \mu + \gamma R_{t-1} + \sum_{k=1}^{p} \delta_k \Delta R_{t-1} + \varepsilon_t.$$

On the basis of the graphical analysis we decided not to include deterministic trends in the Dickey-Fuller regressions. As usual, we test the null hypothesis of a unit root, $H_0 : \gamma = 0$, against the alternative that the time series is stationary, or $I(0)$, $H_1 : \gamma < 0$. We conducted the tests at different levels of augmentation, up to a quarter. The lag length was chosen using the Akaike Information Criterion (AIC). Results are reported in Table A.1 and suggest that all series are $I(1)$ at the 5% significance level. As robustness check, we have moreover computed unit root t-statistics based on weighted symmetric (WS) estimations of ADF-type regressions (see Pantula et al. (1994) for details). Those have according to Leybourne et al. (2005) more power than the standard ADF test. The test statistics of the WS-ADF unit root test are summarised in Table A.2 and provide further evidence for the $I(1)$-ness of the individual series.

2.3.2 Empirical results

Having established that the cointegrating framework is sensible we proceed with testing the EDH. We firstly specify the lag structures of (2.9) and (2.10). Table 2.2 reports the lag order of the individual country models. The length selection is performed using the AIC which suggests that a $VARX^*(2,1)$ suffices for most CEE country models.[17] Subject to residual-based specification tests we decided to treat EMU and the US symmetrically, with $p_i = q_i = 2$.

Country	p_i	q_i
Bulgaria	1	1
Czech Rep.	1	1
Estonia	2	1
Hungary	2	1
Latvia	2	1
Lithuania	2	1
Poland	1	1
Romania	2	1
euro area	2	2

Table 2.2: $VARX^*(p_i, q_i)$ order based on AIC.

Stacking endogenous and exogenous variables in $\boldsymbol{z}_t$, and after some reparameterisations we obtain the $VECMX^*(p_i - 1, q_i - 1)$:

$$\Delta R_{it} = c_{i0} + \alpha_i \beta_i' z_{i,t-1} + \sum_{k=1}^{p-1} \Psi_k \Delta z_{i,t-k} + \sum_{k=1}^{q-1} \Lambda_k \Delta \widetilde{R}_{i,t-k} + \varepsilon_{it}, \qquad (2.11)$$

where $\widetilde{R}_i$ refers to euro rates in case of $i = 1, \ldots, 8$ and to dollar rates for $i = 0$.

The EDH can now be tested using (2.11) in two steps. We start by examining the cointegration properties of the individual country models, followed by an assessment of the weak exogeneity assumption. The country-specific cointegration rank r_i is determined using Johansen's trace statistic. We follow Pesaran et al. (2000)'s testing procedure and restrict the intercept to the cointegrating relations, hereby ruling out linear trends in the data. Critical values are simulated based on 10,000 replications.

[17] By conditioning on weakly exogenous variables we obtain a richer dynamic structure than in VAR models of the same order which would first need to be rewritten in univariate autoregressive (integrated) moving average (AR(I)MA) representations for comparability (Pesaran et al., 2004).

Detailed cointegration test results can be found in Table A.3. In sum, euro and dollar rates cointegrate but there is also strong evidence for cointegration between CEE and EMU rates. Evidence for Bulgaria is slightly weaker but still well within the 10% level. We failed to establish cointegration between Hungarian and EMU interbank rates. This finding may well be a result of the recent economic turmoil in Hugary as the national central bank had to deal with speculative attacks on the forint. While we may find evidence for Euro Dominance in Hungary in a different information set, we conclude that the EDH is not supported by Hungarian money market rates.

To test for Euro and Global Independence (Conditions (II) and (III)), we assess the pivotal weak exogeneity assumption which in econometric terms may be considered a test for misspecification. We test for the significance of the estimated error-correcting term, $ECT_{i,t-1}$, in the marginal model for $\widetilde{R}_{it}$ following Dees et al. (2007). For example, to test for weak exogeneity of EMU interest rates in the Bulgarian country model ($i = 1$) we need to evaluate the null hypothesis that $\gamma_1 = 0$ in the auxiliary regression:

$$\Delta R_{0t} = \mu_1 + \gamma_1 ECT_{1,t-1} + \sum_{k=1}^{s_1} \delta_{1,k} \Delta R_{1,t-k} + \sum_{m=1}^{n_1} \varphi_{0,m} \Delta R_{0,t-m} + \varepsilon_{1,t},$$

where we maintain the lag order of the underlying $VARX^*$ by setting $s_1 = p_1$ and $n_1 = q_1$. Results of this standard t-test are provided in Table A.4 and support the notion of weak exogeneity in all relevant country-specific models.

	(I)	**(II)**	**(III)**
Country	**CEE Dependence**	**Euro Independence**	**Global Independence**
Bulgaria	‡	†	†
Czech Rep.	†	†	†
Estonia	†	†	†
Hungary	–	–	–
Latvia	†	†	†
Lithuania	†	†	†
Poland	†	†	†
Romania	†	†	†

Table 2.3: Summary of EDH testing. ‡ indicates significance at the 10% level; † at the 5% level

Table 2.3 summarises the empirical results. Overall, we seem to have established strong evidence for the notion of Euro Dominance in the enlarging euro area. With the exception of Hungary, domestic CEE money

markets are dominated by the euro area over the long run, which follows from Conditions (I) and (II). The EDH seems to hold in the strong form in the sense that euro rates are weakly exogenous. We also find that dollar rates move independently from the eurozone. US interest rates thus affect CEE money markets only via the euro area which confirms Condition (III) of Global Independence.

2.3.3 Impulse response analysis

Any investigation of financial linkages is of little meaning without analysing the transmission of shocks. Based on the empirical evidence for Euro Independence and Global Independence we shock foreign interest rates in the country-specific models and estimate Generalised Impulse Response Functions (GIRFs). We distinguish between the impulse responses arising from an EMU shock on CEE interest rates and a ROW shock on EMU interest rates. Both shocks are scaled appropriately to correspond to a rise by one standard deviation of the error variance on impact. Graphical output is summarised in Figure 2.3.3. The panel in the far lower right corner shows the eurozone impulse response function. The solid lines plot the country-specific point estimates; the dashed lines represent the 95% confidence intervals which are based on a sieve bootstrap using 5,000 replications.

The Figure illustrates the varying speeds of adjustments of the error-correcting relations over a period of 2 years. The ROW shock on euro rates appears to have quite prolonged effects, with the response only gradually dying out. More interesting for the case at hand is how EMU innovations are transmitted across the CEE countries. Referring back to Table 2.1, we see that by and large the short-term adjustment of exchange rate targeting countries is faster. This is particularly true for the Baltic countries of Estonia (which indeed joined EMU in 2011) and Lithuania. The inflation-targeters Poland and the Czech Republic show quantitatively a relatively weaker and more sustained response. This feature of a more gradual EMU shock adjustment appears to be in accordance with their prevailing official monetary stance. The case for Romania and Bulgaria is somewhat less clear-cut, however. In line with the result on inflation-targeting regimes, effects on Romanian rates are more prolonged but quantitatively quite strong in comparison to the Polish and Czech impulse function. The Bulgarian impulse function is fairly persistent despite the introduction of the CBA already in the late 90s. These differences in the Bulgarian and Romanian shock profile compared to the other CEE countries may be attributed to

their relatively late EU entry but also structural features such as different stages of financial market development and thus differences in transmission mechanisms.

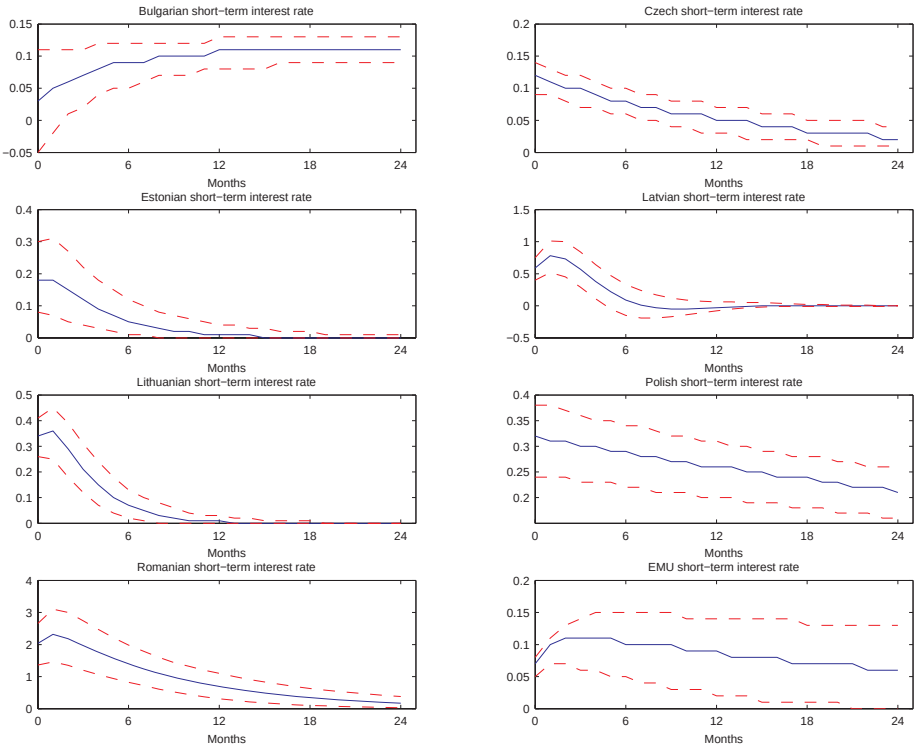

Figure 2.2: GIRF to country-specific shock. The solid lines plot the country-specific point estimates; the dashed lines show the 95% confidence intervals which are based on a sieve bootstrap using 5,000 replications.

2.4 Economic and financial globalisation and the EDH

2.4.1 Global shock analysis

The distinct feature of the GVAR modelling approach is that it permits incorporating aggregated foreign variables to investigate the transmission of shocks both on a regional and global level. This appears particularly relevant given the widespread consensus among academics and policymakers that the ongoing financial and economic globalisation and market integration also require more policy coordination at the supranational level.

Indeed, the recent financial and economic crisis constitutes an obvious reminder of that need. Moreover, thus far, we have only exposed the CEE countries to EMU-specific shocks. We therefore analyse in this section to what extent the evidence on Euro Dominance is affected by such global shocks, also in an attempt to provide some preliminary insights on the impact of the Crisis.

Amidst our particular interest in the efforts of CEE countries to integrate with EMU, we may think of domestic CEE money markets as being driven by a weighted average of foreign rates, i.e. other CEE money markets but also EMU and the US. We refer to this aggregate variable as $\boldsymbol{R^*_{it}}$ to indicate the conjectured linkages across markets. Foreign interest rates for each CEE country are constructed using country-specific weights

$$R^*_{it} = \sum_{j=0}^{N} w_{ij} R_{jt},$$

where w_{ij} is the weight for CEE country i with respect to country j and $w_{ii} = 0$. We experimented with different weighting schemes. As the main results were not materially affected by this choice, we decided to resort to simple equal weighting (to reflect the overall converging pattern) which appeared most natural for the research question at hand. To ensure consistency between country-level and aggregate evidence on the EDH, we exclude the Hungarian series and index the remaining variables from $1, \ldots, n-1$.

We again stack domestic and (now weighted) foreign country-specific variables in the vector z_{it} and introduce the matrix $\boldsymbol{W_i}$ that contains the country-specific weights. This weighting matrix links all domestic models and is needed to solve the GVAR recursively. It can accommodate various weights as long as they are predetermined. Note that the empirical outcomes of the analysis are invariant to the ordering of the countries.

Stacking all endogenous variables in $\boldsymbol{R_t}$ we can write

$$\boldsymbol{z_{it}} = \boldsymbol{W_i R_t} \quad i = 1, \ldots, n-1. \tag{2.12}$$

Using (2.12) allows us to rewrite (2.9)

$$\boldsymbol{A_i}(L,p)\boldsymbol{W_i R_t} = \varphi_{it}, \quad i = 1, \ldots, n-1, \tag{2.13}$$

where

$$\varphi_{it} = \boldsymbol{a}_{i0} + \boldsymbol{a}_{i1} t + \boldsymbol{\varepsilon}_{it}.$$

We retain the lag structure of the previously specified country models and stack them together to obtain the $GVAR(p)$:

$$\boldsymbol{G}(L,p)\boldsymbol{R_t} = \varphi_t, \tag{2.14}$$

where

$$\boldsymbol{G}(L,p) = \begin{pmatrix} \boldsymbol{A_1}(L,p)\boldsymbol{W_1} \\ \vdots \\ \boldsymbol{A_{n-1}}(L,p)\boldsymbol{W_{n-1}} \end{pmatrix}$$

and

$$\varphi_t = \begin{pmatrix} \varphi_{1t} \\ \vdots \\ \varphi_{(n-1)t} \end{pmatrix}.$$

We can solve (2.14) for all endogenous CEE interest rates simultaneously which allows us to analyse impulse responses across the entire information set. We may think of the $GVAR(p)$ in this context as a regional model of CEE money markets because it links this bloc of countries with both EMU and the ROW, whilst at the same time allowing for the existence of linkages across CEE economies. Thus, the presence of a solution to this system also provides indirect evidence against the notion of "CEE insularity" referred to above.

The previous impulse response analysis implicitly assumed that shocks are not global, i.e. they originate from a particular country or region. While this holds by definition for intra-EU shocks, the financial crisis has demonstrated that there are also events that cannot so easily be attributed to a particular country or region. This is in particular due to the strong interconnectedness and global character of the financial market place. We therefore construct a "global" shock which is a weighted average of variable-specific shocks (based on PPP-GDP weights) and as such common to all CEE countries in the model.[18]

Figure 2.3 summarises the estimated GIRFs to a one standard error global shock in CEE. The effects through time are qualitatively rather similar to the previous impulse responses to EMU shocks which confirms the predominant role of the euro area in the setting of CEE monetary policies as well as the strong impact of eurozone events in general on this area. The global analysis thus provides further support for the validity of the EDH. It appears one cannot necessarily claim that the occurrence of global shocks matters for the process of European monetary integration. It rather seems to be the case that predominantly regional E(M)U events drive the adjustment towards a long-run equilibrium or at least that global shocks are largely "absorbed" by the eurozone and from there transmitted further.

[18]See Pesaran et al. (2004) for further technical details and other applications of this procedure.

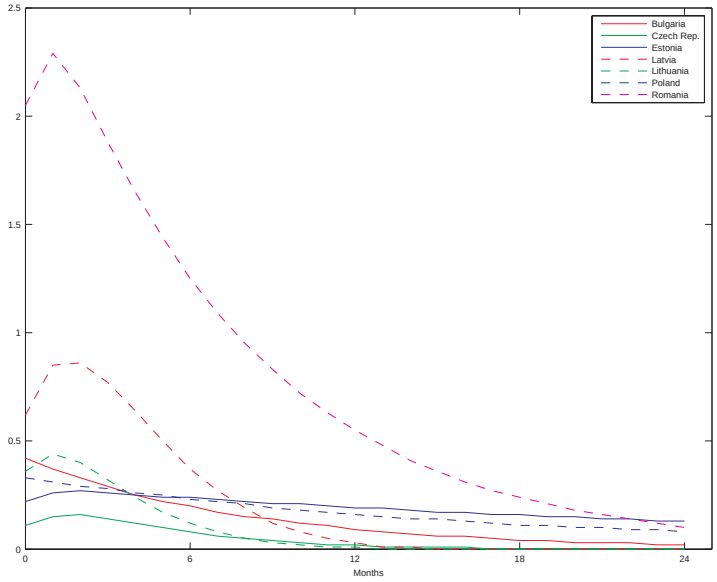

Figure 2.3: GIRF to global shock

2.4.2 Structural break analysis

As is generally accepted, the possibility of structural breaks in macroeconomic data can never be ruled out a priori. This is particularly true for the case of the emerging CEE economies that are and have been subject to political and social changes. The presence of structural breaks would be a serious issue in any cointegrating study as structural stability of both long-run and short-run coefficients is implicitly assumed. However, as Dees et al. (2007) point out, the GVAR framework might help in alleviating the structural problem somewhat as it can readily accommodate co-breaking and the underlying $VARX^*$ models might be more robust to possible structural breaks than for instance reduced-form single equation models.

Given the relatively short time span considered, it appears more meaningful to focus in our structural break analysis on the stability of short-run coefficients and error variances that are crucial for the investigation of the transmission of shocks. In particular, we calculate Ploberger and Krämer (1992)'s maximal OLS cumulative sum (CUSUM) statistic, denoted by PK_{sup} and its mean square variant PK_{msq}. We moreover consider the test for parameter constancy by Nyblom (1989) in its heteroskedasticity-robust version. The critical values of the tests under the null of parameter stability are computed using a sieve bootstrap. Results are reported in Table A.5 and cast little statistical doubt on coefficient stability. There

is some evidence for the Bulgarian series to reject the null of parameter constancy and to a lesser extent for the US and Latvian series using the Nyblom test. Overall, however, structural instability does not seem to have a strong impact on our results on the EDH.

2.5 Concluding remarks

In this Chapter we have upgraded the so-called *German Dominance Hypothesis (GDH)* in two dimensions. First, whereas the earlier literature on the GDH modelled interest rate linkages and causality issues within the former EMS, we reformulate the GDH for the CEE countries vis-à-vis the euro-zone. We seek to answer whether the monetary policy implemented by the ECB dictates CEE monetary policies. Evidence for this *Euro Dominance Hypothesis (EDH)* has important implications for the process of European monetary integration as all these countries have committed themselves to eventually introduce the euro and to join the monetary union with a single central bank. Second, we employ the relatively novel methodology of GVAR modelling to investigate convergence and the transmission of external shocks.

Unlike the traditional approaches of testing the GDH, that are either bivariate in nature or are expressed in terms of high dimensional VECMs, the proposed GVAR model generalises multivariate cointegration analysis to allow for weakly exogenous, structural $I(1)$ variables. This methodology is hence particularly suitable for small open economies. It deals first with error-correcting terms on the country level which allows for richer dynamics and more efficient estimation. One can stack this information in a second step into a global (multi-country) system that can be used to investigate impulse response functions on a "global" level. The proposed approach may hence be considered a consolidation of previous GDH testing procedures.

We tested the EDH as a set of three complementary hypotheses: CEE Dependence, Euro Independence and Global Independence. Our empirical results strongly support the EDH. We find that there is evidence for the notion of Euro Dominance, i.e. CEE Depedence together with Euro Independence, across CEE economies. Domestic CEE policies seem to follow the ECB's monetary policy stance (proxied by money market rates) quite closely, irrespective of the prevailing exchange rate arrangement. Country-specific impulse response functions suggest that countries with relatively tight monetary regimes adjust faster in response to EMU shocks. We re-

ject the EDH for Hungary which may reflect the notion of domestic policies dominating over EMU ones. The fact that our procedure reveals differences across economies shows that it has power. Our analysis moreover suggests that inner E(M)U events rather than external global shocks appear to be crucial drivers of monetary integration in Europe.

European monetary integration is best understood as an ongoing long-term process. The non-rejection of the EDH is somewhat surprising, given the recent turmoil on global financial markets that has posed unprecedented challenges to economic policymakers all over the world. Whilst the Crisis' long-term effects still remain to be seen, one may expect that central banks in CEE will find it increasingly difficult in the near future to mimic the ECB's policies and to maintain the path of monetary convergence with the euro area. In particular, trying to keep exchange rates, interest rates and inflation rates within the Maastricht ranges on a sustainable basis may become ever more challenging. On the other hand, if the evidence on Euro Dominance were true, CEE central bankers would not lose their independent monetary policy stance through joining EMU but are likely to gain influence in the ECB's common monetary policy decisions. Indeed, our analysis suggests that inner E(M)U events rather than external global shocks will determine the future of the enlarged eurozone. This indicates an already fairly advanced state of monetary integration in Europe and implies that policymakers should share a common interest in furthering (as opposed to reversing) the process. Whilst we have deliberately confined ourselves to a somewhat stylised setting, the GVAR approach can readily be extended to investigate further the transmission of euro area and global shocks. This may be a fruitful exercise which is left for future work as it allowed to understand more clearly the long-term impact of the Crisis on the process of European integration.

Acknowledgements

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Chapter 3

The Fair Trade movement: an economic perspective

Chapter Summary

Fair Trade (henceforth FT) products such as coffee and textiles are becoming increasingly popular with altruistic consumers all over the world. This Chapter seeks to understand the economic effects of this grassroots movement which directly links ethically-minded consumers in industrialised countries with marginalised producers in developing economies. We extend the Ricardian trade model and introduce a FT sector in developing South that offers a fair wage – the FT premium. There are indeed positive welfare effects from FT but those come at the expense of rising inequalities within South which are in turn a rational byproduct of FT. The degree of inequalities depends on the specifics of the cooperative structures in the FT sector. Given the rigidities and inequalities FT introduces and rests upon, this form of alternative trade appears to be only sustainable as niche movement.

3.1 Introduction

Fair Trade (FT) is catching on with ethically-minded end-consumers in industrialised countries. Households are more and more willing for altruistic

reasons to pay higher prices to support marginalised producers all over the world. Latest figures show that consumption of products certified by FT organisations more than doubled between 2000-2005 (Krier, 2005). Europe forms the centre of this grassroots consumer movement and coffee, the first product to be FT-certified, its backbone (Hira and Ferrie, 2006). One fifth of the ground coffee sold in the United Kingdom (UK) in 2004 carried one of the various FT labels (Krier, 2005). Worldshops, the traditional distribution channel of FT products, continue to be popular in countries such as Germany and Italy (Krier, 2005). In the UK, FT is going mainstream with an increasing number of major retail chains stocking different FT products (Raynolds and Murray, 2007). Striving to be perceived as ethically responsible companies, textiles made from FT cotton have become one of the fastest growing product group of the British retail business (The Times, 2007).

FT empowers consumers in the developed world to express political views through the shopping trolley and may be thought of as a form of protest against perceived unfavourable terms of trade for poor countries that are allegedly triggered by World Trade Organisation (WTO) trade liberalisation policies (The Economist, 2006b). Alternative Trade Organisations (ATO) like the Fairtrade Labelling Organisations International (FLO) try to offer a third way between the extreme stances of free trade and protectionism (Maseland and de Vaal, 2002).[1] Essentially bypassing middlemen, they guarantee certified cooperatives of farmers in developing countries a "fair" price for their produce.

The focus of this Chapter is distinct. Whilst there are other (more long-term) aspects of FT such as technology transfer or capacity building, we single out the economic implications of the so-called *FT premium* and its relation to FT prices. By the FT premium we essentially refer to the social premium which the FT organisations offer to the certified farmers and their communities. This is arguably the best-known feature to "non-FT campaigners" which motivates our emphasis on this particular aspect. The Chapter intends to provide theoretical underpinnings to the FT movement. This implies, on the one hand, that we need to offer conceptualisations of FT which the non-economist might find hard to swallow. Equally, using standard trade concepts by themselves might not do justice to the essence of this form of alternative trade.

Our Chapter seeks to strike a balance between these two stands by

[1] We shall use the terms ATO and FT organisation interchangeably in the remainder.

providing a model which is highly tractable (and intuitive) yet non-trivial, whilst at the same time reflecting some of the key elements of FT. We develop a Ricardian-type general equilibrium model which in contrast to the benchmark setting introduces two forms of "asymmetries": First, one of the goods (the FT good) is produced only in one country but only consumed in the other. This rations, given fixed expenditure shares, employment in that particular sector. Second, those workers who are part of the FT sector are better off compared to the non-FT sectors. This introduces inequalities. The key point to bear in mind is that this set-up permits an investigation of the economic effects of ethical consumerism in industrialised countries on FT-certified vis-à-vis non-certified producers in the developing world.

The FT premium (i.e. the monetary reward that directly benefits the farmers) is derived from the fair prices on the goods markets such that the consumption of FT goods may be considered an act of altruism. This is in line with the common denotation (the *Oxford English Dictionary* defines altruism as "selfless concern for the well-being of others"). Our notion of altruism is thus consistent with Fehr and Schmidt (1999)'s concept of self-centred inequity aversion in a perfectly rational framework: individuals are willing to sacrifice resources to achieve more equitable outcomes. Similar to Becchetti and Adriani (2002) and Richardson and Stähler (2007), we take the existence of altruistic consumers as given. Indeed, the notion of altruism in households' preferences has become standard in behavioural economics and is a typical result of experimental economics. Households in the North genuinely consider it fair, if marginalised producers in the FT sector receive a higher wage which allows them to close the technology and income gap to the developing world. Research from psychology and related fields suggests (see Hillis and Howie (2010) and the references therein) that this kind of fairness is culturally transmitted and we therefore consider the representative agent assumption on an aggregate level a suitable approximation.

The objective of this Chapter is, first, to make sense of FT in economic terms. Second, we would like to understand its welfare implications. Is the fair wage paid in the FT sector indeed welfare enhancing as commonly claimed by the numerous ATOs? We elaborate in particular on Leclair (2002)'s claim in his seminal contribution that alternative trade only supports one set of producers at the expense of others. We deliberately strive to provide closed-form solutions for greater analytical tractability and economic intuition – both of which we believe is crucial at this explorative stage.

Our model is able to replicate some of the main features of FT and pro-

vides additional insights that have been hitherto neglected in related studies on the issue. We show that FT can be consistently modelled in a rational utility-maximising framework. Without households in the North valuing higher living standards in the South, there is no FT (altruism as source of trade). It is possible that FT is induced by the presence of imperfect competition (oligopolistic structures for intermediate traders) but FT can arise in the presence of perfectly competitive markets as well, thus providing a relevant benchmark to elaborate on. We find that FT is overall welfare enhancing – at least within a distinct and empirically plausible range. This is due to its inequality reducing effects *between* countries in the presence of decreasing marginal utilities. However, the converging pattern comes at the expense of rising inequalities *within* South. These inequalities, however, seem to be a rational byproduct of FT which raises the question as to how sustainable FT would be on a broader scale. FT does not, as often claimed, lead to an excess supply of goods (as caused e.g. by the Common Agricultural Policy of the European Union, EU, or the agricultural policy of the United States, US). The reason for this is that FT is driven by demand, i.e. preferences of households and not by administrative intervention. However, our analysis also suggests that the nature of the cooperative structures in the FT sector matters. Keeping our model's obvious limitations in mind, the analysis might also allow for highlighting (at least tentative) policy implications regarding development policies in general and more specifically design of the FT system.

The remainder of the Chapter is structured as follows. Section 3.2 puts this study into context with the related literature. Section 3.3 provides further background information on FT and introduces the main stakeholders behind the movement. Section 3.4 describes the model's set-up and scope. We augment the Ricardian trade model by FT in Section 3.5. In Section 3.6, we investigate the economic effects of FT – in general equilibrium, from a welfare perspective and finally considering the determinants of distributional outcomes paying particular attention to the cooperative structure in the FT sector. Section 3.7 concludes and outlines policy recommendations as well as potential areas of further research.

3.2 Related literature

Amid its growing importance, the FT concept has received relatively little attention in the economic literature thus far. Early contributions tended

to originate from political sciences (see for example Littrell and Dickson (1999)) or from related strands outside orthodox economics. Leclair (2002) was the first to put the economic analysis of FT on the research agenda. His, largely descriptive, article contains a short section on the economic underpinnings of FT in which he compares the efficiency of subsidising workers' incomes in the South via "fairer" terms of trade with direct payments. He argues that free trade combined with direct aid may be superior to the FT system. Hayes (2006), on the other hand, suggests that FT is efficient in economic terms. Both papers, however, only offer a partial equilibrium context which precludes meaningful welfare statements.

In contrast to organic food, FT produces are not necessarily associated with higher quality levels compared to "conventional" products. This has led some authors (Leclair (2002); Booth and Whetstone (2007)) to imply that FT consumers are either uninformed or irrational. Reinstein and Song (2008) use contract-theoretic arguments to show that altruistic consumption is compatible with rational and informed behaviour in a competitive setting. Poret and Chambolle (2007) provide further theoretical evidence for potential efficiency gains from FT through product differentiation.

Other studies have focused more on the specific components of FT consumption. de Pelsmacker et al. (2005) employ a conjoint analysis for the Belgian coffee market and find that the FT label is on average the second most important attribute (being as important as flavour) in the consumer's purchasing decision. Maietta (2003) estimates hedonic prices for the Italian market and detects significant FT-related elements in coffee consumption. There is empirical evidence (see Arnot et al. (2006) or Becchetti and Rosati (2007) amongst others) that concerned consumers are willing to pay a premium for products which were made under ethical and socially responsible working conditions.

To the best of our knowledge, there are only two papers (Becchetti and Adriani (2002); Richardson and Stähler (2007)) that analyse the FT concept in a general equilibrium framework. Becchetti and Adriani (2002) investigate the effects of globalisation in general and consider FT a bottom-up mechanism which allows Northern consumers with "international equality concerns" to support Southern firms which pay "fair" wages. North's and South's welfare in their analysis, however, is not responsive to the degree of fairness. FT is simply considered a binary outcome which does not depend on the size of the wage mark-up. Becchetti and Adriani (2002)'s idea of FT is thus very similar to a related literature on "green consumerism" (see for example Eriksson (2004)), where consumers only care about the envi-

ronmental impact of a good but not the underlying production process or factor rewards.

Richardson and Stähler (2007) focus more on the behaviour of a vertically-integrated FT organisation in imperfectly competitive goods markets. Their set-up implies that both FT and non-FT firm could compete in the same (high quality) market. We believe this assumption is at odds with the anecdotal and empirical evidence which suggests that FT cooperatives offer a differentiated good in a distinct (albeit growing) niche market. This form of product differentiation, however, does not (at least exclusively) come from different quality levels but rather arises due to differences in production environments. While both papers suggest that marginalised producers benefit from a higher degree of trade integration, they do not consider distributional effects within South.

3.3 Background information on Fair Trade

We provide in this Section more detailed background information on FT and motivate some of the modelling decisions taken. When referring to FT, it is important to distinguish between *Fair Trade* as an idea of creating greater equity in international trade in general and *Fairtrade* as a specific labelling organisation.[2] FLO only certifies producers who provide working standards both in socio-economic and environmental terms that comply with certain international standards.[3] Typical FT products are bananas, cocoa, coffee, honey, fruit, rice, sugar, tea, textiles and other handicrafts.

All products which are sold under a FT claim are associated with one of the numerous FT organisations. This could be a national charity offering ethical products (like Oxfam) or an international body (like the World Fair Trade Organisation, WFTO). The Scottish Executive together with local FT campaigners and Scotland-based Non-Governmental Organisations (NGOs) has launched a forum to promote the idea of Scotland becoming the world's first FT nation (BBC, 2008).[4] Supporters of the FT movement share the same overriding principles as to what constitutes FT: Integrate

[2]In the US fair trade tends to have yet a different, slightly more political, meaning and refers to asymmetric trade liberalisation in which markets of industrial goods are opened up without full reciprocation for the developing world (also see Stiglitz and Charlton (2005) for a further discussion.

[3]24 labelling initiatives worldwide are currently part of FLO. For example, the Fairtrade Foundation licenses the use of the Fairtrade Mark on products sold in the UK. Also see Figure B.1 for the unique Fairtrade label.

[4]See Figure B.2 for the logo of the Scottish Fair Trade Forum.

marginalised producers in the world trading system, develop long-term relationships with them and hence alleviate poverty and inequality in the developing world. It is far from clear, however, to what extent these goals are and can be fulfilled by FT – also see Mohan (2010) for a balanced account of the FT concept and potential benefits but also problems.

Without claiming to be exhaustive, Figure 3.1 illustrates the main features of FT in simplified form. There are essentially five stakeholders: end-consumers in North, wholesale and retail chains (which we shall jointly refer to as *seller*), the ATO and the farmers who join together to form a FT cooperative. We may think of Figure 3.1 as a stylised value chain which describes the production, marketing and delivery links required for the FT commodity to arrive from producer at consumer. Several small farms typically join in to govern their own cooperative. The farmers' cooperative applies to the FT organisation for certification which grants the FT trademark only to those ensuring appropriate working conditions to their members. The cooperative moreover needs to produce a letter of intent from the seller to buy the produce at the higher FT price. The ATO in return maintains the price floor on the global markets which provides economic stability to the cooperatives in case of adverse demand or supply shocks. Booth and Whetstone (2007) therefore like to think of the price floor as hedging instrument.

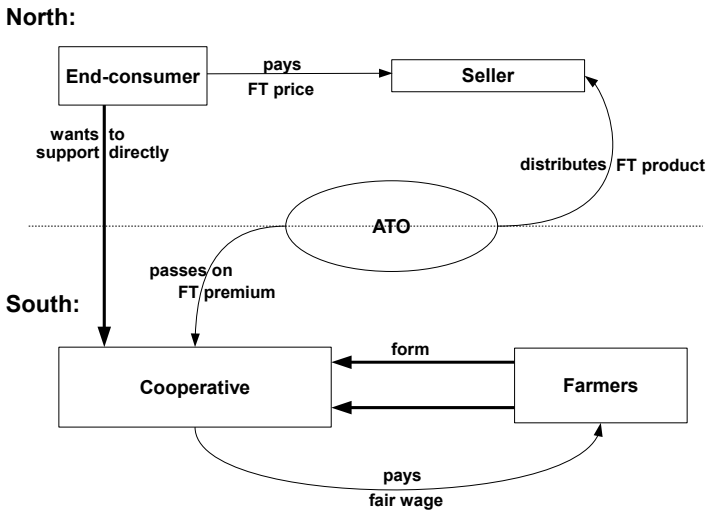

Figure 3.1: Stylised FT value chain

FT is a demand-driven concept. There are no quantity-based interventions in contrast to the EU Common Agricultural Policy, for example. Hence, one may argue that the FT label is a marketing tool which sellers

use to charge higher prices from end-consumers. While the guaranteed minimum fair price is probably the most obvious feature of FT, end-consumers really care about the amount that actually reaches the individual farmers and their families. Indeed, the ATO also provides a so-called social premium for investment in wider community projects. We shall refer to the entire amount that directly benefits the cooperative at large as the *FT premium* which is distributed to the farmers in the form of wages.

Although (as Figure 3.1 implies) the FT organisation acts as intermediary between North and South, the essence of FT is really characterised by the direct relationship between end-consumers and farmers. Our model thus seeks to highlight in particular this market-based link between the two agents across countries and the role of both FT premium and FT cooperatives in South.

Strictly speaking, consumers should be indifferent between donating, say, 10% of their income to charities and buying non-FT-certified goods or spending 10% of their income on FT goods without going through the hassle of the donation. While "giving fatigue" may play a role (Booth and Whetstone (2007)), there seems to be some psychological appeal in using the market-based FT mechanism (Nicholls and Opal, 2005). Moore (2004) explains in his survey article the rising popularity of FT products by their "informational" elements. He argues the differentiating factor may lie in the "meaning" attached to the good which is derived from additional information provided in the form of stories about the individuals who make or grow the product and the reported benefits of FT either for themselves or their communities.

There are also critical voices, however. The Economist (2006b) asserts that the guaranteed minimum price especially harms non-FT farmers. It is argued in a related article that only proper free trade (i.e. trade in the absence of market interventions) might alleviate poverty on a broader scale (The Economist, 2006a). FT products appear to fill (albeit growing) niches (Hira and Ferrie, 2006). Tentative (yet largely anecdotal) findings suggest that farmers and communities are better off due to FT and could benefit more, if demand was higher (see Raynolds (2002) and the references therein).

Overall, the available anecdotal and empirical evidence stresses two aspects of FT: its demand-driven nature but also the clear distinction it seeks to establish between certified vis-à-vis non-certified producers. Any serious model of FT should hence reflect these two elements.

3.4 Model set-up

Our Ricardian world consists of two countries, developed North (N) and developing South (S), trading with each other. There are three goods: X is the numeraire good and the non-FT good is denoted by Y. The FT good F is only produced in S and only consumed in N. Y and F may be considered as largely similar products (though this is not crucial) but in particular differ in the FT label attached to F. Both products are hence thought to serve distinct markets (Nicholls (2002); Becchetti and Huybrechts (2008)). For intuition, think in terms of the coffee market: Y is regular coffee and F is FT-certified coffee. Both products differ in terms of packaging and display. There is also a price differential reflecting the relatively more ethical (i.e. *fair*) production conditions in the certified sector. The degree by which FT workers are better off compared to the non-certified sector is measured by a wage premium paid in F.[5] Farms that do not pay this higher wage bill do not receive FT certification. We may therefore also think of the wage premium as a form of entry costs into the FT sector.

We consider FT and non-FT good as gross substitutes in the analysis for two reasons. First, given the still small scale of FT goods in global trade, there is as of yet no conclusive empirical evidence to suggest that FT produces have a sizable impact on the non-FT goods' market shares. Second, given the somewhat political stand FT consumers take with their purchasing decision, one may also think in terms of complementarities between the consumption of FT and non-FT good. Consumers derive additional utility from the occasional purchase of an ethically-produced good. If anything, FT producers might therefore compete with charities for donations. As we do not intend to model the underlying drivers of FT consumption as such, we remain agnostic in our modelling approach.

Countries differ in their production technologies, hereby allowing for comparative cost advantages.[6] As we shall see below, consumers will only demand F because they are (im)purely altruistic. It is the welfare-enhancing effect of consuming F which gives rise to trade in the FT product. Altruism hence enters as additional (but not exclusive) source of trade. We suppress various other sources of trade to single out the effects of altruistic behaviour:

[5]There is some evidence for inefficiencies in the pass-through of the FT price premium to farmers (Booth and Whetstone, 2007). We capture this by directing our attention to the factor markets.

[6]This assumption is necessary for trade to arise in these products. It would not be very interesting in a perfectly competitive environment to have trade due to heterogeneous preferences only.

there is by assumption only one factor of production (labour) in each country which rules out relative differences in factor endowments. Given our focus on the cooperative nature of FT, we do not allow for price-setting behaviour on the product markets and thus also preclude love-of-variety arguments.

We proceed as follows. We first augment the Ricardian benchmark model by FT. We then investigate the determinants of FT in general equilibrium and consider implications for convergence and sustainability. In a next step, we add further microfoundations to the cooperative structure in the FT-certified sector and endogenise the existing wage premium.

3.5 Introducing Fair Trade in a Ricardian world

As detailed in Section 3.4, the underlying structure of our FT model is Ricardian. In contrast to more conventional North-South frameworks, the emphasis is not so much on the tangible transfer of resources but more on the "transfer of utility", i.e. altruistic behaviour. Consumers in North are willing to pay a price premium for a certain product which is reflected in South in the form of relatively higher wages. An alternative, perhaps more streamlined, way of thinking of this is simply to consider a two-country free trade model with full specialisation. One country produces the numeraire good and consumes all goods available, while the other country produces the non-numeraire goods but refrains from consuming one particular good to meet increased foreign demand. This good is characterised by a protected labour market which leads to a rationing of employment. The goal of the analysis is then to investigate how overall welfare is affected by such an environment and what the policy implications are for both countries.

3.5.1 North

The flexible-wage economy North produces two goods (X and Y) using constant-returns-to-scale technologies. There is one input factor, labour:

$$X^N = A^N L_X^N \tag{3.1}$$

$$Y^N = B^N L_Y^N. \tag{3.2}$$

Sector-wide productivity is measured by A^N and B^N, respectively. Production is linear in labour and hence nests the case of technologies that exhibit constant returns to scale in both capital and labour.

Aggregate labour (L^N) is supplied inelastically, where employment in both sectors is given by L_X^N and L_Y^N . We can thus define North's workforce as

$$L^N = L_X^N + L_Y^N. \tag{3.3}$$

Labour is perfectly mobile across sectors and chosen freely by profit-maximising firms. Goods and labour markets are perfectly competitive which leads to the usual zero profit condition that in equilibrium producers in each sector will always hire workers up to the point at which real wages match productivities:

$$w_X^N = p_X^N A^N \tag{3.4}$$
$$w_Y^N = p_Y^N B^N. \tag{3.5}$$

Households in developed North derive utility from consuming both FT and non-FT good as well as X which may be considered a composite good:

$$U^N = U^N(C_X^N, C_Y^N, C_F).$$

Preferences are convex and the representative household consumes all goods in strictly positive quantities.[7] Following the evidence cited above, FT products serve niche markets and thus satisfy distinct needs. As we argue in Section 3.4, we consider the limiting Cobb-Douglas case as sufficient to illustrate the case:[8]

$$U^N = (C_F)^\theta (C_X^N)^\sigma (C_Y^N)^{1-\sigma-\theta}, \quad \theta > 0, \quad \sigma > 0. \tag{3.6}$$

It is well-known that these preferences ensure an interior solution and that the parameters represent the shares of North's total expenditures (denoted by E^N) on each of the goods.

[7]This is not too restrictive. Recall that Ricardo's original analysis was based on a counterfactual as well: What are the effects of a country opening up for trade? We are interested in the effects of consuming FT goods and hence do not directly compare autarky with free trade but rather free trade with fair trade.

[8]We have also tried more elaborate preference specifications – e.g. allowing for additional warm-glow or imperfect substitutability. In the light of this Chapter's focus on outcomes in South, however, those have just lowered tractability without offering further relevant insights. Those derivations can be found in Appendix B.2.

Constrained utility maximisation (optimality here and in the remainder is denoted by an asterisk) yields the following demand functions

$$C_F^* = \frac{\theta E^N}{p_F} \tag{3.7}$$

$$C_X^{N*} = \frac{\sigma E^N}{p_X^N} \tag{3.8}$$

$$C_Y^{N*} = \frac{(1-\sigma-\theta)E^N}{p_Y^N}, \tag{3.9}$$

which provides an intuitive grasp of altruism in this context: the more altruistic consumers are, the more of their income will be spent on F as captured by a higher θ. We do not provide an explicit theory as to why $\theta > 0$ and take the existence of altruistic spending as one of our model's primitives. We may thus also think of the preference parameters as import shares on an aggregate level.

3.5.2 South

There are three sectors in South. Producers operate in perfectly competitive markets and technologies are characterised by constant returns to scale. The numeraire good is produced in X, whilst Y and F crucially differ in the prevailing working conditions. Producers in the FT sector F offer more ethical occupational standards relative to Y such as increased work safety or better health care. These factors are typical requirements for FT certification and are captured by a wage premium ($w_F > w_Y^S$). In terms of the FT concept, the existence of a wage premium permits segmenting into FT and non-FT producers.

Farmers who are certified as FT producers by the ATO typically belong to one of the several cooperatives that make up F. We abstract for now from any optimisation rationale the representative FT cooperative might have in setting the wage premium and assume that the mark-up is specified exogenously (say, by means of a binding agreement between ATO and cooperative).[9] Wages in the FT sector exceed wages offered in the informal sector by the mark-up μ:

$$w_F = (1+\mu)w_Y^S, \tag{3.10}$$

where μ measures the FT premium.

[9]For expositional convenience, we first focus on the economic effects of a segmented labour market in South, before providing further microfoundations in Section 3.6.4.

Supporters of the FT movement typically claim that better working conditions in the FT sector increase productivity. They essentially relate to the long-term effects of FT which might be productivity-enhancing due to technology transfers and capacity building mechanisms embedded in the relationship between the FT cooperative and FT importers. Thus far, however, no robust empirical evidence has been established for the validity of this claim.[10] Without taking a stand on this debate, we therefore treat productivities as exogenous and conservatively conjecture that $D \geq B^S$ – i.e. workers in F are not less productive than in the non-certified sector.

Output in each sector is a function of the amount of labour used and the sector-specific productivity parameter:

$$X^S = A^S L_X^S \tag{3.11}$$
$$Y^S = B^S L_Y^S \tag{3.12}$$
$$F = D L_F, \qquad D \geq B^S. \tag{3.13}$$

South's labour endowment (L^S) is fully employed across all productive sectors

$$L^S = L_X^S + L_Y^S + L_F, \tag{3.14}$$

and in principle workers from each sector are perfectly mobile within S. In equilibrium, nominal wages equal marginal value products as usual:

$$w_X^S = p_X^S A^S \tag{3.15}$$
$$w_Y^S = p_Y^S B^S \tag{3.16}$$
$$w_F = p_F D. \tag{3.17}$$

We thus follow Becchetti and Adriani (2002) who consider fair working conditions strictly in terms of the usual competitive outcome of real wages equal to productivities. After all, there should be no reason for this fundamental condition not to hold. In Section 3.6.4, we add a further dimension to the notion of *fair wages* in the context of FT. Similar to Grossman and Helpman (2007), amongst others, we introduce a form of relative wage concerns (taking wages paid in the non-FT sector as the relevant benchmark) as crucial element of what workers consider a fair pay.

As often the case in developing countries, certain sectors only produce for foreign markets and FT produces are no exception. Households in South

[10] First studies in this direction are, for example, Becchetti and Costantino (2008) or Becchetti and Castriota (2009).

derive utility from consuming X and Y, making full use of their labour income. Preferences are Cobb-Douglas

$$U^S = (C_X^S)^\alpha (C_Y^S)^{1-\alpha}, \quad 0 < \alpha < 1, \tag{3.18}$$

and optimal consumer behaviour yields the usual Marshallian demand functions

$$C_X^{S*} = \frac{\alpha E^S}{p_X^S} \tag{3.19}$$

$$C_Y^{S*} = \frac{(1-\alpha) E^S}{p_Y^S}, \tag{3.20}$$

where α is a preference parameter and E^S denotes overall nominal expenditure in South.

3.6 Economic effects of Fair Trade

3.6.1 General equilibrium outcomes

There is free trade between North and South to isolate the effects of the FT wage premium in an elsewise undistorted economy. We assume that both countries are of similar size to allow for complete global specialisation.[11] North has a comparative advantage (i.e. relatively lower unit costs) in producing X, while South is by virtue relatively more efficient in producing Y such that $\frac{A^N}{B^N} > \frac{A^S}{B^S}$.

Productivity in the FT sector is driven by two elements: B^S captures a particular level of base productivity which is enhanced by the positive externalities the FT premium might imply. Our framework suggests two complimentary sources of trade: technological differences and altruistic spending ($\theta > 0$). Altruism is hence a necessary condition for trade in F to arise. It enters in general equilibrium not just on the macro level (via higher aggregate spending on FT products) but also on the micro level in that higher consumption of a good made under fairer working conditions reflects empathy felt for the FT workers' utility.

It is straightforward to show that there is a unique equilibrium. World expenditures (denoted by E^w) in this two-country setting without savings equal world income in equilibrium and we can thus write: $E^w = E^N + E^S$. Employment in North is trivial with complete specialisation: $L^N = L_X$.

[11] See Appendix B.3.1 for more detailed derivations of the necessary conditions for complete specialisation.

The main results of our model are driven by the activities taking place in South. In particular, the endogenous allocation of labour across the two active sectors Y and F matters:

$$L^S = L_Y + L_F. \tag{3.21}$$

Employment in each of these sectors determines production, consumption and ultimately international terms of trade.

Labour can in principle move freely across sectors ($w_Y^S = w^S$ and $w_X^N = w^N$) but is country-specific in a Ricardian environment. Wage incomes in N and S equal national expenditure levels in equilibrium which may be written as

$$E^N = w^N L^N \tag{3.22}$$

$$E^S = w^S L_Y + (1+\mu) w^S L_F = w^S (L^S + \mu L_F), \tag{3.23}$$

where (3.21) has been used to replace L_Y.

Despite the wage differential, it is not necessarily the case that South's entire labour force works in the certified sector. It can be shown that in general equilibrium the sectoral allocation of labour depends on preference parameters and wage mark-up as follows[12]

$$L_Y = \left(1 - \frac{\alpha\theta}{(1-\sigma)(1+\mu) - \alpha\theta\mu}\right) L^S \tag{3.24}$$

$$L_F = \frac{\alpha\theta}{(1-\sigma)(1+\mu) - \alpha\theta\mu} L^S, \tag{3.25}$$

which suggests that employment in the FT sector is purely demand-driven. As (3.25) reveals, the higher the demand for FT-products (i.e. larger θ), the more employment ceteris paribus in F. The obvious implication from (3.24) is that all the remaining labour is forced to work in the sector without cooperative structures. We might think of (3.24) as measuring a form of involuntary unemployment which in this Ricardian context is probably most suitably described as *involuntary employment*. Moreover, the higher the mark-up, the lower demand for a given θ and hence less employment in F. Our model is thus able to capture an important trade-off of FT consumption: on the one hand, consumers wish to be supportive of ethical working conditions in developing South, on the other hand, higher prices required to cover the FT premium reduce their budget set. The issue as to what constitutes an optimal wage mark-up will therefore be central in the

[12] See Appendix B.3.2 for detailed derivations.

welfare analysis below. It moreover follows from (3.24) and (3.25) that if $\mu = 0$, i.e. both sectors offer the same working conditions, there is only one active sector in South and $F = C_F = 0$.

In a two-country world all goods produced are demanded in equilibrium:

$$X = C_X^N + C_X^S \tag{3.26}$$
$$Y = C_Y^N + C_Y^S \tag{3.27}$$
$$F = C_F. \tag{3.28}$$

Prices are determined on the world markets through supply and demand. Goods can be traded freely and it therefore holds that

$$p_X^w \equiv p_X = p_X^N = p_X^S, \quad p_Y^w \equiv p_Y = p_Y^N = p_Y^S, \quad p_F^w = p_F. \tag{3.29}$$

Relative prices on the global commodity markets follow endogenously:[13]

$$\frac{p_Y}{p_X} = \left(\frac{1-\sigma}{\alpha} - \frac{\theta\mu}{1+\mu}\right)\frac{L^N}{L^S}\frac{A^N}{B^S} \tag{3.30}$$
$$\frac{p_F}{p_X} = \left(\frac{(1-\sigma)(1+\mu)}{\alpha} - \theta\mu\right)\frac{L^N}{L^S}\frac{A^N}{D}. \tag{3.31}$$

The model's reduced form solution suggests that international terms of trade depend on labour endowments, technologies, preferences and the interaction between the degree of altruistic spending in North and wage mark-up in South. Except for μ, these determinants might be considered "deep" parameters that also drive the main results in the benchmark Ricardian setting.

This raises the question as to how changes in the FT premium affect international terms of trade. Partially differentiating (3.31) with respect to the mark-up

$$\frac{\partial(p_F/p_X)}{\partial\mu} = \left(\frac{1-\sigma}{\alpha} - \theta\right)\frac{L^N}{L^S}\frac{A^N}{D} \tag{3.32}$$

yields an analytic description of the behaviour of prices for FT commodities (relative to the numeraire good) in response to changes in μ. They rise as long as $(1-\sigma)/\alpha > \theta$ and fall if $(1-\sigma)/\alpha < \theta$. The preference ratio $(1-\sigma)/\alpha$ captures the conventional determinants of trade in a comparative advantage environment. As long as the degree of ethical consumption falls within that interval, FT prices rise in μ. The critical point occurs, when these two forces balance at $\theta = (1-\sigma)/\alpha$. Once FT consumption grows

[13] The derivations can be found in Appendix B.3.3.

beyond this point, the concept is only sustainable if p_F adjusts downwards accordingly. In practice, of course, the downward price movement might be prevented by the price floor.

Figure 3.2 sketches this relationship in a stylised fashion. Starting from the intercept ($\mu = 0$), which obviously coincides with the benchmark Ricardian result ($\frac{1-\sigma}{\alpha}\frac{L^N}{L^S}\frac{A^N}{D}$), the intuition is as follows. Suppose the representative FT cooperative wishes to offer higher premia to its members. Eventually, this should be reflected in changing prices determined by basic market forces. FT, however, is purely demand-driven. Depending on preferences, three scenarios might arise. Increasing FT prices are only feasible as long as the ethical consumer movement is on the rising path as indicated by the upper line. However, there is also a lower bound (shown by the horizontal dotted line) along which ethical consumerism stagnates. This turning point occurs, once FT is no longer a niche movement but turns mainstream. It appears intuitively plausible that a demand-driven concept can only gain momentum if it is economically viable to consumers. Figure 3.2 thus visualises the inherent rigidity in the FT concept as downward pressure on market prices (indicated by the dashed falling path) are typically not binding for farmers in the certified sector.

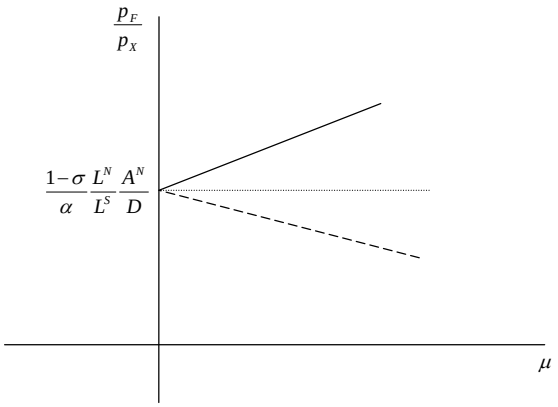

Figure 3.2: Illustration of the behaviour of FT prices as function of mark-up

One might draw several conclusions from this thought experiment. First, given its demand-driven nature, FT seems to be only sustainable as niche movement. Second and perhaps more importantly, being part of this well-defined system gives the FT cooperative a strong incentive to ensure FT remains within that niche which justifies the price differential (we return to this issue in Section 3.6.4). On a slightly different note, the analysis also

suggests that the FT premium could turn out to be too high. In this case, prices would need to be flexible downwards or, if this was prevented, demand would drop which would ultimately hurt the very marginalised producers FT intends to protect (we quantify these effects in Section 3.6.3).

3.6.2 Calibration

We calibrate the model to obtain a better quantitative understanding of the welfare effects of changes in the FT premium. Reflecting the market-based nature of FT, we consider the decentralised solution in deriving the Benthamite social welfare function denoted by U^w. We choose X as numeraire ($p_X = 1$) and obtain[14]

$$U^w = \left(\frac{\theta\alpha D L^S}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right)^{\theta}\left(\sigma A^N L^N\right)^{\sigma}\left(\frac{(1-\sigma-\theta)\alpha(1+\mu)B^S L^S}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right)^{1-\sigma-\theta} + \left((1-\sigma)A^N L^N\right)^{\alpha}\left((1-\alpha)B^S L^S\left[1+\frac{\alpha\theta\mu}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right]\right)^{1-\alpha} \quad (3.33)$$

Table 3.1 summarises the chosen parameter values. The exogenous part includes all the model's primitives that are not altered further. Both countries are of the same mass – normalised to 1 here. The equal size qualification appears plausible comparing the population figures of the EU with typical coffee exporting regions such as Latin America or Eastern Africa. We moreover treat preferences as purely exogenous. Those can be understood in this context as trade shares and are calibrated as follows. We choose α to measure the import share of manufactures in total merchandise trade for South and Central America which according to WTO (2009) data amounts to 0.69. Data provided by the European Commission (2010) suggests that in principle one out of three products traded in the EU could qualify for FT status which implies that $\sigma = 0.67$. Whilst there is no robust data on the demand for FT products, we set $\theta = 0.05$, reflecting the still rather small importance of FT products in global trade.[15]

Sectoral productivities are exogenous in a Ricardian set-up. Technologies are linear such that marginal products coincide with average productivities. If we express real unit labour costs in North and South as $a_N \equiv L_X/X = 1/A^N$ and $b_S \equiv L_Y/Y = 1/B^S$, respectively, we may define labour productivity as the amount of X and Y each country produces on

[14] See Appendix B.3.4 for the derivations.

[15] The Guardian (2010) reports a share of 5% sales of FT-certified products in the British grocery market.

average per hour of labour. The OECD (2008) reports estimates of labour productivity in the range of 43-45 for the EU and values of 19 and 16 for Mexico and Chile, respectively, and based on this empirical evidence we strive to maintain a ratio of $B^S/A^N = 2/5$ in the calibration.

	parameter	value
exogenous	L^N	1^a
	L^S	1^a
	α	0.69^b
	σ	0.67^b
	θ	0.05^b
	B^S/A^N	$2/5^b$
imposed	$D\ (\equiv \psi B^S)$	$\geq B^S$
calibrated	ψ	1
	μ	[0,1]

Table 3.1: Model calibration. *a*: normalised to 1. *b*: based on empirical evidence

The next panel in the Table displays all conditions that are imposed to warrant meaningful results. These relations arise endogenously in the sense that they need to be satisfied for internal consistency. As discussed above, we claim that $D \geq B^S$, which is reflected in our calibration exercise by defining $D \equiv \psi B^S$, where ψ captures all potential positive effects the more sustainable working conditions may have on sector-wide productivity.

It follows that two parameters need to be calibrated as depicted in the lower panel of Table 3.1. Those capture the core elements of FT. Positive values of μ imply the presence of fair wages, whereas $\psi > 1$ captures potential productivity gains in the FT-sector resulting from the premium. Given the prevailing lack of sufficiently strong evidence for productivity-enhancing effects of FT, we ignore those potential long-term aspects of FT and set $\psi = 1$. We specify an 0 to 1 interval for the wage premium such that wages in F can be up to twice as high compared to the non-cooperative sector.

3.6.3 Welfare effects of Fair Trade

We investigate the welfare implications of FT based on the calibration detailed in Table 3.1. Figure 3.3 plots the evolution of global welfare with variations in the FT premium. As discussed above, $\mu = 0$ corresponds to

the benchmark outcome in the conventional Ricardian setting of trade in only two products. The resulting welfare level is indicated in the Figure by the horizontal red line. The Figure reveals that the presence of FT does indeed raise global welfare. The theoretical justification for this finding is that whilst all Walrasian equilibria are Pareto efficient, they need not necessarily be socially optimal from a welfare-theoretic perspective. Indeed, the presence of welfare gains is in line with other theoretical studies (Becchetti and Adriani (2002); Richardson and Stähler (2007); Poret and Chambolle (2007), amongst others) who hint at positive welfare effects through greater trade integration and product differentiation. However, the Figure also shows that those effects are rather sensitive to the level of μ. With premia exceeding 15%, global welfare falls relatively strongly. Quantitatively and qualitatively we can thus identify a distinct segment ($0 < \mu < 0.2$) in which welfare gains outweigh welfare losses. This result is consistent with empirical evidence which suggests that consumers are willing to accept a price premium of roughly 10% (de Pelsmacker et al., 2005).

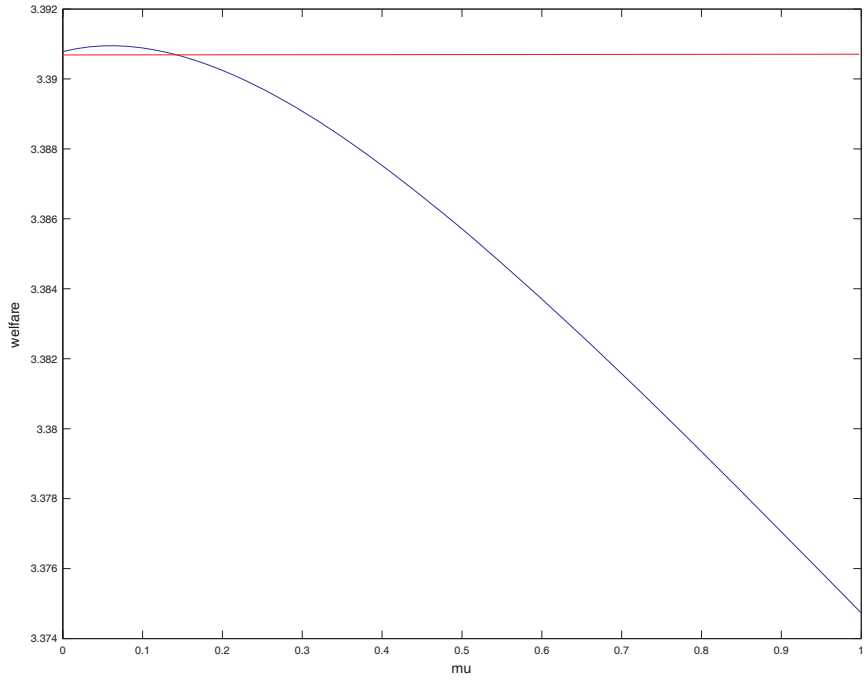

Figure 3.3: Overall welfare effects with varying FT premium.

The model thus provides theoretical evidence for the FT supporters' claim that FT is beneficial for the world as a whole. As can also be shown

analytically, welfare in North falls monotonically with increasing μ, whilst it rises in South. Provided that (at least some) households in North are willing to sacrifice resources to make farmers in South better off (through positive income effects), there can be positive welfare effects. The positive global welfare effects arise because of an altruistically motivated transfer of welfare from North to South. Consumers in North are willing to make themselves slightly worse off to allow the world as a whole to benefit. On an aggregate level, once welfare losses in North dominate due to too high wage premia, global gains are eroded.

It does appear to be the case, however, that the positive global welfare effects only sustain in the presence of sufficiently strong spending on FT goods. We have experimented as robustness check with different values for θ and found that the positive welfare effects do vanish with FT-induced consumption spending dropping below 3%. Moreover, it seems intuitively plausible that this "utility transfer" only sustains within certain limits. Similar to the analytical mechanism described above, the quantitative analysis confirms that for too high premia, demand for FT products falls, hereby hindering further certifications of farmers in South and ultimately making all agents worse off. Due to the price and employment frictions (certification is demand-driven) embedded in the FT concept, overall welfare might thus drop well below levels as for instance predicted in the benchmark Ricardian setting of $\mu = 0$.

3.6.4 Distributional effects of Fair Trade

While the existence of the FT premium raises overall welfare and indirectly allows for a transfer of wealth *between* North and South, it does create adverse distributional effects *within* South. Welfare gains in South arise solely in the FT sector whose farmers benefit from higher wages at the expense of farmers in the non-certified sector. Taking relative wages as measure of income inequalities

$$\omega(\mu) \equiv \frac{w_F}{w_Y}, \quad \omega'(\mu) > 0, \tag{3.34}$$

it is straightforward to see that the FT premium causes economic inequalities across the two active sectors in South which are accelerating as the differences in occupational standards become more pronounced. This is an obvious implication from the model set-up but also the very nature of FT

in general.[16] The interesting aspect lies in understanding what drives these inequalities and whether they are problematic to FT.

The simple answer is that if there were no FT, i.e. $\mu = 0$, there would be only one active sector (see (3.23)) and inequalities would thus vanish. FT supporters, of course, would argue that FT achieves a rise in living standards at least for some individuals and if demand was higher, more farmers could benefit from the fairer working conditions. Identifying the determinants of relative wages in the context of FT is thus likely to yield important policy implications – in particular with respect to rising inequalities – and we therefore provide in the following further microfoundations to the determinants of μ.

As we have already noted, the existence of fair wages in one sector relative to the other introduces rigidities in South. The result is a dual labour market. Labour is homogeneous[17] but F is characterised by cooperative structures. In general, all farmers would like to produce in the FT sector but only those with certification are allowed to enter. Employment (and thus certification) in our framework is endogenously determined through the demand side in North. All remaining workers are *involuntarily employed* in Y. There is, however, a crucial feedback mechanism as with an increasing wage mark-up also demand drops. FT creates an insider-outsider problem: cooperatives have an incentive to offer higher premia, yet they hereby constrain output and foster inequalities.

We can formalise this mechanism as follows. Think of the FT cooperative as a monopoly trade union that not only hires workers but also sets the level of working standards – as captured through μ. It is characteristic of cooperative structures that additional gains are immediately reinvested in the community and thus benefit all members equally. This permits focusing on a representative farmer. The cooperative is assumed to treat the wage, which is determined in general equilibrium, parametrically. Profit maximisation can hence be described as a two-stage process, similar to the well-known efficiency wage model of Solow (1979). In step one, the cooperative sets the level of working standards (i.e. μ) which fully describes w_F. In step two, the cooperative hires workers up to the point at which the marginal value product equals the wage resulting from the previous step.

[16] This point has already been observed, amongst others, by Leclair (2002) but it has not been formalised thus far.

[17] In other words, we focus on the determinants of the wage for *unskilled* labour. More conventional dual sector models differentiate between urban and rural sectors and the effects on *skilled* wage rates and unemployment.

The latter result has already been used above and it thus suffices to describe the cooperative's rationale of setting μ.

Suppose the representative farmer in F derives utility from his wage income which rises in μ. His efforts are governed by

$$\epsilon_F = min\left(\frac{w_F}{w_F^*}, 1\right). \tag{3.35}$$

This description goes back to Akerlof and Yellen (1990)'s seminal fair wage-effort hypothesis which states that workers' efforts ϵ_F depend on their conception of a fair wage, denoted by w_F^*. Workers provide the normal level of effort (normalised to 1) if they are paid at least their fair wage. Effort levels could then be linked to average productivities (D in our notation) but this is not crucial as we only consider the equilibrium case in which workers receive their fair wage.

In the context of our model, the fair wage has two determinants: the degree by which the more ethical working standards exceed the informal sector (proxied by $w_F - w_Y$) and the remuneration FT farmers could expect in the competitive benchmark sector. The latter factor is scaled in more conventional fair wage models by the sector-specific unemployment rate to express the probability with which workers could end up outside their own job (Kreickemeier and Nelson, 2006). Here, we could think in terms of relative employment $h(\mu) \equiv L_F/L_Y$, where $L_F \leq L_Y$. Relative employment is demand-driven and indeed the FT cooperative has an incentive to exploit inequalities in employment levels: As long as there are sectoral employment differences, an increasing fair wage is justified. We might therefore think of $h(\mu)$ as measure for the ease of entry into the certified sector with $h'(\mu) < 0$ to capture the insider-outsider mechanism described above.

Fair wages are thus expressed as:

$$w_F^* = \Lambda\mu w_Y + (1-\Lambda)(1-h(\mu))w_Y, \tag{3.36}$$

where we have used (3.10) to replace the wage differential and Λ is the weight attached to the respective factors of the fair wage concept. In the context of developing countries, this weight is likely to be driven by macroeconomic conditions and could thus also be interpreted as need for sustainable working conditions vis-à-vis the degree of duality among unskilled workers. The latter term in (3.36) obviously drops out in the absence of employment differences.

Due to (3.35), the cooperative rationally sets μ such that $w_F = w_F^*$, i.e. actual and fair wages should coincide to avoid inefficiencies. Thus,

$$\omega = \Lambda\mu + (1 - \Lambda)(1 - h(\mu)). \tag{3.37}$$

While the interpretation obviously differs from Akerlof and Yellen (1990)'s original notion, we might consider (3.37) the *fair wage constraint* in the sense that it establishes a link between equilibrium levels of wage inequalities and fair wages. More specifically, wage inequalities are determined by a weighted average of wage rigidities (the first term of the right hand side) and employment frictions (the second term of the right hand side). Differentiating (3.37) with respect to μ gives

$$\omega'(\mu) = \Lambda + (1 - \Lambda)h'(\mu).$$

The fair wage constraint is obviously upward-sloping in the $\omega - \mu$-space. However, for a given Λ, the more responsive relative employment is to changes in employment conditions in F (i.e. the higher the ease of entry), the lower the degree of inequalities. Equally, the lower the weight workers attach to the FT premium, the lower the cooperative's incentive to raise the FT premium and thus inequalities become less pronounced.

The variant of the fair wage constraint suggests several policy implications regarding the design of the FT system. First, it may not necessarily be the case that lower employment in F is exclusively due to insufficient demand in North. Other institutional features inherent in the FT system (entry costs, limitations in labour mobility) might give rise to a segmented labour market. Wage inequalities would be lower without those barriers in equilibrium. Second, the actions of the FT cooperative and its incentives to offer fair wages (hereby allowing for more ethical working conditions) follow rationally in line with optimal behaviour. Indeed, in the absence of economic inequalities, FT can hardly prevail. Third, we know from (3.32) that a rising degree ethical consumerism puts downward pressure on FT prices. If, however, income and employment differentials are crucial drivers of the FT premium, our analysis raises the question of the sustainability of FT on a broader scale.

3.7 Concluding remarks

In this largely explorative Chapter we have sought to make sense of the economic implications of Fair Trade (FT). We have deliberately provided

closed form expressions to ensure tractability and greatest economic intuition. Our model set-up moreover allows for comparisons against a meaningful (the Ricardian) benchmark. We have shown that FT can arise in a perfectly competitive environment. FT is compatible with the notion of free trade and indeed both forms of trade are complementary to some extent. FT is the result of utility maximising altruistic spending behaviour and thus completely rational.

We have found that FT can be overall welfare-improving within an empirically plausible range. This does require a sufficient level of altruistic spending which ultimately gives rise to a transfer of utility from North to South. However, the converging pattern between North and South comes at the cost of rising income inequalities within South. The characteristic FT premium which ensures sustainable working conditions in the FT sector introduces rigidities which can be explained by deriving a variant of a fair wage constraint.

Whilst it is difficult not to oversimplify the complex phenomenon of FT in a theoretical study, the model is able to capture characteristic elements of FT. Our analysis suggests that FT as a concept largely operates on the input markets. Employment in the FT sector is essentially rationed through North's demand side. Therefore, any subsidy or other mechanism (say, further advertising) which might entice consumers to buy more FT products would be a way of not only raising living standards in South but also of limiting inequalities. However, this is by far not the complete picture. Indeed, there are several rigidities embedded in FT which not only characterise but ultimately drive the system. FT cooperatives need to ensure for efficiency reasons an appropriate level of the FT premium. Also, to become a truly mainstream movement, FT prices would need to be subjected to basic market forces. This, however, is against the very idea of FT. Overall, our analysis suggests that FT might only be sustainable as niche movement.

Keeping the inevitable limitations of our theoretical approach to the matter in mind, one might draw several conclusions regarding development policies from the analysis. First, too much reliance of South on the FT mechanism is likely to accelerate regional heterogeneities. Given the implied sustainability issues, FT should be considered what it claims to be, that is an *alternative* form of trade. If at all, FT might be able to complement existing development policies but appears unlikely to replace wider programmes in a satisfactory manner. Second, for FT to allocate labour efficiently, the transition between secondary and FT sector should be made as smooth as

possible. Low entry barriers and a sufficient degree of labour mobility are crucial to limit inequalities. Policymakers should be aware that the FT cooperative has a rational incentive to exploit inequalities. Relying on FT as an effective tool to alleviate poverty on a broader scale thus seems to be a questionable strategy.

The economic analysis of FT is still in its infancy. We do see promising avenues for further research. Particularly empirical evidence on the effects of ethical FT consumption is rather scant. Does the FT premium really raise productivities both on an individual and community level? How does the cooperative nature in the FT sector affect sectoral employment? Further empirical insights would inform the theoretical modelling process. This is crucial because ultimately one would like to space the model across time to investigate the long-term effects of FT further. As yet, this evidence is still to be established. As consumers' awareness in industrialised countries increases, understanding the economic impact of ethical consumerism is crucial and will ultimately determine its future path.

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Chapter 4

Should the Fed be worried about rising economic inequalities?

Chapter Summary

Numerous factors such as global imbalances or weak financial regulation haven been attributed to the outbreak of the recent global economic crisis. However, as also argued by Rajan (2010), there are other – slightly less salient (and thus probably at least as important) factors – like rising economic inequalities that have led to instabilities. Indeed, there is compelling empirical evidence for growing socio-economic divergence in many industrialised countries. In particular the U.S. economy is characterised by increasing internal imbalances but at the same time features an institutional environment in which labour markets place a wage premium on skilled workers (the so-called college premium) as well as a central bank that officially pursues a dual mandate of both caring for stable prices and maximum employment. We therefore consider in this Chapter the relationship between rising economic inequalities in the U.S. and monetary policy. Instead of dealing with wage inequalities directly (say, through income redistribution), we analyse to what extent monetary policy can be used as rather blunt tool in an attempt to mitigate the sufferings of lower-class households. In considering distributional effects of monetary policy we augment the benchmark New Keynesian model by heterogeneous labour, distinguishing skilled vis-à-vis unskilled workers. This introduces the notion of relativities in key macroeconomic variables such as real wages, consumption and wealth, hereby provid-

ing a natural measure of economic inequalities. Our results indicate that monetary policy has asymmetric effects across the two sets of households which can lead in a rule-based environment to a further widening of the consumption, wage and in particular wealth gap. We moreover consider how the presence of inequalities affects the design of optimal monetary policy. We find that whilst inequalities do matter, it is not optimal for a monetary authority to seek to fully tackle those inequality-increasing effects. Policy objectives that explicitly seek to limit inequalities appear hardly feasible and seem to introduce additional trade-offs into the conduct of monetary policy.

4.1 Introduction

Since the end of the Great Moderation, it has become increasingly self-evident to economic policymakers around the world also to consider the wider implications of their actions. Indeed, the growing asset price bubble in the United States (U.S.) – whose burst set off a whole chain of events ultimately leading to the global financial crisis – was to a large extent driven by the political desire to create access for households of lower income ranks to their own housing. Home ownership has always been an important element of the American Dream and as such was actively supported under both President Bill Clinton's and later President George W. Bush's administration. When domestic interest rates were low and global savings high, policymakers in the U.S. saw a golden opportunity to do something about the rising income inequalities at home.[1] As Rajan (2010) argues, in the light of steadily rising economic inequalities, there was increasing political pressure to tackle those using short-run measures. Given the alleged potency of monetary policy to steer the evolution of the economy, it thus appears natural to ask what role monetary policy could and should possibly play in this regard.

Whilst there is an evolving empirical literature (see Bordo and Meissner (2011) for example) that analyses how Rajan (2010)'s argument relates to financial instability, the focus of this Chapter is distinct in that it is on real inequalities and how they relate to the conduct and optimal design

[1] See Section 4.2 for further stylised facts on income inequalities and rising wage gaps in the U.S. in the recent past.

of monetary policy.[2] In particular, we want to investigate whether it is desirable and feasible for a central bank to be worried about rising economic inequalities over the business cycle. More specifically, how does monetary policy operate in an environment that is marked by inequalities and are there asymmetric effects across households in response to exogenous shocks? Economic inequalities and their relationship with monetary policy have not been investigated to the best of our knowledge from this angle thus far.[3]

It should be noted that there are different notions of asymmetry in relation with monetary policy and we use that term to refer to asymmetric effects of monetary policy across households. The related but different notion of asymmetric monetary policy behaviour in a rule-based environment implies that policymakers assign different weights to positive and negative deviations of inflation and output from their reference values. This issue has been investigated for different countries by a number of authors (Cukierman and Muscatelli (2002) and Surico (2007) amongst others), typically using a linear-quadratic framework.

There is already a rather active literature on the evolution of economic inequalities over the business cycle that focuses on the welfare state and fiscal policies. Horvath and Nolan (2011), for example, study the short-run effects of a progressive tax and benefit system on inequalities. Another strand of literature is more concerned with the econometric analysis. A widely accepted stylised fact in that regard is that in particular earnings inequalities tend to widen during periods of economic downturn. Barlevy and Tsiddon (2006), however, argue empirically that this does not necessarily need to be the case as the short-run evolution of inequalities rather depends on the underlying long-run trend.

To investigate the short-run relationship between economic inequalities and monetary policy, we set up a New Keynesian (NK) model that extends the prototypical framework (Clarida et al. (1999); Galí (2003)) in two dimensions: First, labour is heterogeneous, i.e. we distinguish between skilled vis-à-vis unskilled households. Second, financial markets are incomplete and

[2]It should be noted that Rajan's investigation into the root causes of the Crisis is richer and serves in this Chapter chiefly to motivate the analysis.

[3]There is an ongoing debate about the future design of monetary policy in light of the recent crisis. See, amongst others, Blinder (2010) and Mishkin (2010) for a further discussion. It should be noted that our analysis is motivated by the case of the U.S. Fed whose political mandate and prevailing academic orthodoxy is distinct. Lessons for the monetary policy strategy of the ECB amid recent developments are for instance discussed by Orphanides (2010).

subject to transaction costs.[4]

Differentiating between different types of labour based on skill levels introduces the notion of relativities in key macroeconomic variables into the monetary policy problem and, as we discuss in more detail in Section 4.2, matches well with more recent U.S. labour market data. Whilst our analysis is motivated by developments in the U.S., there is strong evidence for rising inequalities in other industrialised countries such as the UK but also eurozone economies like Germany (see Goos and Manning (2009) for a recent overview). As also noted by the OECD (2012), it is not so much the level of inequalities that gives reason for concern in industrialised countries but the rates at which those are growing. Thus, it appears to be increasingly important to also consider distributional effects of monetary policy. The objective of this Chapter is to take a first step of the analysis in that direction.

The approach taken in this Chapter is as follows. We first specify a conventional Taylor rule in which the central bank sets interest rates in line with changes in inflation. This permits investigating how households' responses differ using well-established perturbation techniques. We compare our results with the benchmark economy with homogeneous labour throughout. Based on this positive evidence, we turn in a next step to the optimal monetary policy response from a welfare-theoretic perspective taking household utility into account and, in an attempt to capture the essence of Rajan (2010)'s argument, also analyse a Ramsey plan that explicitly cares about the welfare of the unskilled.

A main result of the Chapter is that monetary policy by itself seems to be neither a suitable nor feasible tool to deal with economic inequalities. Our findings indicate that monetary policy has asymmetric effects across the two sets of households which leads to a further rise in economic inequalities over the business cycle. This applies in particular to wealth inequalities. Wage inequalities appear to be largely driven by swings in relative hours worked. The analysis of the optimal design of monetary policy reveals that inequalities do matter. However, the Ramsey planner seems to be unable to effectively limit the inequality-increasing effects. A Ramsey plan that explicitly seeks to cater for the well-being of unskilled households reveals

[4]Whilst the elementary components of the benchmark NK model (such as nominal price rigidities or rational expectations) stem from the well-established literature on micro-founded dynamic stochastic general equilibrium (DSGE) models, these type of models have come under increased scrutiny lately (Arestis and Sawyer, 2008). Our model addresses some of the methodological shortcomings typically brought forward in that it relaxes the notion of a single representative household and features financial frictions.

that mitigating the effects of inequalities on the real side of the economy appears a hardly implementable target for monetary policymakers and may introduce additional trade-offs over the short run.

The policy lesson is that the monetary authority should thus not be overly concerned about rising economic inequalities in terms of wages or consumption. Although his argument is more nuanced, this does counter at least to some extent Rajan (2010)'s idea of the potency of monetary policy in tackling inequalities over the short run. However, monetary policy does have a considerable bearing on the evolution of wealth inequalities. Next to the normative dimension our model also features positive elements in that it explores to what extent the presence of heterogeneous labour affects outcomes compared to the benchmark NK model. We see that whilst overall responses are in line with predictions arising in a NK economy, considering distributional effects of monetary policy is crucial as it allows for more nuanced policy implications.

The Chapter is structured as follows. Section 4.2 summarises important stylised facts on income inequalities in the U.S. in the recent past. Section 4.3 presents the NK-type model with heterogeneous labour. The model is calibrated in Section 4.4. Section 4.5 presents the simulation results. We analyse the design of optimal monetary policy in Section 4.6. Section 4.7 concludes.

4.2 Stylised facts

Economic inequalities can be measured along several dimensions (e.g. income, consumption and wealth). These forms of inequalities are obviously closely linked and we therefore investigate them jointly in this Chapter. Wages form the most important income component and the following discussion is in particular concerned with inequalities arising from relative wage income differentials.[5] Rising income inequalities have not always been considered problematic for the economy as a whole. President Reagan's economic policies, for example, were rather openly aimed at the benefit of the wealthy. The credo was that the additional disposable incomes created through deregulation and lowering income as well as capital gains taxes

[5]Accounting for inequalities in wages (a flow variable) alone is unlikely to sufficiently capture the households' economic position. In the calibration (discussed in Section 4.4) we thus also seek to match inequalities arising from wealth (a stock) and consumption.

would eventually "trickle down" to poorer households as well.[6]

From a purely economic perspective, relative wage differentials might reflect differences in efforts and productivities and can help identifying the kind of jobs that require the highest skill levels, eventually providing incentives to workers to invest in human capital. According to the World Values Survey (2005), U.S. citizens generally believe more in the virtues of hard work and self-made entrepreneurship as means of overcoming poverty than for example British, French or Germans. This belief is commonly captured by the notion of "going from rags to riches" and tends to make voters less agreeable to a tax-induced redistribution of incomes (Alesina et al., 2001). Income inequalities are becoming problematic (and would ultimately call for some form of policy action), however, if factors other than innate ability and individual efforts came into play. Indeed, a recent study by Kopczuk et al. (2010) using social security data suggests that both short-term (up to five years) income mobility as well as long-term (i.e. lifetime) income mobility have been fairly stable since the 1950s.

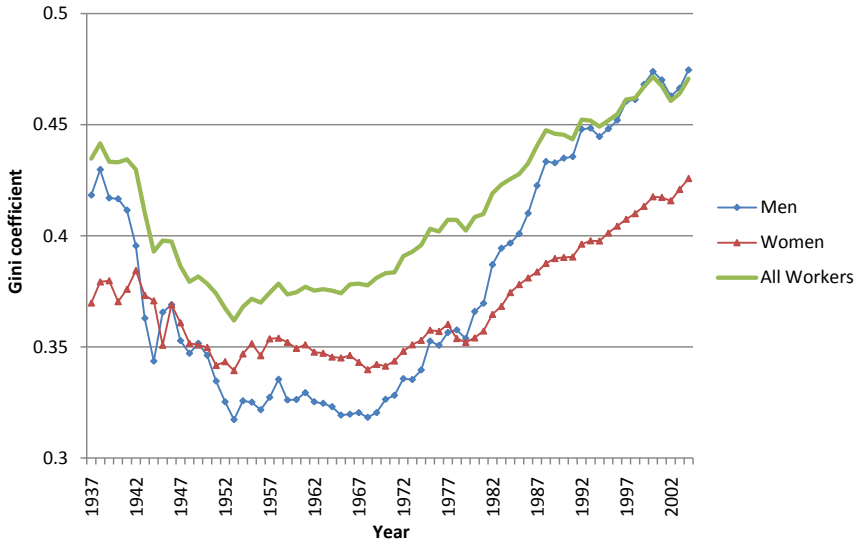

Figure 4.1: Gini coefficients based on individual annual earnings. Workers are defined here by employment in commerce and industrial sectors, aged 25 to 60. See Kopczuk et al. (2010) for further methodological details.

Amid the empirical evidence for a rather limited mobility across income

[6]Poverty as share of total population in these days, however, rather stagnated according to U.S. Census Bureau (2010) data.

groups, considering yearly snapshots of cross-sectional measures of income inequality hence closely corresponds to the evolution of income inequality over the longer term. Figure 4.1, based on data provided by Kopczuk et al. (2010), shows annual Gini coefficients from 1937 to 2004 for the entire sample and split by gender.[7] Long-term inequality has been evolving in a U-shaped pattern, implying steady increases since 1953 that accelerated especially in the 1980s. This evidence is line with other studies. Since the late 1970s, there has been an increasing "polarisation" particularly in British and U.S. labour markets into high-skill and low-skill jobs at the expense of middle-skill jobs (Autor et al., 2006). Among all workers, the increase in the Gini coefficient over the five decades from 1953 to 2004 is almost linear suggesting an upward trend that is not confined to single events. As Figure 4.1 shows, a similar U-shaped pattern can be observed for the gender-specific series. Income inequalities appear particularly pronounced among male workers.

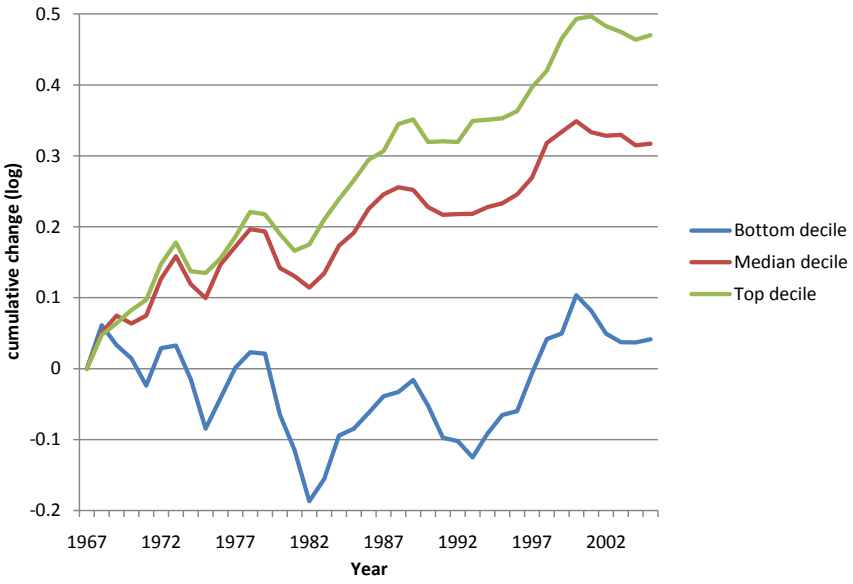

Figure 4.2: Percentiles of annual household earnings distribution (normalised to 0 in 1967). Source: Current Population Survey (CPS).

The divergence of wages is typically quantified by considering different percentiles of the earnings distribution. Figure 4.2 plots the trends in

[7] As usual, the Gini coefficient varies from 0 to 1, where 0 represents perfect equality and 1 corresponds to complete inequality.

U.S. household earnings for the top, median as well as bottom decile. The data, based on a recent study by Heathcote et al. (2010), ranges from 1967 to 2005 and illustrates the growing widening of the distribution as higher percentiles have experienced relatively higher wage growth. The Figure moreover suggests that households earnings at the bottom of the distribution suffer relatively strongly during recessions. Consider for example the contraction of the U.S. economy between 1980 to 1982. Earnings at the bottom decile declined by nearly 20% and did not return to pre-recession levels until the late 1990s.

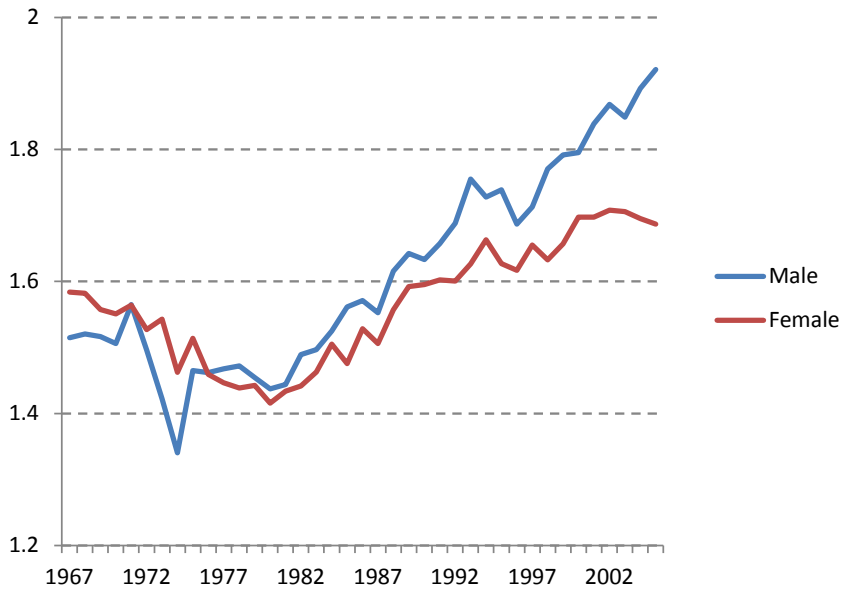

Figure 4.3: Evolution of the college premium. Source: Heathcote et al. (2010).

In particular two factors have been identified in the literature as proximate causes of wage inequalities in the U.S.: skill-biased technological change (SBTC) and the so-called college premium. Both factors share a similar underlying mechanism and are in a way complimentary. SBTC suggests that technological advances (such as automatisation, computerisation, etc.) benefit skilled workers in a biased fashion as it increases demand for them and hereby pushes up their wages relative to the unskilled. Since the level of skills and thus individual productivity is largely determined by the level of education (i.e. the accumulation of human capital), there is a corresponding supply-side argument that is often overlooked. Whilst basic

high-school education was sufficient for many jobs in the 1950s-70s, there is nowadays an increasing premium on college education. Goldin and Katz (2008) describe this phenomenon as a "race between education and technology", which is characterised by a situation in which labour is becoming ever more skill-intensive, requiring an increasing level of educational attainment of subsequent cohorts to keep up. However, as numbers show, growth of educational attainment (measured by the share of college graduates in the U.S. workforce) has been particularly sluggish for those at the bottom of the income distribution – in particular for racial and ethnic minorities (Goldin and Katz, 2008). Income inequalities could therefore also be explained by a relative lack of supply of skilled local workers.

In the calibration of steady-state wage inequalities below, we particularly resort to the notion of this college wage premium which is the most common driver of inequalities for the U.S. considered in the literature. Heathcote et al. (2010) present evidence for the college premium to evolve in the typical U-shaped pattern as shown in Figure 4.3.

Overall, it appears the appropriate long-term policy response to rising inequalities may lie in fostering the domestic workforce's accumulation of human capital. This would shield workers from outside influences (say through immigration or the the threat of outsourcing) but would also increase their adaptability to technological advancement in general. Whilst probably both supply and demand side effects matter, in this Chapter we do not offer a theory of the deep causes of wage inequalities. We focus instead on the short-run effects of exogenous productivity shocks to skilled and unskilled labour and the use of monetary policy as quick remedy without tackling the problem at its roots. The evidence for limited social mobility and rising wage gaps motivates in particular our modelling decision to distinguish between skilled and unskilled workers as two separate sets of households. Workers cannot retrain over the short run and are thus treated as ex-ante heterogeneous.

4.3 The model

We develop in this Section a model of a closed NK economy populated by two types of households who differ in terms of their skill levels. Since labour is ex-ante heterogeneous, it appears reasonable to relax the assumption of complete financial markets. In particular, there is both aggregate and individual uncertainty about future incomes and prices. The repre-

sentative skilled and unskilled households thus desire to insure themselves against aggregate technology shocks but they face transaction costs when restructuring their asset portfolios. We want to single out the effects on aggregates like household-specific consumption and wages and consider the two types of households as similar in several other dimensions (such as relative risk aversion). The remaining economic agents in our model are as usual a continuum of monopolistically competitive firms, the government and a monetary authority.

4.3.1 Households

Households are of two types, skilled (S) and unskilled (U) and infinitely-lived. The representative household of type $i, i = S, U$ seeks to maximise the following objective function

$$E_0 \sum_{t=0}^{\infty} (\beta^t)^i U(C_t^i, N_t^i), \tag{4.1}$$

where C^i is a composite consumption index for type i and N^i denotes the skill-specific aggregate labour supply. Time endowments for each household are normalised to 1 such that $1 - N^i$ measures time allocated to leisure (i.e. non-productive activities). Lifetime utility is thus determined through the consumption of goods and leisure across time in keeping with standard micro-foundations. Instantaneous utility in (4.1) is assumed to satisfy the usual conditions. In particular, the marginal utility of consumption is assumed to be positive and non-increasing, while a marginal increase in labour supply creates non-decreasing disutility.

The type-specific utility function is given by

$$E_0 \sum_{t=0}^{\infty} (\beta^t)^i \left[\frac{(C_t^i)^{1-\sigma} - 1}{1-\sigma} - \Psi^i \frac{(N_t^i)^{1+\varphi^i}}{1+\varphi^i} \right], \tag{4.2}$$

where E_t is the mathematical expectations operator conditional on the information available in period t, $\beta^i \in (0, 1)$ denotes the household's discount factor and $\Psi^i > 0$. Preferences are intertemporally additive with σ capturing the (inverse) of the intertemporal elasticity of substitution and φ^i measuring the degree of disutility from labour which we allow to differ across households. This specification reduces the role of money to being a nominal unit of account, thereby considering the limiting case of a cashless economy in which the relative preference weight on real money balances is arbitrarily close to zero.

As our economy is characterised by heterogeneous agents, it appears plausible to impede risk sharing in consumption. Households seek to obtain (at least partial) insurance against uncertainty about future labour income in the absence of complete financial markets. More specifically, they can only invest in risk-free bonds b^i_{t+1} but incur costs for doing so. Real bond holdings are governed by the following quadratic cost function

$$\omega(b^i_{t+1}) = \frac{1}{2}\Omega^i(b^i_{t+1})^2, \tag{4.3}$$

where Ω^i scales the degree of financial frictions each household faces.[8] In variation to Schmitt-Grohé and Uribe (2003) who specify the quadratic costs in terms of deviations from some fixed level of bond holdings, (4.3) does not vanish in the long run. This permits capturing empirically observed differences in savings behaviour. Households for instance face costs in gathering and processing the information related to their bond holding decision and thus access bond markets to a different extent, which is treated as a structural as opposed to a cyclical characteristic of the economy.[9] Our model features this realism by allowing the bond holding costs to differ across the two sets of consumers as discussed in more detail in Section 4.4.

The type i nominal budget constraint is given by

$$P_t C^i_t + P_t b^i_{t+1} + \frac{1}{2}\Omega^i P_t (b^i_{t+1})^2 + T_t = \Pi^i_t + R_{t-1}P_{t-1}b^i_t + W^i_t N^i_t, \tag{4.4}$$

where P_t is the aggregate price level. We adopt the following notation for the holdings of assets: b^i_{t+1} represents the purchases of one-period bonds that yield a pay-off of one unit of currency at maturity in $t+1$ and the nominal (gross) return is denoted by R_t. Households also pay nominal lump-sum taxes $T_t \geq 0$ to the government. The right hand side of (4.4) summarises the different sources of income at time t: Households supply labour and receive a nominal wage income of $W^i_t N^i_t$. Moreover, households receive monopoly profits in the form of dividends Π^i_t.

The budget constraint can obviously be written in real terms as

$$C^i_t + b^i_{t+1} + \frac{1}{2}\Omega^i(b^i_{t+1})^2 + \tau_t = \frac{\Pi^i_t}{P_t} + r_{t-1}b^i_t + \frac{W^i_t}{P_t}N^i_t, \tag{4.5}$$

where τ_t denotes real lump-sum taxation and r_t are real interest rates.

[8] The frictionless model is thus obtained by $\omega(\cdot) = 0$.

[9] In a similar vein, Benigno (2009) introduces costs in changing asset holdings to impede risk sharing of households across countries.

Household-specific consumption is aggregated by the following constant elasticity of substitution (CES) basket of differentiated products

$$C_t^i \equiv \left(\int_0^1 C_t^i(j)^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}}, \tag{4.6}$$

where θ describes the elasticity of substitution between any two varieties among the continuum of differentiated goods on the unit interval and $C_t^i(j)$ is household's i demand for consumption good j. Constrained maximisation yields the usual demand function for goods variety j:

$$C_t^i(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\theta} C_t^i. \tag{4.7}$$

The resulting CES price index (defined through the Lagrange multiplier from the intratemporal maximisation problem) is given by

$$P_t = \left(\int_0^1 P_t(j)^{1-\theta} dj \right)^{\frac{1}{1-\theta}}. \tag{4.8}$$

Considering household's i intertemporal problem, we obtain the following first order conditions, respectively, for consumption, labour supply and bond holdings:

$$(C_t^i)^{-\sigma} + \lambda_t^i = 0 \tag{4.9}$$

$$-\Psi^i (N_t^i)^{\varphi^i} - \lambda_t^i \frac{W_t^i}{P_t} = 0 \tag{4.10}$$

$$\lambda_t^i [1 + \Omega^i(b_{t+1}^i)] = E_t\{\lambda_{t+1}^i\} r_t. \tag{4.11}$$

Eliminating the Lagrange multiplier in (4.9) yields the Euler equations for labour supply

$$\Psi^i (N_t^i)^{\varphi^i} = (C_t^i)^{-\sigma} \frac{W_t^i}{P_t} \tag{4.12}$$

and bonds

$$1 + \Omega^i(b_{t+1}^i) = r_t \beta^i E_t \left\{ \left(\frac{C_{t+1}^i}{C_t^i} \right)^{-\sigma} \right\}. \tag{4.13}$$

Note how (4.13) yields the standard consumption Euler equation in the absence of trading frictions.

4.3.2 Firms

The domestic economy consists of a continuum of monopolistically competitive firms that are indexed by $j \in [0, 1]$. Each firm j employs skilled $N_t^S(j)$

and unskilled $N_t^U(j)$ labour to produce a differentiated product using the following CES production function

$$Y_t(j) = A_t \left[\delta_t^S N_t^S(j)^{\frac{\rho-1}{\rho}} + \delta_t^U N_t^U(j)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, \tag{4.14}$$

where ρ is the elasticity of substitution between the types of workers, A_t is aggregate productivity and δ_t^i is a time-varying weight capturing demand for skilled vis-à-vis unskilled labour. Note that in the extreme case of $N^U = 0$, (4.14) reduces to a linear production function in (only skilled) labour.[10] The level of productivity A_t follows an AR(1) process:

$$ln\frac{A_t}{A^*} = \rho^A ln\frac{A_{t-1}}{A^*} + \epsilon_t^A, \tag{4.15}$$

where the persistence parameter $\rho^A < 1$ in magnitude and ϵ_t^A are the non-serially correlated technology shocks that are normally distributed with mean zero and standard deviation σ^A.

Considering the benchmark case in which each firm j freely chooses input factors in a perfectly competitive fashion, the static cost minimisation problem boils down to

$$\begin{aligned} min \quad & W_t^S N_t^S(j) + W_t^U N_t^U(j) \\ st. \quad & P_t Y_t(j) = P_t A_t \left[\delta_t^S N_t^S(j)^{\frac{\rho-1}{\rho}} + \delta_t^U N_t^U(j)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}. \end{aligned}$$

The Lagrange multiplier associated with the constraint (denoted by mc) can be interpreted as the real marginal cost of producing one extra unit of output. We hence obtain a system of three equations in three unknowns. The input demands for skilled and, respectively, unskilled labour can be written as follows:

$$\begin{aligned} \frac{W_t^S}{P_t} &= mc_t A_t^{\frac{\rho-1}{\rho}} \delta_t^S (N_t^S(j))^{-\frac{1}{\rho}} Y_t^{\frac{1}{\rho}} \\ \frac{W_t^U}{P_t} &= mc_t A_t^{\frac{\rho-1}{\rho}} \delta_t^U (N_t^U(j))^{-\frac{1}{\rho}} Y_t^{\frac{1}{\rho}} \end{aligned}$$

such that the equilibrium relative wage is

$$\frac{W_t^S}{W_t^U} = \frac{\delta_t^S}{\delta_t^U} \left(\frac{N_t^S(j)}{N_t^U(j)} \right)^{-\frac{1}{\rho}}. \tag{4.16}$$

[10] The benchmark case of an economy with homogeneous labour is investigated in Appendix C.2.

The model is thus able to accommodate both potential sources of wage inequalities discussed in Section 4.2. There is an increasing wage premium modelled ceteris paribus by a rise in δ_t^S, whereby skilled workers are demanded relatively more – capturing SBTC. Similarly, an increase in the relative employment of skilled labour reduces the skill premium. Relative wages moreover depend on the degree of substitutability between input factors. A rise in A_t does not affect relative wages and therefore captures factor-neutral technical change.

Marginal costs of production (common to all firms) are given by:

$$MC_t \equiv P_t mc_t = A_t^{-1} \left[(\delta_t^S)^\rho (W_t^S)^{1-\rho} + (\delta_t^U)^\rho (W_t^U)^{1-\rho} \right]^{\frac{1}{1-\rho}}. \tag{4.17}$$

Following Rotemberg (1982), we assume that each firm j faces quadratic adjustment costs in changing output prices:

$$\frac{\phi}{2} \left(\frac{P_t(j)}{\pi^* P_{t-1}(j)} - 1 \right)^2 P_t Y_t, \tag{4.18}$$

where π^* is the gross steady state inflation rate. The parameter ϕ measures the degree of economy-wide price stickiness. The higher ϕ, the more sluggish the adjustment of nominal prices, where $\phi = 0$ captures the special case of perfectly flexible prices. Price adjustment costs increase in magnitude with the size of the adjustments made (particularly large price changes in excess of steady-state inflation are costly) and the overall level of economic activity. The presence of costly price adjustment renders the producer's pricing problem dynamic and is examined next.

The firms are only owned by skilled households who receive the monopoly profits to capture the related source of inequalities in wealth. Skilled households may thus be considered the entrepreneurs in this economy in the absence of a rental market for capital. Firms pay total dividends of $s\Pi_t$ (derived from the aggregate profits, where s denotes the population share of skilled workers) and set prices to maximise the net present value of future profits. Each firm faces the following pricing problem:

$$max \quad E_t \sum_{s=0}^{\infty} Q_{t,t+s} \Pi_{t+s}(j),$$

where the firms' stochastic cash flows are priced using the stochastic discount factor of the representative skilled household, Q, which can be backed out as:

$$Q_{t,t+k} = \left(\beta^k\right)^S \left(\frac{C_{t+k}^S}{C_t^S} \right)^{-\sigma}. \tag{4.19}$$

Firm's j profit function can be written as

$$\Pi_t(j) = P_t(j)Y_t(j) - MC_tY_t(j) - \frac{\phi}{2}\left(\frac{P_t(j)}{\pi^* P_{t-1}(j)} - 1\right)^2 P_tY_t, \tag{4.20}$$

where we have assumed that quadratic adjustment costs and portfolio adjustment costs are payable in terms of the aggregate consumption good. The firm's demand curve is thus given by

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\theta} Y_t. \tag{4.21}$$

In the Rotemberg quadratic price adjustment cost model there is no price dispersion and in a symmetric equilibrium all firms make the same decisions. Moreover, the aggregate resource constraint in this case is given by:

$$Y_t\left[1 - \frac{\phi}{2}\left(\frac{\pi_t}{\pi^*} - 1\right)^2\right] = sC_t^S + (1-s)C_t^U + s\frac{1}{2}\Omega^S(b_{t+1}^S)^2 + (1-s)\frac{1}{2}\Omega^U(b_{t+1}^U)^2, \tag{4.22}$$

where $\pi_t = P_t/P_{t-1}$ is the gross inflation rate.[11] Note how the adjustment costs "tighten" the constraint because part of the output is used to cover the price changes. This inefficiency wedge is obviously removed in the absence of price stickiness or in the stationary steady state.

Using (4.21) and the symmetry condition, we can rewrite (4.20) as follows turning this into an unconstrained optimisation problem:

$$\Pi_t(j) = P_t(j)^{1-\theta}P_t^{\theta}Y_t - mc_tP_t(j)^{-\theta}P_t^{1+\theta}Y_t - \frac{\phi}{2}\left(\frac{P_t(j)}{\pi^* P_{t-1}(j)} - 1\right)^2 P_tY_t.$$

The first order condition is readily derived as

$$(1-\theta) + \theta mc_t - \phi\frac{\pi_t}{\pi^*}\left(\frac{\pi_t}{\pi^*} - 1\right) + E_tQ_{t,t+1}\phi\frac{\pi_{t+1}}{\pi^*}\frac{Y_{t+1}}{Y_t}\left(\frac{\pi_{t+1}}{\pi^*} - 1\right) = 0 \tag{4.23}$$

which represents the non-linear New Keynesian Phillips Curve (NKPC) relationship under Rotemberg pricing.

4.3.3 Government and monetary authority

The public sector consists of the fiscal authority and the central bank. The government issues one-period bonds which determines the amount of economy-wide borrowing $\bar{b}_t$ in every period t and levies a lump-sum tax T_t

[11] See Section 4.3.4 for details.

to maintain the outstanding source of government bonds. The government budget constraint is

$$P_t\bar{b}_{t+1} = R_{t-1}P_{t-1}\bar{b}_t - T_t,$$

where $P_t\bar{b}_{t+1}$ expresses the nominal value of the stock of government debt at the end of period t and T measures aggregate tax collection.

We can express the government budget constraint in real terms as

$$\frac{R_{t-1}}{\pi_t}\bar{b}_t = \bar{b}_{t+1} + \tau_t, \tag{4.24}$$

where the real return on the outstanding stock of government debt that needs to be financed is denoted by $r_{t-1} = R_{t-1}/\pi_t$.

While there is no active role for fiscal policy, monetary policy can have real effects in the short run in the presence of price stickiness. The monetary authority implements its policies by choosing the sequence of nominal interest rates $\{R_t\}_{t=0}^{\infty}$ following a simple monetary policy rule (MPR):

$$R_t - R^* = \phi_\pi\left(\pi_t - \pi^*\right) + \phi_y\left(y_t - y^*\right), \tag{4.25}$$

where R_t denotes the gross one-period nominal interest rate, π^* denotes the targeted inflation rate, Y_t is output in period t and Y^* describes the non-stochastic steady state output level. The various ϕ-parameters attach weights to the different components of this conventional interest rate rule.

4.3.4 Aggregate resource constraint

The aggregate resource constraint (4.22) can be derived by consolidating both the private and public households' budget constraints as follows. In our model, the aggregate workforce (normalised to 1) is segmented into two sub-populations: skilled and unskilled, where s measures the amount of skilled labour and the remainder $1-s$ constitutes the unskilled part. Both labour markets clear:

$$\begin{aligned} N_t^S(j) &= sN_t^S \\ N_t^U(j) &= (1-s)N_t^U \end{aligned}$$

and firms (of total measure 1) are symmetric. Using Walras' Law and given market-clearing in the bond markets, we know that in equilibrium all output produced is consumed. Noting that aggregate consumption is divided into consumption by both skilled and unskilled households (weighted by their

population shares) and recalling the equivalence between national income (i.e. the sum of factor incomes) and aggregate output, it follows that

$$s\left(\frac{W_t^S}{P_t}N_t^S+\frac{\Pi_t}{P_t}\right)+(1-s)\left(\frac{W_t^U}{P_t}N_t^U\right)=Y_t\left[1-\frac{\phi}{2}\left(\frac{\pi_t}{\pi^*}-1\right)^2\right]=sC_t^S+(1-s)C_t^U,$$

which can be combined with (4.24) and the private households' real budget constraints to yield (4.22).

4.3.5 Equilibrium

The dynamic general equilibrium is characterised by the households' and firms' optimal behaviour subject to their individual and aggregate constraints and under the proviso that all markets clear. The numerical results presented below are thus based on a system of non-linear equations and equilibrium conditions that be can be summarised as follows.

As for the **skilled households**, we obtain the following Euler conditions: *Labour supply*

$$\Psi^S(N_t^S)^{\varphi^S}=(C_t^S)^{-\sigma}\frac{W_t^S}{P_t}, \tag{4.26}$$

and *bonds*

$$1+\Omega^S(b_{t+1}^S)=r_t\beta^S E_t\left\{\left(\frac{C_{t+1}^S}{C_t^S}\right)^{-\sigma}\right\}, \tag{4.27}$$

given the following intertemporal *budget constraint*

$$C_t^S+b_{t+1}^S+\frac{1}{2}\Omega^S(b_{t+1}^S)^2+\tau_t=\frac{\Pi_t^S}{P_t}+r_{t-1}b_t^S+\frac{W_t^S}{P_t}N_t^S. \tag{4.28}$$

Similarly, **unskilled households**, *supply labour*

$$\Psi^U(N_t^U)^{\varphi^U}=(C_t^U)^{-\sigma}\frac{W_t^U}{P_t}, \tag{4.29}$$

and hold *bonds*

$$1+\Omega^U(b_{t+1}^U)=r_t\beta^U E_t\left\{\left(\frac{C_{t+1}^U}{C_t^U}\right)^{-\sigma}\right\}, \tag{4.30}$$

given the following intertemporal *budget constraint*

$$C_t^U+b_{t+1}^U+\frac{1}{2}\Omega^U(b_{t+1}^U)^2+\tau_t=r_{t-1}b_t^U+\frac{W_t^U}{P_t}N_t^U. \tag{4.31}$$

The **bond market clearing condition** is as follows:

$$sb_{t+1}^S + (1-s)b_{t+1}^U = \bar{b}, \tag{4.32}$$

where the **government** sets taxes in a rule-like form to fix the stock of economy-wide *debt*:

$$\tau_t = \left(\frac{R_{t-1}}{\pi_t} - 1\right)\bar{b}. \tag{4.33}$$

Firms hire labour in the following mix which gives rise to an economy-wide *relative wage* of

$$\frac{W_t^S}{W_t^U} = \frac{\delta_t^S}{\delta_t^U}\left(\frac{sN_t^S}{(1-s)N_t^U}\right)^{-\frac{1}{\rho}}. \tag{4.34}$$

They face *marginal costs* of

$$MC_t \equiv P_t mc_t = A_t^{-1}\left[(\delta_t^S)^\rho (W_t^S)^{1-\rho} + (\delta_t^U)^\rho (W_t^U)^{1-\rho}\right]^{\frac{1}{1-\rho}} \tag{4.35}$$

and the *profit* function under symmetry can be expressed as

$$s\frac{\Pi_t}{P_t} = Y_t\left[1 - mc_t - \frac{\phi}{2}\left(\frac{\pi_t}{\pi^*} - 1\right)^2\right]. \tag{4.36}$$

Aggregate technology is given by

$$Y_t = A_t\left[\delta_t^S\left(sN_t^S\right)^{\frac{\rho-1}{\rho}} + \delta_t^U\left((1-s)N_t^U\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}, \tag{4.37}$$

the *aggregate resource constraint* is

$$Y_t\left[1 - \frac{\phi}{2}\left(\frac{\pi_t}{\pi^*} - 1\right)^2\right] = sC_t^S + (1-s)C_t^U + s\frac{1}{2}\Omega^S(b_{t+1}^S)^2 + (1-s)\frac{1}{2}\Omega^U(b_{t+1}^U)^2, \tag{4.38}$$

and *inflation* evolves according to

$$(1-\theta) + \theta mc_t = \phi\frac{\pi_t}{\pi^*}\left(\frac{\pi_t}{\pi^*} - 1\right) - \phi E_t\beta\left(\frac{C_{t+1}^S}{C_t^S}\right)^{-\sigma}\frac{\pi_{t+1}}{\pi^*}\frac{Y_{t+1}}{Y_t}\left(\frac{\pi_{t+1}}{\pi^*} - 1\right), \tag{4.39}$$

where the **monetary authority** sets *interest rates* in a rule-based manner.

4.4 Calibration

The model is calibrated to the U.S. economy at a quarterly frequency. As discussed in Section 4.2, we account for the polarisation of wage incomes by

splitting the (working) population into two parts: skilled and unskilled. We define skilled households as those with education beyond high school level (i.e. college equivalent) and unskilled households as those with less than 16 years of schooling. Goldin and Katz (2008) report evidence for the increase in educational attainment to be rather stagnant in the U.S. over the last 25 years, and we therefore consider the share of college graduates a natural measure for the size of skilled households compared to the unskilled. We use CPS data to calibrate the population share and set $s = 0.35$ in line with evidence that 35% of the young adults hold some form of a college degree, where the remainder $1-s = 0.65$ only hold a high school diploma or did not finish education and thus fall into the unskilled bracket of the workforce.

Having pinned down the household-specific contribution to aggregate output, we fix in a next step their relative differences in key macroeconomic variables. Our calibration draws heavily upon the evidence provided by Heathcote et al. (2010) who offer a coherent analysis of the various forms of inequality in the U.S. over a longer horizon. This is important as the different sources of inequality are linked and thus need to be considered jointly using comparable figures. More specifically, we want to account for inequalities in wage incomes, consumption and wealth and we discuss the chosen calibration for those in turn.

To calibrate steady-state wage inequalities, we draw upon the idea of the so-called college wage premium which is the most common driver of inequalities for the U.S. considered in the literature. Evidence based on CPS data suggests that the premium on college education accounts for nearly a doubling of the relative wage (90%) and we therefore aim for a steady-state relative wage of 1.9. In line with (4.34), steady-state relative wages are driven by four factors: relative labour demand, relative labour supply, the degree of substitutability between the input factors and the given relative population shares. We follow common practice in the RBC literature and calibrate Ψ^i such that both sets of households supply the same amount of labour in the steady state, i.e. $N^{i^*} = 1/3$. This permits focusing on relative differences in skills (due to different levels of education) as the major determinant of long-run wage inequalities. Katz and Murphy (1992) use a factor-specific productivity accounting approach to back out the elasticity of substitution between skilled (i.e. college-educated) and unskilled (i.e. having high school education) labour. Their estimates are consistent with the empirical literature on factor substitution and suggest that the degree of substitutability between these input factors, measured by ρ, amounts to 0.29. We are thus left with pinning down relative labour demand to hit the

desired relative wage level. We express labour demand in terms of unskilled labour ($\delta^{U^*} = 1$) which implies that $\delta^{S^*} = 0.22$, reflecting the relative lower share of skilled workers in the production process.

	Parameter	Value
Population share (skilled)	s	0.35
Population share (unskilled)	$1-s$	0.65
Discount factor (skilled)	β^S	0.99
Discount factor (unskilled)	β^U	0.98
Transaction costs (skilled)	$\frac{\Omega^S}{y^*}$	0
Transaction costs (unkilled)	$\frac{\Omega^U}{y^*}$	0.03 (percent)
Steady-state relative labour demand	$\frac{\delta^{S^*}}{\delta^{U^*}}$	0.22
Steady-state relative labour supply	$\frac{N^{S^*}}{N^{U^*}}$	1
Steady-state relative wage	$\frac{W^{S^*}}{W^{U^*}}$	1.9
Steady-state relative wealth	$\frac{b^{S^*}+(\Pi^*/\beta^S)}{b^{U^*}}$	2.4
Steady-state relative consumption	$\frac{C^{S^*}}{C^{U^*}}$	1.7
Steady-state inflation rate	π^*	1.02 (annual)
Intertemporal elasticity of substitution	$1/\sigma$	1/2
Frisch elasticity of labour supply (inverse)	φ	1/3
Labour elasticity of substitution	ρ	0.29
Consumption elasticity of substitution	θ	5
Rotemberg adjustment parameter	ϕ	30
Taylor rule parameter (inflation gap)	ϕ_π	1.5
Technology shock persistence	ρ_A	0.85
Technology shock variance	σ_A^2	0.01^2

Table 4.1: Model calibrated at quarterly frequency

Information on the distribution of wealth is taken from the Survey of Consumer Finances (SCF) which is a triennial survey of U.S. families commissioned by the U.S. Fed and the U.S. Treasury that provides extensive micro data on household-level assets and liabilities. To ensure comparability, we resort to the 2007 survey (hereby also excluding the recent decline in economic activity) and again consider skilled vis-à-vis unskilled households. We moreover need to establish a coherent mapping between empirical evidence on relative household wealth (recall that throughout we only consider inter-group as opposed to intra-group differences) and what is actually captured by our model. In doing so, it is important to recognise that accumulating wealth is a basic economic activity of any household and indeed 98% of all the households surveyed hold some form of assets for that pur-

pose. The skilled households hold all the equity (i.e. the present value of the firms' monopoly profits) in our model and both types of households save by holding government bonds. To quantify the differences in asset holdings, we again partition the workforce by its skill level and calculate the relative difference of the median value (in 2007 dollars) in bond holdings accounting for the fact that the skilled segment also holds stocks. The resulting ratio is 2.4 which is in line with the empirical observation of wealth inequalities being more pronounced than income inequalities.

We calibrate the intertemporal discounting factors (β^i) and the scaling factors (Ω^i) to match this observed heterogeneity in savings and equity holdings. As indicated in the description of the model, households differ in their subjective intertemporal discounting factors (β^i) to capture different degrees of patience across households.[12] Indeed, empirical studies for the U.S. suggest that time preference is a key determinant of occupational choice, investments in human capital and resulting wage structures. Munasinghe and Sicherman (2006) find that households with lower discount rates are more likely to select into jobs with steeper wage profiles. It therefore appears plausible to assign a relatively higher value of β to skilled households. The common approach in the real business cycle literature to pin down β is to infer its numerical value from the average long-run real interest rate (Prescott, 1986). Taking an annual net real interest rate of about 4%, β^S amounts to 0.99 at a quarterly frequency. Thus, $\Omega^S = 0$, i.e. bond holding costs only apply to unskilled households as further discussed below. Given the obvious problems with quantifying time preference (see Frederick et al. (2002) for a discussion), we only require unskilled households to be *relatively* less patient without creating stark absolute differences across the two households. In our calibration, β^U amounts to 0.98. There is an evolving literature (Hendricks (2007); Iacoviello (2008)) that seeks to exploit differences in discount rates to capture wealth inequality, typically from a life-cycle perspective, and our value for β^U is line with the discount factors used there.

We use the different degrees of financial frictions (captured by Ω^i) to help defining a steady state. For expositional convencience, we claim that skilled households do not pay any transaction costs, whereas a tiny cost of monitoring (0.03% of steady-state output) applies to unskilled households. An alternative interpretation of those costs is that unskilled households face

[12]Recall the inverse relationship between the individual discount rate and time preference: the lower the discount rate, the more value individuals place on future benefits relative to current consumption; they are "more patient".

certain barriers (for instance of informational kind) to trade and thus participate to a lower degree in financial markets. The idea of skilled households not being characterised by limited financial participation is in line for example with Iacoviello (2008) and not overly restrictive given that all the equity is held by skilled households.[13] The degree of financial frictions prevailing in this economy is arguably small but it is needed to ensure model stability and to capture inequalities which is this Chapter's focus. Unskilled households moreover do not hold any shares to reflect the empirical evidence on limited financial participation (see Hong et al. (2004) and the references therein). Indeed, data suggests that the stock market participation rate in the U.S. rises in the level of wealth and education (Hong et al., 2004). This may be explained by thinking of investing in stocks being associated with fixed costs. The wealthier households are, the more funds available to invest such that the fixed costs are less deterring to them. Similarly, the level of fixed costs (say, in acquiring and interpreting stock market information) is lower, the more educated households are.

Evidence for the degree of inequalities in consumption is based on the Consumer Expenditure Survey (CEX). Switching from the CPS to capture wage inequalities to the CEX sample is not problematic because, as Heathcote et al. (2010) find, both tell a consistent story regarding cross-sectional variation. The CEX sample runs from 1980 to 2006 and provides extensive panel information regarding the households' characteristics. As before, we only consider representative households in the working age (between 25 and 60 years of age). Splitting the sample by household skills permits deriving a consistent measure of consumption inequality. We use a narrow definition of consumption focusing only on real non-durable consumption expenditures which is in line with our model. The resulting skilled-to-unskilled consumption ratio is 1.6 – a target which we could only meet with implausibly high values of transaction costs. We therefore confine ourselves to the general observation of consumption inequalities being lower than income inequalities and aim for a steady-state consumption ratio of 1.7 which is fairly close to the cited empirical evidence.

The remaining model parameters are more conventional in the RBC literature and have been calibrated as follows. The Frisch elasticity of labour supply is set to 3 which lies well within the range of values typically used (also see Prescott (2004) for a discussion). A more critical parameter to calibrate is the elasticity of the marginal utility of consumption, σ. We

[13]This assumption moreover permits a seamingless transition between homogeneous and heterogeneous labour economy. See Appendix C.2 for details.

follow Schmitt-Grohé and Uribe (2007) and choose $\sigma = 2$ which implies that households desire a smoother consumption profile than in the common logarithmic case of unitary relative risk aversion. Parameterisations for the aggregate technology process are in line with the standard literature. The productivity level at the steady state is normalised to 1. The calibration of the aggregate productivity shock follows Schmitt-Grohé and Uribe (2007) with serial correlation of $\rho_A = 0.85$ and a standard deviation of the innovation to a productivity shock of $\sigma_A^2 = 0.01^2$. The price elasticity of demand (θ) is assumed to be 5, corresponding to a gross steady state mark-up of prices over marginal costs of 1.25. The Rotemberg price adjustment parameter ϕ is 30 (see Keen and Wang (2007)), given the mirco-data evidence that on average U.S. firms reoptimise prices every three quarters suggesting a slightly lower level of price rigidities than for instance in the euro area (Sbordone, 2002). The annual inflation target is set to 2% with the standard Taylor rule weight on the inflation gap of 1.5. As for the fiscal side, government debt in steady state amounts to 60% of GDP at an annual rate. Table 4.1 summarises the chosen parameter values.

4.5 Simulation results

Since we are ultimately interested in investigating potential asymmetric effects of monetary policy across the different sets of households, we cannot simply rely on linear approximations to our model's equilibrium conditions but need to resort to non-linear solution techniques instead. We use perturbation techniques along the lines of Schmitt-Grohé and Uribe (2004)'s second-order accurate approximation of the policy function. Based on the model's deterministic steady state (see Appendix C.1 for details), we investigate impulse response functions of core variables in response to an aggregate technology shock. We first consider a simple inflation-targeting rule before turning to a conventional Taylor (1993)-type rule which adds considerations for the output gap (e.g. as forecaster of future inflation) into the monetary policy rationale (Clarida et al., 1998). The simple linear MPR, which we label *Rule I* is obtained by setting $\phi_\pi = 1.5$ and equating ϕ_y in (4.25) to zero. *Rule II* adds further considerations to monetary policy behaviour in that there is also concern about output gap minimisation ($\phi_y = 0.125$).

Figure C.1 summarises the responses under the different MPR variants for an aggregate technology shock. We see that, whilst in line with the benchmark case of homogeneous labour (discussed in Appendix C.2), there

appears to be somewhat less inflation variability under *Rule II*, overall responses are similar across the different monetary policy stances. Output increases, which is more accommodated under *Rule I*. The fall in real interest rates induces both types of households to reduce their savings. The increase in aggregate productivity makes – at least on impact – both types of workers better off. Both consume more and earn higher wages. The drop in marginal costs reduces immediately inflationary pressures in the economy, reflecting the forward-looking nature of the model. There is moreover a wealth effect that is typically suggested in the RBC paradigm: households start consuming more leisure which leads to a drop of hours worked.

If both sets of households responded in a symmetric fashion, as is to be expected amidst a factor-neutral shock, relativities should not be affected. However, this is is not entirely the case. Whilst skilled households consume on impact relatively more, the difference is hardly sizable and consumption inequalities remain quantitatively largely unaffected over the business cycle. The impact on relative wages is somewhat more noticeable. The further (albeit small) widening of wage inequalities stems from the endogenous labour supply decision which is the distinctive feature of this class of models. As skilled hours worked drops by relatively more, there is a relative scarcity of skilled labour. The skilled labour market tightens relatively strongly as a result, and hence wage inequalities increase in line with the idea of the college premium. The strongest effects, however, are observed in terms of wealth inequalities. Those increase considerably as unskilled households dissave relatively strongly and moreover do not benefit from the increased overall economic profitability. Thus, the model suggests that whilst monetary policy may not have sizable effects on household-specific consumption profiles, it does exercise a strong intertemporal effect on the households' relative wealth position. Differences in savings behaviour appear to be the most prominent channel through which monetary policy is capable of affecting economic inequalities.

Overall, the simulation results provide some evidence for asymmetries in the responses of skilled and unskilled households. As households respond in different absolute magnitudes, relative measures and thus inequalities change. Inequalities are real phenomenena that are affected by real influences (e.g. shifts in relative labour supply) and thus can also rise in an economic upswing. Empirical evidence on the evolution of inequalities (Heathcote et al. (2010); Hornstein et al. (2005)) typically suggests that earnings inequalities widen only by a little and then remain relatively stable during periods of expansion. Our model is able to capture this stylised

fact.

Wage inequalities are in particular driven by differences in hours worked. As the skilled supply relatively less labour in periods of economic expansion, their labour market is relatively tight which keeps up wage pressures in the skilled segment of the domestic labour market. This effect is in line with Buch and Pierdzioch (2009) who report stylised facts which suggest that the volatility of hours worked is higher for skilled than for low-skilled workers.

The model in particular stresses the possibility of shifts in the distribution of wealth. Relatively more wealth is accumulated by the skilled households being the shareholders in the economy. This feature is not new to the literature. Krusell and Anthony A. Smith, Jr. (1998) already point at the importance of changes in the wealth distribution for the macroeconomy. Similarly, models along the lines of Obstfeld and Rogoff (1995) emphasize the importance of short-run wealth accumulation for the international transmission of policies across countries. Our findings highlight the importance of this channel between heterogeneous households within an economy.

4.6 Optimal monetary policy

Keeping our model's obvious limitations in mind, an important (at least tentative) policy implication that appears to arise from the impulse response analysis is that monetary policy does not seem to be a suitable tool to effectively deal with economic inequalities in the presence of exogenous shocks. This raises the general question from a welfare-theoretic point of view whether the monetary authority should be worried about economic inequalities and take them into account when choosing its policy path. Having obtained a descriptive understanding of the effects of shocks in a NK economy characterised by inequalities subject to a monetary policy rule, we therefore turn in a next step to the normative dimension and consider the optimal monetary policy response to a positive aggregate technology shock.

Our welfare analysis is based on the well-known Ramsey problem under commitment. The policy problem in Ramsey's seminal study takes the form of an allocation problem, in which the policymaker can be thought of as benevolent planner who directly chooses the feasible allocation subject to the model's equilibrium conditions that summarise the evolution of the economy. This welfare-theoretic approach has evolved as the conventional tool for analysing optimal policy in dynamic economies and we shall follow this tradition.

The Ramsey-type approach to characterising optimal monetary policy is based on the constrained optimisation of the planners objective function subject to the model's equilibrium conditions and constraints and under consideration of all the distortions that characterise the economy. Rather than following some exogenously specified monetary policy rule, however, the approach is micro-founded in that the social planner's policy objective is to maximise overall social welfare in the economy. The optimal policy problem can be set up in terms of a Lagrangian as

$$\mathcal{L}_0 = \max_{\mathbf{y}_t} E_0 \sum_{t=0}^{\infty} \beta^t \left\{ U^w(\mathbf{y}_{t+1}, \mathbf{y}_t, \mathbf{y}_{t-1}, \mathbf{u}_t) - \boldsymbol{\lambda}_t f(\mathbf{y}_{t+1}, \mathbf{y}_t, \mathbf{y}_{t-1}, \mathbf{u}_t) \right\},$$

where $\mathbf{y}_t$ and $\mathbf{u}_t$ are vectors containing the model's endogenous and exogenous variables, respectively, U^w describes the planners objective function, $f(\mathbf{y}_{t+1}, \mathbf{y}_t, \mathbf{y}_{t-1}, \mathbf{u}_t) = 0$ are the model's equilibrium conditions (see Section 4.3.5) and $\boldsymbol{\lambda}_t$ is the vector of Lagrange multipliers associated with these constraints.

The Ramsey planner seeks to maximise overall household welfare which in this case is a weighted average of skilled and unskilled households' utility. The period objective function is

$$U_t^w = s^w U_t^S + (1 - s^w) U_t^U + \beta U_{t+1}^w, \tag{4.40}$$

where $\beta = 0.99$ is the discount factor and s^w represents the weight attached to the skilled household period t utility with the type-specific utility function given by (4.2).

In studying the Ramsey dynamics, we seek to investigate the optimal monetary policy response to an aggregate technology shock with particular focus on the desirability of introducing asymmetries into monetary policy-making over the course of the business cycle. In particular, we assign different weighting schemes to household utility. First, we choose $s^w = s = 0.35$ to reflect the population share of skilled households in the economy. We explore in a next step how the dynamics are affected, if policymakers (say, due to political pressures) only worried about skilled households ($s^w = 1$) or unskilled households ($s^w = 0$), respectively.

Figure C.3 depicts the resulting Ramsey dynamics for the different weighting patterns. Overall, we see that regardless of the weights attached, the Ramsey planner uses monetary policy in a consistent way to stabilise the volatility in the endogenous variables. On impact, the planner raises nominal interest rates and allows inflation to fall. Those dynamics are in line with a flexible-price economy the planner tries to mimic. More interesting

for the matter at hand is the way the Ramsey policy seeks to alter the allocation between skilled vis-à-vis unskilled households. Given that the Ramsey planner is concerned with the maximisation of household utility per se, we should expect inequalities to be lowest, the more importance is given to the economic position of the unskilled households. Our results confirm this intuition. Consumption and wage inequalities are less pronounced, the higher the weight on unskilled households' utility. This suggests that in principle monetary policy may find it optimal to desire to counteract inequality-increasing effects. However, the Ramsey dynamics also raise a feasibility issue as the Ramsey plan with greatest concern for the unskilled households shows the greatest variability in inflation.

Thus, inequalities and distributional concerns matter for the optimal conduct of monetary policy. However, even if full consideration is given to the utility of the unskilled, the Ramsey planner seems to be unable to effectively limit the extent of the different forms of inequalities in an economy. Whilst the Ramsey planner is able to counteract wealth inequalities rather effectively, the responses to consumption and wage inequalities are more sluggish. The Ramsey planner rather finds it optimal to seek to stabilise inflation. This raises the question as to whether it is feasible for a monetary authority, given the tools it has at its disposal, to actively worry about economic inequalities that are not arising from a redistribution of wealth. Whilst further empirical investigation as to how monetary policy responds to economic inequalities (also in conjunction with output variability) would inform the analysis, the Ramsey dynamics appear to suggest that lowering inequalities over the short run might require compromising on other goals such as price stability.

4.7 Concluding remarks

In this Chapter we have sought to shed light on the link between economic inequalities and monetary policy. We have augmented the benchmark NK model that has evolved as the workhorse for monetary policy analysis by the presence of heterogeneous labour. This permits investigating distributional effects on skilled vis-à-vis unskilled households. In particular, key macroeconomic variables such as wages, consumption and wealth can now be expressed both in absolute and relative terms. An increase in relativities therefore provides a natural measure of rising inequalities and we consider jointly economic inequalities stemming from relative differences in the three

aforementioned variables.

Our analysis is motivated by the case of the U.S. and the prevailing social imbalances that characterise the internal economic structure. However, there is increasing empirical evidence that inequalities also start to matter in major European economies. Indeed, the evolution of inequalities in the U.S. and the UK has been largely similar in shape. Given the known potency of monetary policy to have a bearing on the evolution of the economy, we have therefore investigated in this Chapter to what extent monetary policy is a suitable tool to deal with those rising inequalities. We take up Rajan (2010)'s political economy argument which claims that inequalities were an important (yet largely unnoticed) long-run driver of the recent Crisis. He suggests that there has been increasing political pressure on policymakers to limit these inequalities through short-run measures. Particularly lowering consumption inequalities was allegedly regarded as a quick "palliative" (Rajan, 2010).

We find that in line with empirical evidence there are asymmetric effects on households in response to exogenous shocks, which leads to a further increase of inequalities over the business cycle. Monetary policy seems hardly capable of limiting the inequality-increasing effects using simple rules. We moreover consider the optimal monetary policy response in an economy characterised by inequalities. We find that even if the monetary authority only considered the unskilled households' utility, it would not find it optimal to seek to aggressively limit inequalities since this might compete with other policy goals.

An important policy implication that appears to arise from the analysis is that monetary policy on its own is neither a suitable nor feasible tool to tackle inequalities over the short run; in particular those that are not related to an unexpected redistribution of wealth. Our results counter to some extent Rajan (2010)'s idea of a consumption-fueled crisis. It should be noted, however, that his argument is richer and accounts for further institutions (welfare programs, government-backed mortgage agencies, subprime lending, etc.) that were in place during the build up of the Crisis to actively support unskilled consumption. Not surprisingly, our framework falls short of those effects.

We see promising extensions for future work on the link between monetary policy and inequalities. It would be interesting to also give a more active role for fiscal policy which was for motivational reasons deliberately neglected in this Chapter. Moreover, our model features perfect market-clearing of labour markets. It would be interesting to incorporate into

existing frameworks that explicitly account for unemployment the notion of asymmetric effects of monetary policy on heterogeneous households in a rule-based environment.

Acknowledgements

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Chapter 5

Conclusion

This dissertation has sought to shed light on topical issues relating to European integration and economic inequalities. We have analysed in three self-contained core chapters monetary integration between the euro area and the transition economies from CEE after the EU Eastern enlargement, the effects of the emerging FT movement that seeks to establish a direct link between altruistic consumers in the North and poor farmers in developing countries and finally the conduct of monetary policy in the presence of economic inequalities – an issue that is becoming increasingly obvious to many industrialised countries. In doing so, we have employed a wide range of methodologies depending on the fit to the specific research question. We have used econometric cointegration techniques to investigate long-run linkages, static Walrasian equilibrium concepts to introduce FT in the Ricardian trade model and short-run dynamic stochastic general equilibrium modelling approaches for a closed economy characterised by inefficiencies such as price rigidities and limited financial participation. We have sought to provide intuitive insights throughout the analysis, highlighting policy implications but also possible avenues for further research. In this concluding Chapter of the monograph we want to briefly summarise the main findings but also to elaborate on the shortcomings of our analysis and, building upon those, trying to identify directions for future work.

5.1 Main findings and policy implications

Chapter 2 provides a direct extension to my Master's thesis. We use a GVAR model to test for co-movements of short-term interest rates between the euro area and the transition economies from CEE, focusing on long-term aspects of monetary policy and economic integration. Our framework provides both an institutional and methodological upgrade of the GDH and permits an assessment of the degree of Euro Dominance in the enlarging eurozone. The results indicate that, apart for the case of Hungary, there is evidence for Euro Dominance in CEE. The EDH appears to hold in its strong form which implies weak exogeneity of euro rates. Including US interest rates as proxy for the ROW moreover allows us to test for Global Independence. The idea is to investigate whether global developments are transmitted to CEE indirectly via the eurozone. We find that indeed dollar rates move independently from the euro rates. To investigate these linkages further, we consider impulse responses arising from an EMU shock on CEE interest rates and a ROW shock on EMU interest rates. The analysis reveals that the effects on interest rates die out more quickly for countries with a relatively tight exchange rate regime towards the euro. We finally aggregate foreign interest rates to introduce the notion of a global shock in reflection of the recent Crisis. Findings confirm the predominant importance of the euro area to outcomes in CEE in that global shocks appear to be largely transmitted via the eurozone. The global analysis therefore provides further support for the validity of the EDH.

The empirical evidence for the presence of Euro Dominance has several policy implications for the process of European monetary integration. It suggests that as stipulated in the Treaty on European Community countries from CEE show a credible commitment to join the common currency over the long run. Overall, there are indications for an equilibrium relationship between euro and CEE interest rates. From a monetary policymaker's perspective this appears to imply that domestic CEE policies follow the ECB's stance (proxied by money market rates) quite closely. This relationship prevails regardless of the exchange rate regime in place which confirms the idea of different monetary strategies being capable of ensuring convergence. It might appear puzzling at first sight that Euro Dominance prevails in times of global financial unrest. However, banking sectors in the enlarging euro area are already fairly integrated and as such it seems plausible that events in the eurozone play such a dominant role in CEE countries. Also, European monetary integration is best thought of as a long-run pro-

cess. Given the already close linkages between CEE and EMU and the evidence on the EDH, it appears reasonable for policymakers to further this process as CEE central bankers would no longer lose an independent monetary policy stance but are likely to gain influence in the ECB's common decision-making process.

Chapter 3 anlayses the economic effects of the FT movement. We augment the Ricardian trade model by the presence of a FT sector that offers more ethical working conditions relative to the non-FT sector, captured by a wage premium. We show that altruistic spending on FT products is in line with rational behaviour. FT could not arise without households in industrialised countries valuing higher living standards in the developing world. The presence of FT indeed raises overall welfare – at least within a distinct and empirically plausible range. The positive global welfare effects arise because of an altruistically motivated transfer of wealth from North to South. It appears plausible that such a utility transfer only sustains within certain limits and under certain conditions. For too high FT premia, ethical demand falls which hinders further certifications of FT farmers and thus ultimately makes all agents worse off. Similarly, the welfare effects only prevail under a sufficiently strong degree of FT-induced consumption spending. Our results moreover indicate that whilst the presence of the FT premium allows for convergence between North and South, it does generate adverse distributional effects within South. Farmers in the FT sector gain at the expense of non-FT farmers. Endogenising the degree of wage inequalities reveals that FT as concept introduces and hinges upon rigidities and inequalities. We formalise the insider-outsider problem surrounding FT by depicting the FT cooperative as monopoly trade union that not only hires workers but also sets the level of working standards, captured by a fair wage. The FT cooperative has an obvious rationale in exploiting sectoral employment differences as only those justify an increasing fair wage. Our analysis suggests that the higher the ease of entry into the FT sector, the lower the degree of inequalities. The model implies that whilst FT is very much a demand-driven concept, insufficient certification levels in the FT sector may not be exclusively due to insufficient demand in North but could also be driven by other institutional features inherent in the FT system. Given that inequalities arise as part of the FT framework (but also drive the success of the system in the first place), it appears that this form of alternative trade can only sustain as niche movement.

Although it is difficult not to oversimplify the complex phenomenon of FT in a theoretical study, several policy lessons may be drawn regarding

design of the FT system but also development policies in general. It appears that FT is first and foremost a demand-driven concept which under certain conditions may have positive welfare effects. Thus, any mechanism which entices Northern consumers to increase their FT-induced spending could benefit the world as a whole. This could be achieved for instance through further advertising or perhaps by lowering prices for FT commodities. Indeed, in many European countries, and particularly in the UK, FT is turning mainstream and major retailers increasingly stock FT-certified products. However, our analysis also suggests that FT is best understood as niche movement. For FT to attract consumers on a broader scale, produces should be economically viable; yet, our model implies that downward pressure on market prices might be prevented by the price floor that is embedded in this trade concept. Moreover, it is not the demand side on its own that appears to determine the future path of the movement. The nature of the cooperative structures in the FT sector matters as well. FT is a concept that rests upon and highlights inequalities. Whilst the FT movement seeks to achieve a higher level of global integration between developing and developed world, it essentially creates an insider-outsider problem between certified and non-certified workers. This is not problematic per se but inequalities would increase if labour mobility, say due to administrative hurdles in the certification process, was limited. The overriding goal of the FT movement is to alleviate poverty on a global scale. The analysis does suggest that free trade and FT are to some extent complementary and could co-exist. Relying on FT as development tool on its own, however, seems a questionable development strategy at least at present. FT appears to appeal to specific type of ethical consumers and indeed might simply compete with other charities for their donations. In that regard, FT gives direct empowerment to consumers but to make an impact on a greater scale one would need to re-assure consumers of the positive effects of FT. This is a long-term challenge which the movement faces and which certainly needs to be investigated further (also see the discussion below). For the time being, FT is probably best considered what it claims to be, namely an alternative form of trade.

Chapter 4 considers the interplay between monetary policy and economic inequalities. We extend the workhorse NK model and segment the workforce into skilled and unskilled labour. Introducing household heterogeneity into the framework allows for analysing potential asymmetric effects across households in response to aggregate shocks, which in principle should affect all households equally. Our results suggest that monetary policy in-

deed has asymmetric effects across the two sets of households which leads to a further stretch of internal coherence. Wage inequalities rise over the business cycle as skilled labour becomes relatively scarce, reflecting the notion of the college premium. Monetary policy appears to have particularly a bearing on the evolution of wealth inequalities. We moreover analyse different Ramsey plans to investigate how the presence of inequalities affects the design of optimal monetary policy. Although inequalities do appear to matter for optimal policy, the Ramsey planner does not find it optimal to seek to strongly limit inequality-increasing effects. A plan that is exclusively concerned about the utility of the unskilled households reveals that doing this might conflict with other policy goals.

A central policy implication arises from the analysis: Monetary policy is not "neutral" over the business cycle when it comes to the evolution of inequalities. This seems to apply in particular to wealth inequalities. However, monetary policy on its own appears to be neither a suitable nor feasible tool to effectively tackle inequalities within an economy. The underlying reasoning is that long-run structural problems cannot be addressed by purely short-run measures. Economic inequalities are first and foremost real phenomena that are likely to be outside the scope of a monetary authority. Whilst a monetary authority is capable of – as is well established – affecting output, inflation and unemployment in the short run (and also observing a redistribution of wealth through unanticipated inflation), it cannot make up for inefficiencies for instance in productivity or relative scarcity of skilled labour. An additional complication for a central bank is the well-known instrument-goal problem. If a monetary authority has only one instrument at its disposal, it faces a trade-off for example in ensuring both price stability and lowering inequalities. Of course, as Romer and Romer (1999) argue, this trade-off might vanish in the long-run, where a prudent monetary policy stance that ensures low inflation and steady output growth might enhance the well-being of the poor on a lasting basis. Creating pressure on an institution that does not have the appropriate tools available seems therefore not only unjustified but indeed could exacerbate structural imbalances of an economy. It should be noted, however, that the NK framework presented here is somewhat stylised. As also discussed further below, several features are missing. For example, there is no physical capital which would permit an investigation of capital-skill complementarities. Moreover, an extension to the open economy dimension would allow for considering migration of labour across countries. The interplay between monetary policy and economic inequalities thus appears to be a fruitful area to be explored further.

Overall, the dissertation seeks to highlight the importance of investigating economic aspects of European integration and inequalities. As it stands, those are becoming ever more important. The introduction of the euro more than ten years ago was a significant step in the integration of EU economies as discussed in Chapter 1. However, open questions about the future architecture of the "European house" remain. What are the suitable institutional and policy-related arrangements for the EU in general and the eurozone in particular? Further applied research will be necessary to help shaping an environment that ensures macroeconomic stability in Europe and beyond. In a similar vein, as recent events have shown, social unrest arising from economic inequalities are no longer confined to developing countries. Whilst it was commonly believed that a society that is divided between rich and poor would be a rational byproduct of a well-functioning market economy, providing incentives to "move up", economic inequalities in industrialised countries are increasingly being identified as root causes of instability. Those are not only confined to socio-economic factors such as inequalities in health or employment histories (Roubini, 2011) but indeed can also give rise to financial instability (Rajan, 2010).

5.2 Directions for future research

The overall goal of this dissertation is to provide a deeper economic understanding of topical aspects pertaining to economic integration and inequalities. All our findings are based on established methodologies (cointegrating error-correcting model, Ricardian trade model, NK workhorse model), where we have tried to give a methodological twist to each of the frameworks. Of course, all modelling exercises (whether of empirical or theoretical nature) being simplifications of reality are open to several caveats and as such our analysis is not free of shortcomings. In this final Section we therefore want to critically reflect upon some of them – also in an attempt to formulate ideas for future research.

Given the topical nature of this study, the models developed to provide answers to the different research questions are inevitably somewhat exploratory. We have deliberately sought to single out distinct mechanisms to allow for a clearer economic understanding of the effects at work. Building upon this analysis, several aspects could be explored further that may be roughly categorised as follows:

- empirical evidence

- real features

We shall discuss in the remainder each of these items in turn and close with some final thoughts on the current state of macroeconomic research.

Empirical evidence

Whilst we have sought to establish robust findings in Chapter 2 by carefully motivating the estimation steps and by considering the research question from slightly different angles, the GVAR analysis could easily be extended by adding additional countries. For instance, one could incorporate the UK as non-eurozone country that unlike the CEE countries has decided to opt out from the monetary integration process. Confining ourselves to the most minimal set-up allowed for a coherent mapping of the EDH from the VECM to the GVAR – an important methodological idea. But the GVAR can be generalised by introducing further variables (in particular real ones as discussed below).

The more theoretical Chapters 3 and 4 are based on calibration techniques to quantify results. Whilst calibration essentially is an empirical method as well, it is not directly concerned with estimation and hypothesis testing. Amid the interrelationship between empirical evidence and theoretical modelling, further empirical results might help in progressing the theoretical frameworks. For example, the empirical evidence on the effects of ethical FT consumerism is rather scant. Does the FT premium enhance productivity and living standards in the Southern communities? Are there for example administrative inefficiencies in the certification process that affect sectoral employment differences? Having a deeper understanding of the long-term effects of FT is important as this is likely to determine the future success of the movement. Moreover, one would like to have a better idea of the drivers of ethical consumption patterns. Which factors motivate consumers to buy FT products? How does this purchasing decision for instance differ from buying organic products that are more associated with higher quality levels but less so with development aspects? Further empirical insights on these aspects would inform the theoretical modelling process.

On a related note, there is an evolving literature on the estimation of DSGE models (see for example del Negro and Schorfheide (2004)). The theoretical conciseness of the developed NK framework could thus be exploited further and our model could be taken to the data directly. This might be

a worthwhile exercise given that the calibration approach was able to highlight some continuity between benchmark and heterogeneous labour NK economy.

Real features

Beyond tractability, model simplicity offers an additional virtue: it allows for disentangling distinct features that drive this dissertation's results. For example, focusing on short-term nominal interest rates provides an indicator of European monetary integration that is established in the literature and that moreover represents an empirically accepted proxy for analysing monetary policy behaviour and transmission. Also, introducing additional features to a baseline model (such as the Ricardian trade model or the NK monetary policy model) with known properties permits detecting certain effects at a time. Building upon these findings, one could add further features to the models. Particularly considering further real variables might turn out to generate additional insights.

To take an example, we have ignored the notion of unemployment throughout the analysis. Indeed, it is far from being clear how to analyse unemployment in a general equilibrium context. Economists typically like to think of aggregate labour markets as being characterised by search and matching processes (Mortensen and Pissarides, 1994), but given that this framework was initially set up in a partial equilibrium setting, researchers have taken different routes to capture some labour market features (e.g. hiring costs) under the DSGE paradigm (see for example Blanchard and Galí (2010)). These methodological considerations apart, it might be worthwhile to have different degrees of wage rigidities between skilled and unskilled labour or to allow workers outside the FT sector to be unemployed.

Moreover, there is no active role for fiscal policy in this monograph. One could relax the assumption of lump-sum taxation or attribute a richer role to the welfare state for instance by introducing unemployment benefits or subsidies to consumption. It does appear at present that further steps in European integration are particularly necessary on the fiscal side. Thus, whilst we focus on monetary integration, the scope of the analysis could be widened by considering the presence of integration in terms of fiscal policies. At the current juncture, the notion of debt sustainability has become ever more relevant. One could in this regard not only consider the public sector but also turn to the different levels of private household debt within and across economies.

Concluding thoughts

Economics is very much a problem-solving discipline. In particular macroeconomics looking at the "big picture" should be (and indeed is) open for "outside" influences, when this picture changes, and should seek to continuously widen its scope of methods. The Crisis of 2008 and its aftermath was one of those events that has changed the picture also for academic research. As many modelling frameworks (but also empirical studies) were not properly taking features of social and economic imbalances into account, they were unable to guide policymakers through current times of important decisions. Whilst many of these "missing elements" are increasingly being addressed within mainstream macroeconomics, alternative approaches have gained in popularity as well. Experimental insights and behavioural elements are increasingly being explored for instance. Of course, a basic problem is to incorporate those findings coherently in a general equilibrium setting. To take an example, measures of individual discount rates in experimental studies turn out to be much higher than those typically used in macroeconomic models (see amongst others Dohmen and Falk (2011) for such a micro study and also the discussion in Frederick et al. (2002)).

Probably one of the major pitfalls when looking at economics as a subject is to believe that evidence on the micro level matters to the same extent to (representative) aggregates and conversely that changes in the policy environment would affect all agents in the same fashion. It has been arguably one of the greatest achievements of recent macroeconomic theory to build a bridge between microeconomic foundations and macroeconomic insights; yet it is important to keep the purpose of an empirical or theoretical thought framework in mind and to alway assess to what extent the particular approach is capable of capturing those desired features. Indeed, this still existing methodological divide between micro and macro sphere is a commonplace to many other social sciences and even occurs in life sciences such as biology and poses challenges to natural sciences like physics. Thus, it remains to be seen to what extent for instance more closely linking psychology with economics would give insights that have been up until now not fully understood.

As also Wickens (2010) argues, there may not bee too much wrong with the basic foundations of modern macroeconomics after all. However, macroeconomics as way of analysis increasingly needs to address issues pertaining to integration but also divergence both on a European and global scale. Whilst the present dissertation has sought to at least consider some of

these aspects, an overriding conceptual framework on the matter that guides empirical analysis and vice versa empirical insights that direct theoretical conceptualisations is yet to evolve.

Appendix A

Appendix Chapter 2

A.1 Figures

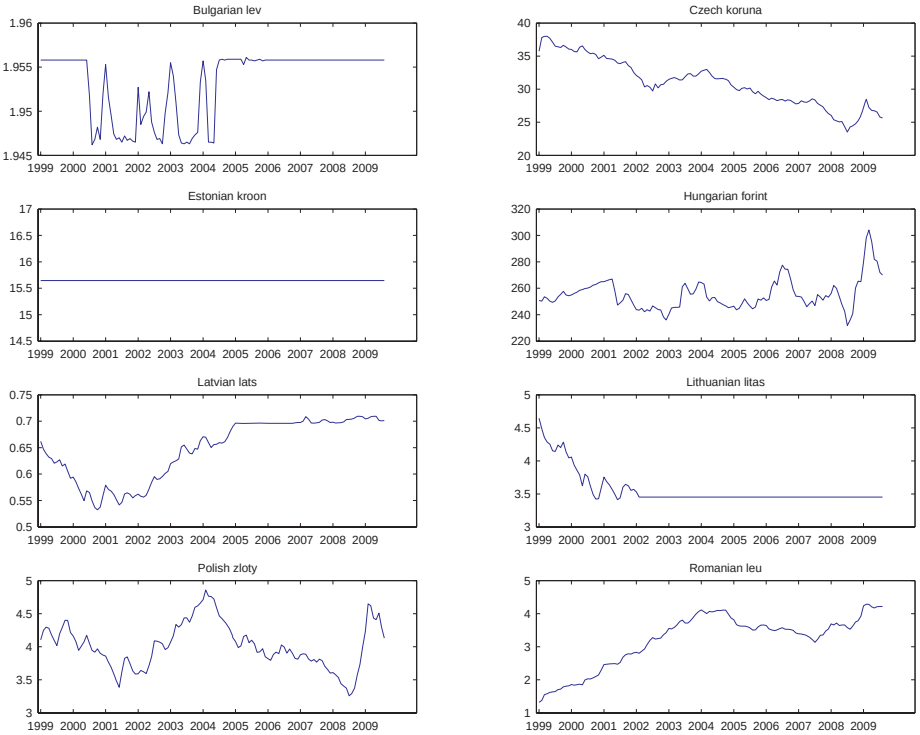

Figure A.1: Bilateral euro-CEE exchange rates. Euro exchange rates in terms of domestic CEE currency. Source: ECB. Monthly averages; the old Romanian lei was replaced by the leu on 1 July 2005

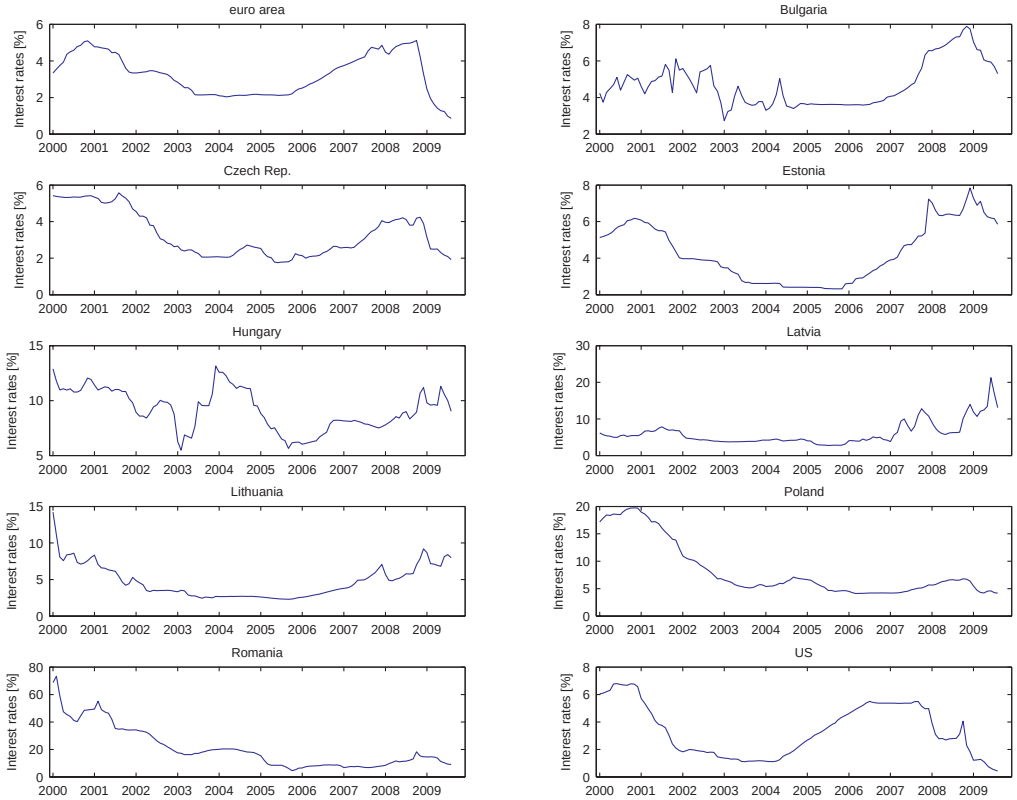

Figure A.2: Levels of individual series

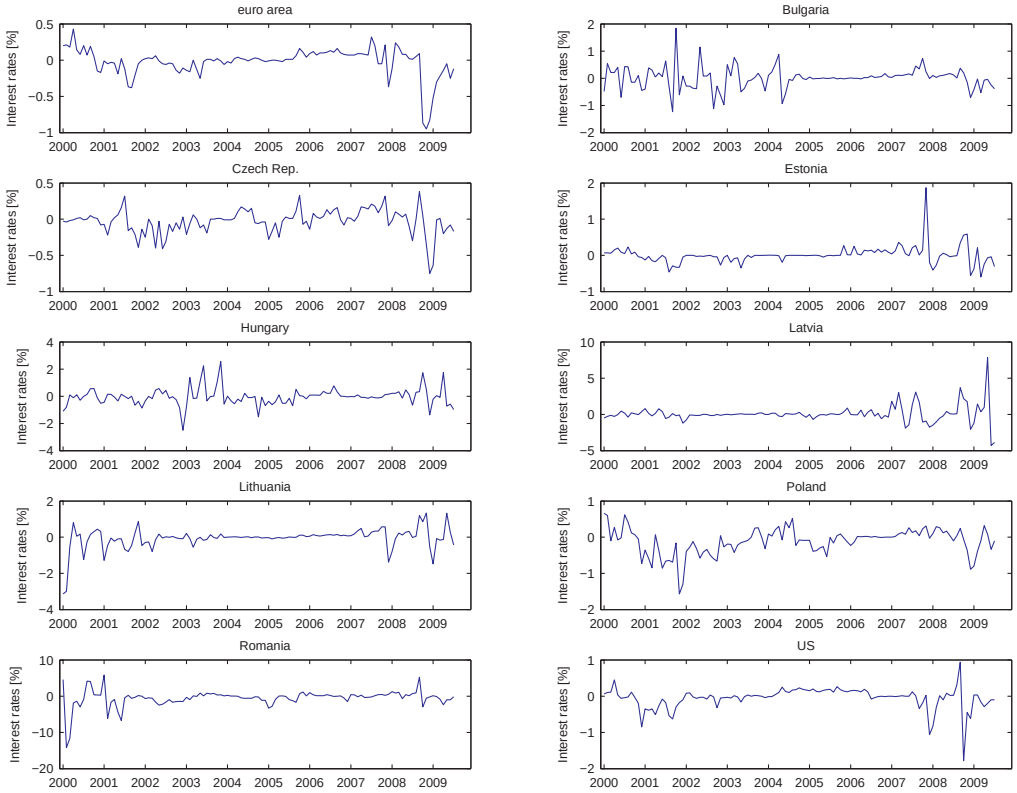

Figure A.3: First differences of individual series

A.2 Tables

	p=0	**p=1**	**p=2**	**p=3**
1st differences				
euro area	-4.38^a	-4.35	-3.52	-3.88
Bulgaria	-11.20	-7.76	-5.84	-6.68^a
Czech Rep.	-5.93^a	-5.50	-4.44	-3.87
Estonia	-8.59^a	-7.10	-4.94	-4.15
Hungary	-8.46^a	-7.35	-5.85	-5.10
Latvia	-8.85	-8.29	-6.87	-6.97^a
Lithuania	-8.12	-10.88^a	-8.09	-6.78
Poland	-5.04^a	-4.18	-3.07	-3.02
Romania	-7.81^a	-7.78	-6.77	-5.11
US	-7.46	-5.16^a	-4.45	-3.58
Levels				
euro area	0.27	-1.78^a	-1.62	-2.05
Bulgaria	-1.81^a	-1.79	-1.69	-1.79
Czech Rep.	-1.35	-1.59^a	-1.53	-1.61
Estonia	-0.64	-0.91^a	-0.83	-1.06
Hungary	-2.41	-2.53^a	-2.24	-2.32
Latvia	-1.52	-2.11	-0.81^a	-0.61
Lithuania	-4.56	-2.29	-1.47^a	-1.46
Poland	-2.08	-2.18	-2.48	-2.27^a
Romania	-3.89	-4.60^a	-2.32	-1.48
US	-0.73	-1.15^a	-1.42	-1.52

Table A.1: ADF test results. ADF test statistics for the levels are computed with an intercept. The 5% critical values are -1.94 for the first differences and -2.89 for the levels. Tests are conducted for different lag lengths p with a maximum order of three, where the a in superscript denotes the order of augmentation chosen in the Dickey-Fuller regressions according to the AIC.

Country	**Levels**	**First differences**
euro area	-2.02	-3.65
Bulgaria	-1.99	-6.84
Czech Rep.	-0.83	-5.80
Estonia	-1.26	-7.22
Hungary	-2.12	-7.14
Latvia	-1.20	-8.45
Lithuania	1.13	-6.07
Poland	-1.12	-3.21
Romania	0.60	-4.22
US	-1.01	-5.42

Table A.2: WS-ADF test results. Choice of lag length based on AIC as in ADF test. The 5% critical value is -2.55.

			trace	**critical values**	
Country	H_0	H_A	**statistic**	**95%**	**90%**
Bulgaria	r=0	r=1	11.14	12.53	10.69
Czech Rep.	r=0	r=1	20.93	12.53	10.69
Estonia	r=0	r=1	14.86	12.75	10.79
Hungary	r=0	r=1	5.19	12.75	10.79
Latvia	r=0	r=1	16.83	12.75	10.79
Lithuania	r=0	r=1	27.20	12.75	10.79
Poland	r=0	r=1	19.56	12.53	10.69
Romania	r=0	r=1	27.07	12.75	10.79
euro area	r=0	r=1	16.93	12.80	10.82

Table A.3: Cointegration rank statistics. Critical values are simulated using 10,000 replications.

Country	**t-statistic**	**p-value**
Bulgaria	0.44	0.66
Czech Rep.	0.66	0.51
Estonia	0.01	0.99
Hungary	–	–
Latvia	0.04	0.96
Lithuania	-0.03	0.97
Poland	0.50	0.62
Romania	1.54	0.13
euro area	-0.81	0.42

Table A.4: Weak exogeneity test results. Hungary not included in the testing procedure due to lack of evidence for cointegration.

Country	PK_{sup}		PK_{msq}		robust Nyblom	
	t-statistic	crit. value	t-statistic	crit. value	t-statistic	crit. value
euro area	0.85	5.29	0.21	3.14	2.37	6.84
Bulgaria	0.56	2.90	0.05	0.25	1.83	0.74
Czech Rep.	1.00	4.57	0.22	1.98	1.82	3.83
Estonia	0.78	5.00	0.11	2.62	1.97	5.54
Latvia	0.69	4.81	0.07	2.31	1.59	0.97
Lithuania	0.64	5.09	0.08	2.77	0.56	5.59
Poland	1.20	4.01	0.27	1.36	1.14	1.46
Romania	0.80	5.04	0.15	2.68	1.22	5.77
US	0.74	2.93	0.09	0.26	1.28	0.73

Table A.5: Structural break test statistics. 95% critical values reported; based on sieve bootstrap with 1,000 replications.

Appendix B

Appendix Chapter 3

B.1 Figures

Figure B.1: FT Trademark

Figure B.2: Logo of the Scottish FT forum

B.2 Alternative preference specifications in North

B.2.1 Introducing a warm-glow term

FT intends to link Northern households with Southern farmers. This link shows up in our model through the demand-driven employment in the FT sector. Alternatively, we could make the relationship between consumption in North and production in South already visible in North's utility function. Suppose North derives additional warm-glow from higher welfare in South. Consider South's indirect utility function, denoted by v^S, for that matter. Using (3.19) and (3.20), indirect utility can be expressed as

$$v^S = \left(\frac{\alpha E^S}{p_X}\right)^{\alpha} \left(\frac{(1-\alpha)E^S}{p_Y}\right)^{1-\alpha},$$

which describes a homothetic function and we can thus also write

$$v^S = \left(\frac{\alpha}{p_X}\right)^{\alpha} \left(\frac{(1-\alpha)}{p_Y}\right)^{1-\alpha} E^S. \tag{B.2-1}$$

The goods market-clearing condition $F = C_F$ together with the production function (3.13) permits rewriting South's budget constraint as

$$E^S = w_X^S L_X^S + w_Y^S L_Y^S + w_F \frac{C_F}{D},$$

which is now a function of C_F. The more altruistic consumers in North are, the higher C_F such that Southern income (and welfare by the same token) rises in θ.

We incorporate v^S as warm-glow term in North's utility function as follows:

$$U^N = (C_F)^\theta (v^S)^\beta (C_X^N)^\sigma (C_Y^N)^{1-\sigma-\theta}, \tag{B.2-2}$$

where $0 \leq \beta \leq 1$ such that this parameter scales the warm-glow FT consumers feel.[1] The representative household maximises (B.2-2) subject to the usual budget constraint

$$p_X C_X^N + p_Y C_Y^N + p_F C_F = E^N.$$

It can easily be shown that the constraint cannot be slack and optimality requires all income to be spent due to strictly increasing utility. It follows from Weierstrass' Theorem that there has to be a global maximum within the compact opportunity set.

We log-linearise (B.2-2) and form the Lagrangian

$$\mathcal{L} = \theta ln(C_F) + \beta ln(v^S) + \sigma ln(C_X^N) + (1-\sigma-\theta) ln(C_Y^N) - \lambda \left(p_X C_X^N + p_Y C_Y^N + p_F C_F - E^N \right).$$

The first order conditions are:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial C_X^N} &= \frac{\sigma}{C_X^N} - \lambda p_X = 0 && \text{(B.2-3)} \\
\frac{\partial \mathcal{L}}{\partial C_Y^N} &= \frac{1-\sigma-\theta}{C_Y^N} - \lambda p_Y = 0 && \text{(B.2-4)} \\
\frac{\partial \mathcal{L}}{\partial C_F} &= \frac{\theta}{C_F} + \frac{\beta}{E^S}\frac{w_F}{D} - \lambda p_F = 0 && \text{(B.2-5)} \\
\frac{\partial \mathcal{L}}{\partial \lambda} &= p_X C_X^N + p_Y C_Y^N + p_F C_F = E^N.
\end{aligned}$$

We know from (B.2-3) that $\lambda = \frac{\sigma}{p_X C_X^N}$ and thus

$$\begin{aligned}
\frac{C_X^N}{C_Y^N} &= \frac{p_Y}{p_X}\frac{\sigma}{1-\sigma-\theta} \\
\frac{\theta}{C_F} + \frac{\beta}{E^S}\frac{w_F}{D} &= \frac{p_F}{p_X}\frac{\sigma}{C_X^N} \\
p_X C_X^N + p_Y C_Y^N + p_F C_F &= E^N,
\end{aligned}$$

[1] We could easily introduce consumer heterogeneity by assuming a distribution for β, say, uniform. However, the model readily implies the effects of low or high values for β and could be calibrated accordingly.

which describes a systems of three equations in three unknowns, the consumption levels. We may use $p_X C_X^N = \frac{\sigma}{1-\sigma-\theta} p_Y C_Y^N$ and further simplify

$$p_Y C_Y^N = \frac{1-\sigma-\theta}{\theta + \frac{\beta w_F C_F}{E^S D}} p_F C_F$$
$$\frac{\sigma}{1-\sigma-\theta} p_Y C_Y^N + p_Y C_Y^N + p_F C_F = E^N.$$

The system can thus only be solved explicitly for the consumption levels, if we abstract from the additional warm-glow ($\beta = 0$) in which case we would arrive at the same demand functions as in (3.7), (3.8) and (3.9). In the presence of warm-glow, we could substitute in for C_F/D as done in Section B.2.2, albeit at the expense of analytical transparency.

B.2.2 Introducing imperfect substitutability between FT and non-FT good

Our chosen preference specification (3.6) is consistent with empirical evidence on product differentiation (see for instance Becchetti and Huybrechts (2008)) but at odds with other theoretical studies (such as Richardson and Stähler (2007)) that consider FT and non-FT good imperfect substitutes. In contrast to the economic analysis of charities, as amongst others pioneered by Andreoni (1990), FT is a consumption-based mechanism in basic agricultural produces that in our view can be captured by Cobb-Douglas preferences. We do allow for corner solutions in this Section that may arise in the presence of imperfect substitutability.

We express North's utility function as follows:[2]

$$U^N = (C_X^N)^\sigma (C_Y^N + C_F)^{1-\sigma} (v^S)^\beta, \quad \sigma > 0. \tag{B.2-6}$$

The Kuhn-Tucker Theorem permits distinguishing among different cases, where we rule out the trivial outcome of no consumption at all, given positive labour income. In particular, (B.2-6) is maximised keeping C_Y^N and/or C_F slack:

$$max \quad U^N = (C_X^N)^\sigma (C_Y^N + C_F)^{1-\sigma} (v^S)^\beta \quad s.t.$$
$$w_X^N L_X^N + w_Y^N L_Y^N = p_X C_X^N + p_Y C_Y^N + p_F C_F = E^N$$
$$C_X^N > 0, \quad C_Y^N, C_F^N \geq 0.$$

[2]We could also write (B.2-6) in terms of a constant elasticity of substitution (CES) aggregator. However, the present specification suffices to illustrate the point.

As before, it is easy to see that South's indirect utility function is a function of C_F and, again, the scaling parameter β lies within the [0,1] interval.

We apply the usual positive monotonic log transformation and set up the Kuhn-Tucker Lagrangian

$$\mathcal{L} = \sigma ln(C_X^N) + (1-\sigma) ln(C_Y^N + C_F) + \beta ln(v^S) - \lambda \left(p_X C_X^N + p_Y C_Y^N + p_F C_F - E^N \right).$$

The first order and complementary slackness conditions are:

$$\frac{\partial \mathcal{L}}{\partial C_X^N} = \frac{\sigma}{C_X^N} - \lambda p_X = 0 \tag{B.2-7}$$

$$\frac{\partial \mathcal{L}}{\partial C_Y^N} = \frac{1-\sigma}{C_Y^N + C_F} - \lambda p_Y \leq 0 \tag{B.2-8}$$

$$\frac{\partial \mathcal{L}}{\partial C_F} = \frac{1-\sigma}{C_Y^N + C_F} + \frac{\beta}{E^S} \frac{w_F}{D} - \lambda p_F \leq 0 \tag{B.2-9}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = p_X C_X^N + p_Y C_Y^N + p_F C_F = E^N \tag{B.2-10}$$

$$C_Y^{N*} \geq 0 \tag{B.2-11}$$

$$C_Y^{N*} \left[\frac{1-\sigma}{C_Y^N + C_F} - \lambda p_Y \right] = 0 \tag{B.2-12}$$

$$C_F^{*} \geq 0 \tag{B.2-13}$$

$$C_F^{*} \left[\frac{1-\sigma}{C_Y^N + C_F} + \frac{\beta}{E^S} \frac{w_F}{D} - \lambda p_F \right] = 0. \tag{B.2-14}$$

Obviously, (B.2-8) rules out that both $C_Y^{N*} = C_F^* = 0$.

Let us first consider the standard two goods Ricardian case ($C_X^{N*}, C_Y^{N*} > 0$ and $C_F^* = 0$). We obviously obtain similar Cobb-Douglas demand functions for X and Y as in South:

$$C_X^{N*} = \frac{\sigma E^N}{p_X} \tag{B.2-15}$$

$$C_Y^{N*} = \frac{(1-\sigma) E^N}{p_Y} \tag{B.2-16}$$

$$C_F^{*} = 0. \tag{B.2-17}$$

Suppose consumers in North exclusively consume the FT good (say fairly produced coffee as opposed to conventional coffee brands). To evaluate $C_Y^{N*} = 0$ and $C_F^* > 0$, we are left with

$$\frac{\sigma}{C_X^N} - \lambda p_X = 0 \tag{B.2-18}$$

$$\frac{1-\sigma}{C_F} + \frac{\beta}{E^S} \frac{w_F}{D} - \lambda p_F = 0 \tag{B.2-19}$$

$$p_X C_X^N + p_F C_F = E^N.$$

Solving (B.2-18) for $\lambda = \frac{\sigma}{p_X C_X^N}$ yields a system of two equations in the two unknown consumption levels

$$\begin{aligned} 1 - \sigma + \frac{\beta w_F}{E^S D} C_F &= \sigma \frac{p_F}{p_X} \frac{C_F}{C_X^N} \\ p_X C_X^N + p_F C_F &= E^N, \end{aligned} \tag{B.2-20}$$

where, using (3.28) and (3.13), (B.2-20) can be rewritten as

$$\frac{C_F}{C_X^N} = \frac{1-\sigma}{\sigma} \frac{p_X}{p_F} + \beta \frac{p_X}{p_F} \frac{w_F L_F}{\sigma E^S}. \tag{B.2-21}$$

The resulting demand functions are

$$C_X^{N*} = \frac{\sigma E^N}{p_X[1 + \beta \frac{w_F L_F}{E^S}]} \tag{B.2-22}$$

$$C_Y^{N*} = 0 \tag{B.2-23}$$

$$C_F^{*} = \frac{(1 - \sigma + \beta \frac{w_F L_F}{E^S}) E^N}{p_F[1 + \beta \frac{w_F L_F}{E^S}]}, \tag{B.2-24}$$

where the usual Cobb-Douglas results prevail in the absence of warm-glow (i.e. $\beta = 0$). For $\beta > 0$, there is an additional term depending on wages and employment in the FT sector as well as overall wealth in South. Demand for X, for example, not only rises in its preference parameter (σ) and overall income (E^N) but also falls, next to its price (p_X), in the parameter β. Moreover, higher wages (in our model driven by μ) and employment in the FT sector lower demand for X. The warm-glow effect is dampened if South's wealth increases. The demand functions deliver intuitive implications and effectively illustrate the ceteris paribus effects of fair wages and employment in the FT sector on warm-glow. One would indeed expect that warm-glow is strongest, if a relatively large portion of farmers in South benefits from higher wages.

We analyse in the following whether similar implications arise in the empirically more relevant three goods case. The case in which all optimal consumption levels are supposed to occur at the interior of the opportunity set gives a system of four equations in four unknowns:

$$\frac{\sigma}{C_X^N} - \lambda p_X = 0 \tag{B.2-25}$$

$$\frac{1-\sigma}{C_Y^N + C_F} - \lambda p_Y = 0 \tag{B.2-26}$$

$$\frac{1-\sigma}{C_Y^N + C_F} + \frac{\beta}{E^S} \frac{w_F}{D} - \lambda p_F = 0 \tag{B.2-27}$$

$$p_X C_X^N + p_Y C_Y^N + p_F C_F = E^N.$$

The optimal consumption levels are derived as follows. First, solve for λ in (B.2-25) as above and eliminate in others. This gives

$$\begin{aligned} \frac{1-\sigma}{C_Y^N + C_F} &= \frac{\sigma}{p_X C_X^N} p_Y && \text{(B.2-28)} \\ \frac{1-\sigma}{C_Y^N + C_F} + \beta \frac{w_F}{E^S D} &= \frac{\sigma}{p_X C_X^N} p_F && \text{(B.2-29)} \\ p_X C_X^N + p_Y C_Y^N + p_F C_F &= E^N. \end{aligned}$$

Ratios of marginal utility (in (B.2-28) and (B.2-29) if rearranged) are identical to relative prices. This is a system of three equations in three unknowns, the consumption levels. Now use $p_X C_X^N = \frac{\sigma}{1-\sigma}(C_Y^N + C_F^N) p_Y$ from (B.2-28) to eliminate C_X^N. We are thus left with two equations in two unknowns

$$\begin{aligned} \frac{1-\sigma}{C_Y^N + C_F} + \beta \frac{w_F}{E^S D} &= \frac{1-\sigma}{C_Y^N + C_F} \frac{p_F}{p_Y} && \text{(B.2-30)} \\ \frac{\sigma}{1-\sigma}(C_Y^N + C_F) p_Y + p_Y C_Y^N + p_F C_F &= E^N, \end{aligned}$$

where we can rewrite (B.2-30)

$$\beta \frac{w_F}{E^S D} = \frac{1-\sigma}{C_Y^N + C_F} \left(\frac{p_F}{p_Y} - 1 \right) \qquad \text{(B.2-31)}$$

such that (B.2-31) shows a crucial aspect of optimal behaviour. If $\beta = 0$, that is if Northern consumers do not feel additional warm-glow from consuming FT products, this equation only holds if $p_F = p_Y$. After all, (B.2-6) assigns the same preference parameter for both types of goods. An implication of this result is that β really measures the degree of substitutability. Without the notion of warm-glow, both goods are perfect substitutes and consumers are hence indifferent between consuming the two. Now, what if $\beta > 0$? We first see that there is no solution either if $p_F < p_Y$. The right hand side of (B.2-31) is negative in this case, yet consumption cannot be negative. Economically speaking, if $p_F < p_Y$, i.e. the fair good yielding higher utility is cheaper, there is no reason to consume the normal Y good. If $p_F = p_Y$, there is no solution either as this implies that only the fair good is consumed. The system seems to suggest the existence of a solution, iff $p_F > p_Y$.

Provided that $p_F > p_Y$ and hence $\beta > 0$, we obtain

$$p_Y C_Y^N = \frac{(1-\sigma) E^S D [p_F - p_Y]}{\beta w_F} - p_Y C_F$$

thus

$$C_F^* = \frac{E^N}{p_F - p_Y} - \frac{E^S D}{\beta w_F},$$

which gives

$$C_Y^{N*} = \frac{E^S D[(1-\sigma)\frac{p_F}{p_Y} + \sigma]}{\beta w_F} - \frac{E^N}{p_F - p_Y},$$

and with $C_X^{N^*} = \frac{\sigma}{1-\sigma}\frac{p_Y}{p_X}(C_Y^{N^*} + C_F^*)$, demand functions in a world in which households wish to consume all three goods are:

$$C_X^{N^*} = \frac{\sigma E^S D[p_F - p_Y]}{p_X \beta w_F} \tag{B.2-32}$$

$$C_Y^{N*} = \frac{E^S D[(1-\sigma)\frac{p_F}{p_Y} + \sigma]}{\beta w_F} - \frac{E^N}{p_F - p_Y} \tag{B.2-33}$$

$$C_F^{N*} = \frac{E^N}{p_F - p_Y} - \frac{E^S D}{\beta w_F}. \tag{B.2-34}$$

Compared to the previous cases, the three goods scenario yields rather untidy demand functions. An important determinant of the decision between consuming FT good as opposed to the non-FT good is the price differential between the two. The absence of income effects (similar to quasilinear specifications) for the demand for X is striking. There still seems to be the idea of warm-glow, depending on fair wages and thus μ, but it is rather hidden.

While we obtain non-trivial demand functions for all three goods, they somewhat lack analytical transparency. This is largely due to the introduction of the warm-glow term. As the analysis suggests, $\beta > 0$ is the only meaningful way to capture the notion of altruism, that is consumers being willing to pay a price premium for an otherwise similar good. We therefore consider the path we take using (3.6) a more elegant way of capturing altruism, whilst at the same time allowing for greater analytical tractability.

B.3 Derivations

B.3.1 Conditions for complete specialisation

The international terms of trade discussed in the main text and derived in more detail below need to satisfy several conditions for the assumption of complete specialisation to sustain. We discuss those in this section.

Following the logic of the original Ricardian analysis, let us first consider both countries in isolation. It is straightforward to see that in autarky (aut.)

relative prices equal domestic relative productivities and hence measure opportunity costs of production:

$$\frac{p_Y}{p_X}|_{aut.} = \frac{A^i}{B^i}, \quad i = N, S.$$

We postulate that North has a comparative cost advantage in producing X:

$$\frac{A^N}{B^N} > \frac{A^S}{B^S}.$$

This implies that Y is in autarky in South relatively cheaper than in North:

$$\frac{p_Y}{p_X}|_{aut.N} > \frac{p_Y}{p_X}|_{aut.S}$$

South will therefore only have an incentive to trade Y internationally, if terms of trade at least match domestic market prices:

$$\frac{p_Y}{p_X} \geq \frac{p_Y}{p_X}|_{aut.S} = \frac{A^S}{B^S}. \tag{B.3-1}$$

Similarly, North will only open up for trade, if

$$\frac{p_Y}{p_X} \leq \frac{p_Y}{p_X}|_{aut.N} = \frac{A^N}{B^N}, \tag{B.3-2}$$

such that international terms of trade have to lie between relative autarky prices:

$$\frac{A^S}{B^S} \leq \frac{p_Y}{p_X} \leq \frac{A^N}{B^N}. \tag{B.3-3}$$

Either country does not specialise completely, if terms of trade coincide with relative prices under autarky as in this case the amount of X that can be produced per unit of Y domestically equals the relative prices offered on global markets. It follows from the notion of comparative advantage that at least one country needs to specialise completely.[3]

Countries will always specialise in line with their comparative cost advantage but several conditions need to be satisfied to rule out the case that one of the countries only specialises partially. Intuitively, if one economy is relatively large compared to the other, it might need to produce both goods just like in autarky to ensure all domestic demand is met. If the (large) economy remains incompletely specialised, intersectoral labour mobility implies that a single nominal wage rate must prevail in both active

[3]If (B.3-3) held with strict equality ($p_Y/p_X = A^S/B^S = A^N/B^N$), there would not be any comparative cost differences and hence no scope for international trade to arise.

sectors. Terms of trade then follow in a straightforward fashion. Suppose that North is incompletely specialised. Profit maximisation in North and South yields:

$$\begin{aligned} w^N &= p_X A^N = p_Y B^N \\ w^S &= p_Y B^S \end{aligned}$$

and as a result international terms equal relative prices under autarky in North. The same line of reasoning applies to the case of partial specialisation in South.

We have therefore established that countries will only specialise completely, if international terms of trade lie *strictly* between domestic relative productivities such that the equality case in (B.3-3) needs to be ruled out.

We can solve our FT model (see below) to obtain relative country wages:

$$\frac{w^S}{w^N} = \left(\frac{1-\sigma}{\alpha} - \frac{\theta\mu}{1+\mu}\right)\frac{L^N}{L^S} \tag{B.3-4}$$

$$\frac{w_F}{w^N} = \left(\frac{(1-\sigma)(1+\mu)}{\alpha} - \theta\mu\right)\frac{L^N}{L^S}. \tag{B.3-5}$$

In the benchmark Ricardian outcome ($\mu = 0$), two components determine the specialisation pattern: the countries' relative size ($\frac{L^N}{L^S}$) and relative preferences ($\frac{1-\sigma}{\alpha}$). The model augmented by FT delivers two additional factors: the interaction between altruistic spending and wage mark-up ($\theta\mu$) and the mark-up itself ($1+\mu$) pin down relative wages.

Thus, the following results emerge under FT. First, and not too restrictive, it has to hold that $\frac{\theta\mu}{1+\mu} < \frac{1-\sigma}{\alpha}$ to ensure positive terms of trade. The economic intuition is that the combination of (relative) mark-up and altruistic spending should not dominate the conventional determinants of specialisation under free trade. Second, (B.3-4) and (B.3-5) suggest a natural measure in terms of relative preferences, mark-up, altruistic spending and relative size according to which the specialisation pattern in North and South evolves.

Figure B.1 illustrates the different cases by means of the number line. Note that $\frac{B^S}{B^N}$ has to be to the right of $\frac{A^S}{A^N}$ because of the assumed direction of comparative advantage. The focus is on preferences since $L^N = L^S$. As discussed above, the measure has to lie between $\frac{A^S}{A^N}$ and $\frac{B^S}{B^N}$ for complete specialisation to arise – indicated by the shaded area.

If both countries are completely specialised in line with their comparative cost advantage, it follows for South that $L^S = L_Y + L_F$. The wage differential created by $(1+\mu)$ does affect specialisation, however.

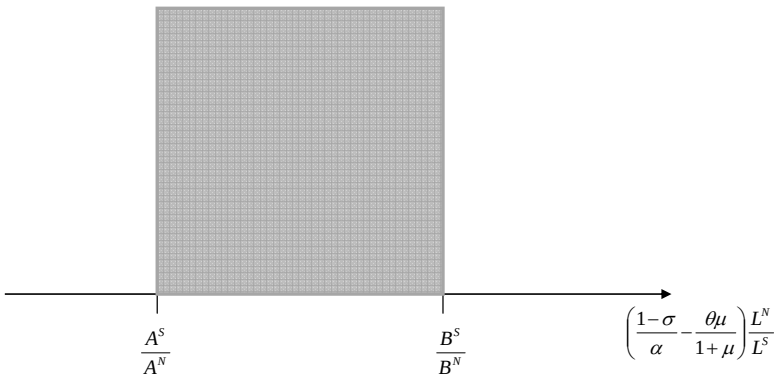

Figure B.1: Area of complete specialisation

Figure B.2 illustrates the effects of the presence of the additional FT sector. We see from (B.3-5) that as long as $D = B^S$, the measure (now adjusted by the mark-up) shrinks the shaded area (indicated by the dotted line). FT therefore reduces the scope for complete specialisation and is hence only to some extent compatible with a Ricardian world of comparative advantage. This effect is relaxed (and potentially offset), however, if FT does raise workers' productivity ($D > B^S$) as indicated by the additional lightly shaded area created in Figure B.2.

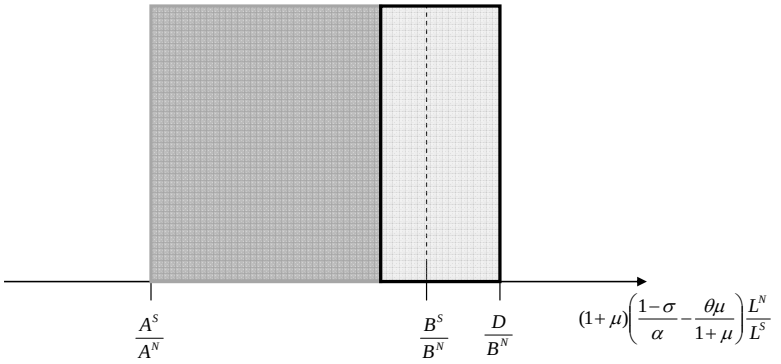

Figure B.2: Effect of wage premium on specialisation pattern

B.3.2 Allocation of labour across sectors in South in general equilibrium

Using the demand functions and technologies in North and South we can write the equilibrium conditions for the goods markets as follows

$$A^N L^N = \frac{\sigma w^N L^N + \alpha w^S (L^S + \mu L_F)}{p_X} \tag{B.3-6}$$

$$B^S L_Y = \frac{(1-\sigma-\theta) w^N L^N + (1-\alpha) w^S (L^S + \mu L_F)}{p_Y} \tag{B.3-7}$$

$$D L_F = \frac{\theta w^N L^N}{p_F}. \tag{B.3-8}$$

World prices follow from the firms' first-order conditions:

$$p_X = \frac{w^N}{A^N} \tag{B.3-9}$$

$$p_Y = \frac{w^S}{B^S} \tag{B.3-10}$$

$$p_F = \frac{w_F}{D} = \frac{(1+\mu) w^S}{D}. \tag{B.3-11}$$

Expressions (B.3-9), (B.3-10) and (B.3-11) allow us to write (B.3-6), (B.3-7) and (B.3-8) in terms of relative costs as follows

$$\frac{w^S}{w^N} = \frac{(1-\sigma) L^N}{\alpha (L^S + \mu L_F)} \tag{B.3-12}$$

$$\frac{w^S}{w^N} = \frac{(1-\sigma-\theta) L^N}{\alpha L_Y - (1-\alpha)(1+\mu) L_F} \tag{B.3-13}$$

$$\frac{w^S}{w^N} = \frac{\theta L^N}{(1+\mu) L_F}, \tag{B.3-14}$$

where obviously $(1-\sigma)$ measures all (remaining) income spent on both FT and non-FT good.

Using (B.3-14) together with South's full employment condition in (B.3-12) and (B.3-13), we obtain a system of two equations in two unknowns, the endogenous employment levels in Y and F

$$\begin{aligned} \frac{\theta L^N}{(1+\mu) L_F} &= \frac{(1-\sigma) L^N}{\alpha (L_Y + (1+\mu) L_F)} \\ \frac{\theta L^N}{(1+\mu) L_F} &= \frac{(1-\sigma-\theta) L^N}{\alpha L_Y - (1-\alpha)(1+\mu) L_F}, \end{aligned}$$

which can be solved for the relative employment levels as follows

$$\frac{L_Y}{L_F} = \frac{(1-\sigma)(1+\mu)}{\alpha\theta} - (1+\mu) \tag{B.3-15}$$

$$\frac{L_Y}{L_F} = \frac{(1-\sigma)(1+\mu)}{\alpha\theta} - (1+\mu). \tag{B.3-16}$$

(B.3-15) and (B.3-16) suggest that there is indeed a unique solution.

Solving for L_Y

$$L_Y = \left(\frac{(1-\sigma)(1+\mu)}{\alpha\theta} - (1+\mu)\right) L_F$$

and using the fact that $L^S = L_Y + L_F$ gives

$$L_Y = \left(\frac{(1-\sigma)(1+\mu)}{\alpha\theta} - (1+\mu)\right) (L^S - L_Y)$$

we are thus left with

$$L_Y = \left(1 - \frac{\alpha\theta}{(1-\sigma)(1+\mu) - \alpha\theta\mu}\right) L^S$$

and hence

$$L_F = \frac{\alpha\theta}{(1-\sigma)(1+\mu) - \alpha\theta\mu} L^S.$$

Equations (3.24) and (3.25) ■

B.3.3 International terms of trade

The allocation of labour in N and S determines production, consumption and ultimately international terms of trade. As shown in B.3.2, (B.3-12), (B.3-13) and (B.3-14) are identical. Using (B.3-14) and (3.25) as derived, we can thus uniquely determine relative wages:

$$\frac{w^S}{w^N} = \frac{(1-\sigma)(1+\mu) - \alpha\theta\mu}{(1+\mu)\alpha} \frac{L^N}{L^S}. \tag{B.3-17}$$

Relative prices in terms of the numeraire good follow from the firms' first-order conditions (B.3-9), (B.3-10) and (B.3-11):

$$\frac{p_Y}{p_X} = \frac{(1-\sigma)(1+\mu) - \alpha\theta\mu}{(1+\mu)\alpha} \frac{L^N}{L^S} \frac{A^N}{B^S}$$

$$\frac{p_F}{p_X} = \frac{(1-\sigma)(1+\mu) - \alpha\theta\mu}{\alpha} \frac{L^N}{L^S} \frac{A^N}{D}$$

Equations (3.30) and (3.31) ■

B.3.4 Social welfare function

The welfare analysis is based on the concept of utilitarian welfare which weights individual utility equally. The Benthamite social welfare function is maximised, if overall welfare (U^w) comprising both North and South is largest. Substituting the Marshallian demand in the domestic utility functions, we obtain indirect utility as a function of prices and income

$$U^w = \left(\frac{\theta E^N}{p_F}\right)^{\theta}\left(\frac{\sigma E^N}{p_X}\right)^{\sigma}\left(\frac{(1-\sigma-\theta)E^N}{p_Y}\right)^{1-\sigma-\theta}+\left(\frac{\alpha E^S}{p_X}\right)^{\alpha}\left(\frac{(1-\alpha)E^S}{p_Y}\right)^{1-\alpha}.$$

We can use the firm's first order conditions as above and also the fact that $E^N = w^N L^N = p_X A^N L^N$ and $E^S = w^S(L^S + \mu L_F) = p_Y B^S(L^S + \mu L_F)$ to obtain

$$U^w = \left(\frac{\theta\alpha D L^S}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right)^{\theta}\left(\sigma A^N L^N\right)^{\sigma}\left(\frac{(1-\sigma-\theta)\alpha(1+\mu)B^S L^S}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right)^{1-\sigma-\theta}+$$
$$\left((1-\sigma)A^N L^N\right)^{\alpha}\left((1-\alpha)B^S L^S\left[1+\frac{\alpha\theta\mu}{(1-\sigma)(1+\mu)-\alpha\theta\mu}\right]\right)^{1-\alpha},$$

where we have chosen X as numeraire. Equation (3.33) ■

Appendix C

Appendix Chapter 4

C.1 Steady state

The model is solved based on its deterministic long-run equilibrium. As in the main text, the steady-state values are denoted by an asterisk as superscript. The model is described by (4.26) to (4.39) and the monetary policy rule.

The stationary steady state is described by the following set of thirteen non-linear equations in the endogenous real variables $\{C^{S^*}, C^{U^*}, N^{S^*}, N^{U^*},$

$\left(\frac{W^S}{P}\right)^*, \left(\frac{W^U}{P}\right)^*, b^{S^*}, b^{U^*}, \tau^*, Y^*, \left(\frac{\Pi}{P}\right)^*, mc^*, r^*\}$:

$$\Psi^S (N^{S^*})^{\varphi^S} = (C^{S^*})^{-\sigma} \left(\frac{W^S}{P}\right)^* \tag{C.1-1}$$

$$\Psi^U (N^{U^*})^{\varphi^U} = (C^{U^*})^{-\sigma} \left(\frac{W^U}{P}\right)^* \tag{C.1-2}$$

$$\frac{W^{S^*}}{W^{U*}} = \frac{\delta^{S^*}}{\delta^{U*}} \left(\frac{sN^{S^*}}{(1-s)N^{U^*}}\right)^{-\frac{1}{\rho}} \tag{C.1-3}$$

$$1 + \Omega^S b^{S^*} = r^* \beta^S \tag{C.1-4}$$

$$1 + \Omega^U b^{U^*} = r^* \beta^U \tag{C.1-5}$$

$$C^{S^*} + b^{S^*} + \frac{1}{2}\Omega^S (b^{S^*})^2 + \tau^* = \frac{\Pi^{S^*}}{P^*} + r^* b^{S^*} + \frac{W^{S^*}}{P^*} N^{S^*} \tag{C.1-6}$$

$$C^{U^*} + b^{U^*} + \frac{1}{2}\Omega^U (b^{U^*})^2 + \tau^* = r^* b^{U^*} + \frac{W^{U^*}}{P^*} N^{U^*} \tag{C.1-7}$$

$$sb^{S^*} + (1-s)b^{U^*} = \bar{b}^* \tag{C.1-8}$$

$$\tau_t^* = \bar{b}^* \left(\frac{R^*}{\pi^*} - 1\right) \tag{C.1-9}$$

$$Y^* = \left[\delta^{S^*} (sN^{S^*})^{\frac{\rho-1}{\rho}} + \delta^{U^*} \left((1-s)N^{U^*}\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \tag{C.1-10}$$

$$s\frac{\Pi^*}{P^*} = Y^* \left[1 - \frac{MC^*}{P^*}\right] \tag{C.1-11}$$

$$\frac{MC^*}{P^*} = \frac{\theta - 1}{\theta} \tag{C.1-12}$$

$$mc^* = \left[(\delta^{S^*})^\rho \left(\frac{W^{S^*}}{P^*}\right)^{1-\rho} + (\delta^{U^*})^\rho \left(\frac{W^{U^*}}{P^*}\right)^{1-\rho}\right]^{\frac{1}{1-\rho}} \tag{C.1-13}$$

The monetary authority sets interest rates in line with its inflation target, where the following equilibrium relationship holds: $r^* = R^*/\pi^*$. Given values for the structural parameters, the system can be solved for its steady state, where we have checked for determinacy of the solution.

C.2 The economy with homogeneous labour

C.2.1 Model

We analyse in this Appendix the benchmark scenario of homogeneous labour to obtain a better both quantitative and qualitative feeling of the model. Dropping the i superscript implies that we no longer distinguish between

skilled and unskilled households and our model can thus be fully described in absolute terms. We want to investigate how the MPR operates in an otherwise standard NK model under the chosen calibration. In particular, we resort to values selected for the skilled households as those are more in line with the benchmark NK model. We thus reinstate financial market completeness in the presence of homogeneous consumers. Our model can now be represented as follows.

The household's first order conditions are as in the benchmark NK framework:

$$\Psi(N_t)^{\varphi} = (C_t)^{-\sigma}\frac{W_t}{P_t} \tag{C.2-1}$$

$$\frac{1}{R_t} = \beta E_t\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\frac{1}{\pi_{t+1}}\right\}. \tag{C.2-2}$$

As a result of homogeneous input factors, the time-varying weight δ_t remains normalised at 1 for all t and (4.14) simplifies to a linear production function in labour:

$$Y_t(j) = A_t N_t(j), \tag{C.2-3}$$

which implies the usual form of real marginal costs:

$$mc_t = \frac{W_t/P_t}{A_t}. \tag{C.2-4}$$

These four equations together with the goods market clearing condition and (4.36), (4.39) as well as the policy rule represent a system of eight equations in $\{C_t, N_t, \frac{W_t}{P_t}, Y_t, \frac{\Pi_t}{P_t}, mc_t, r_t, \pi_t\}$ that describe the economy's unique equilibrium.

C.2.2 Steady state

The model's deterministic steady state is characterised by the following set of equations:

$$Y^* = A^*N^* = C^* \tag{C.2-5}$$

$$\Psi\left(N^*\right)^{\varphi} = \left(C^*\right)^{-\sigma} w^* \tag{C.2-6}$$

$$r^* = \frac{1}{\beta} \tag{C.2-7}$$

$$mc^* = \frac{w_t^*}{A_t^*} = \frac{\theta-1}{\theta} \tag{C.2-8}$$

$$\frac{\Pi^*}{P^*} = Y^*\left[1 - mc^*\right], \tag{C.2-9}$$

where w denotes the real wage.

C.2.3 Log-linear representation

We present in this Section a log-linearised version of the model's equilibrium conditions with homogeneous labour. Let $\hat{x}$ denote the relative deviation of x_t from its stationary state level x^*.[1] The relevant expressions log-linearise as:

$$\hat{Y}_t = \hat{A}_t + \hat{N}_t \tag{C.2-10}$$

$$\hat{Y}_t = \hat{C}_t \tag{C.2-11}$$

$$\widehat{mc}_t = \hat{w}_t - \hat{A}_t \tag{C.2-12}$$

$$\varphi \hat{N}_t = -\sigma \hat{C}_t + \hat{w}_t \tag{C.2-13}$$

$$\hat{C}_t = E_t \hat{C}_{t+1} - \frac{1}{\sigma}\left(\hat{R}_t - E\hat{\pi}_{t+1}\right) \tag{C.2-14}$$

$$\phi\hat{\pi}_t - \phi\beta E_t\hat{\pi}_{t+1} = \theta\frac{w^*}{A^*}\widehat{mc}_t + \phi\beta E_t(\sigma\hat{C}_t - \sigma\hat{C}_{t+1} + \tag{C.2-15}$$

$$\hat{Y}_{t+1} - \hat{Y}_t) \tag{C.2-16}$$

$$\hat{A}_t = \rho_A \hat{A}_{t-1} + \epsilon_t^A \tag{C.2-17}$$

Note that the Rotemberg-type NKPC (C.2-16) corresponds to the linearised form of the NKPC under Calvo (1983) pricing upon suitable reparametrisations.[2] The NKPC together with the consumption Euler equation (C.2-14) – commonly referred to as dynamic IS curve – and some exogenously specified variant of the monetary policy rule form the backbone of the workhorse NK model and can be used to conduct various policy exercises.

C.2.4 Simulation outcomes

We can simulate in a next step the model's response to an aggregate technology shock as introduced in the main text – see Appendix C.3.2 for the graphical output. We again differentiate between the different monetary policy stances described by variants of (4.25), in particular a simple linear MPR as well as a MPR that also responds to deviations from the steady state output.

Figure C.2 shows the impulses under *Rules I and II*. There is the usual increase of output and consumption to a favourable (+1%) technology shock. The increase in aggregate productivity raises the workers' wages and the firms' profitability. The improvement in technology is accommodated by

[1] Thus, $\hat{x} = \frac{dx_t}{x^*} \approx ln(x_t) - ln(x^*)$. Also see Uhlig (1995) for a "toolkit" approach.

[2] However, with the crucial difference that with quadratic price adjustment costs we do not need require the gross steady state inflation rate being equal to one.

the central bank which lowers interest rates and thus boosts consumption. Given the forward-looking nature of the model, there is a decline in inflation with the effects being stronger under *Rule I*. Moreover, hours worked decline consistent with empirical evidence for the U.S.

C.3 Figures

C.3.1 The model with heterogeneous labour

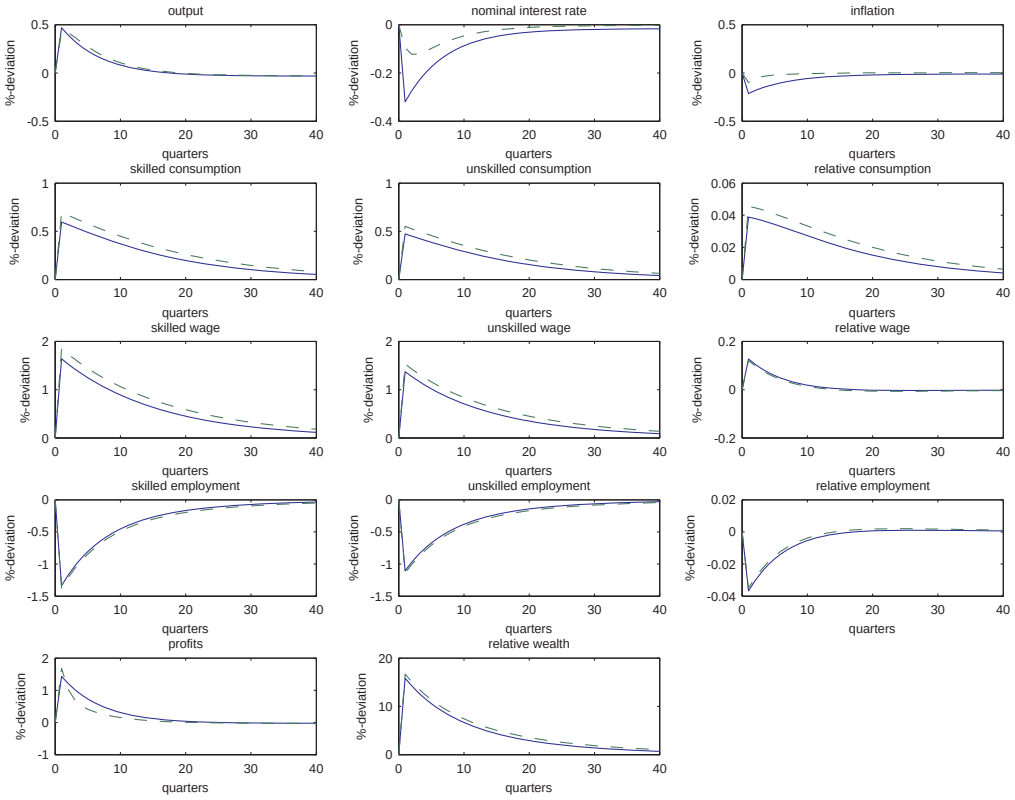

Figure C.1: Simple MPR, dashed line refers to Rule II

C.3.2 The model with homogeneous labour

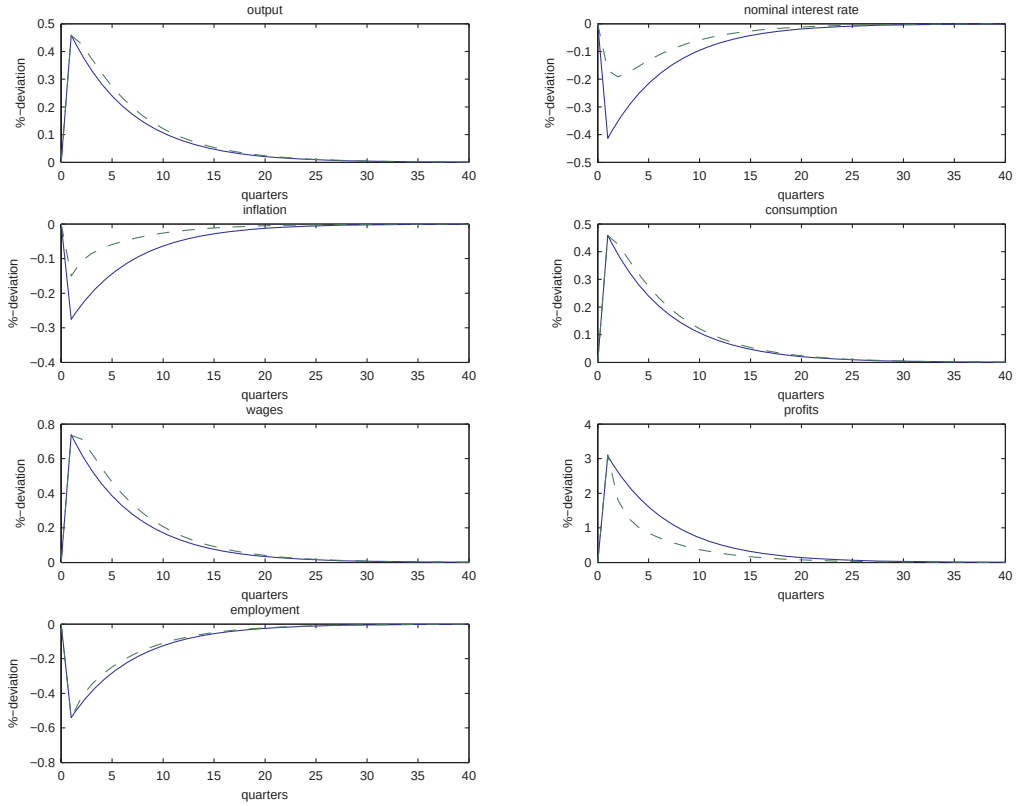

Figure C.2: Simple MPR, dashed line refers to Rule II

C.3.3 Ramsey plans

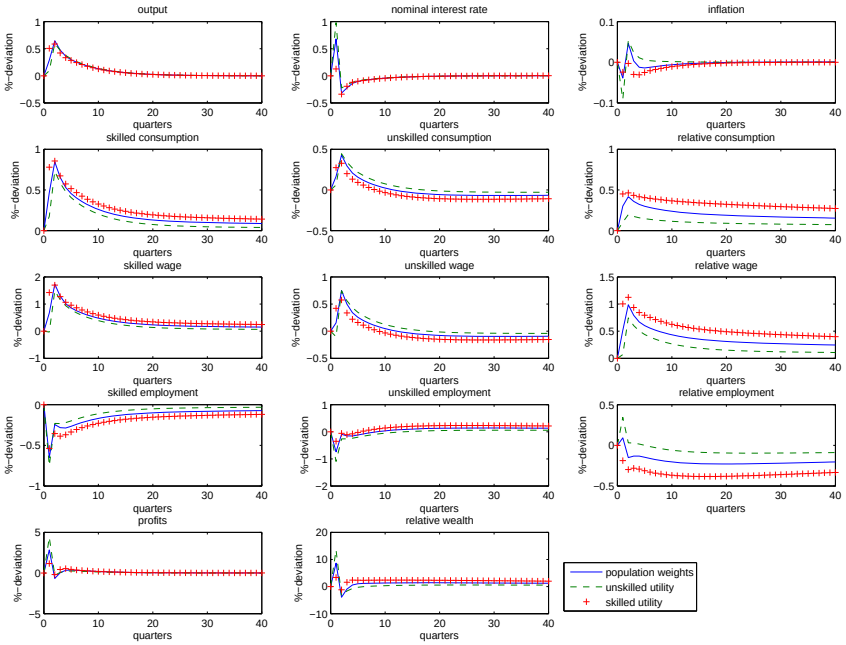

Figure C.3: Ramsey plan for different utility weighting patterns

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