DEUTSCHE
BUNDESBANK
EUROSYSTEM

International financial markets' influence on the welfare performance of alternative exchange rate regimes

Mathias Hoffmann

Discussion Paper
Series 1: Economic Studies
No 27/2008

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0
Telex within Germany 41227, telex from abroad 414431

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978-3–86558–471–7 (Printversion)
ISBN 978-3–86558–472–4 (Internetversion)

Abstract:

In this paper Friedman (1953) and Mundell's (1968) position favouring flexible over alternative exchange rate regimes is reassessed in the context of international financial market integration. In a new open economy macroeconomic framework the paper shows that financial market integration causes a monetary policy trade-off between stabilising domestic goods prices as opposed to stabilising the terms of trade. Therefore, the welfare ranking of different exchange rate rules changes during the process of international financial integration. It becomes evident that no single exchange rate regime outperforms in stabilising both domestic consumption and output variability in the process of financial market integration.

Keywords:

International Financial Market Integration, Exchange Rate Rules, Optimal Monetary Policy, Welfare

JEL-Classification:

F21, F36, F41

Non-technical summary

This paper examines whether international financial market integration alters the welfare ranking of alternative exchange rate regimes in a small open economy. Particularly a number of emerging economies are debating which exchange rate regime is the most appropriate one for their economies and whether the benefits of certain regimes have changed over time. The traditional argument in favour of flexible exchange rates follows Friedman's (1953) formalisation that flexible exchange rates act as a shock absorber in a small open economy in internationally segmented financial markets. In case of a real external shock and sticky goods prices it is easier to adjust the nominal exchange rate than to wait until imbalances in the goods and labour market push the relative prices into the desired direction. Consequently, a floating exchange rate insulates the economy against external shocks. Mundell (1968) confirmed this argument in a world of high international capital mobility by showing that a floating exchange rate is preferable when the small open economy is hit by real disturbances.

In this study Friedman and Mundell's hypothesis that flexible exchange rates are superior to alternative exchange rate regimes during the process of international financial integration is investigated. More precisely, it is assessed whether a change in the monetary authority's exchange rate target (e.g. a switch from a float to a dirty float or an exchange rate peg) becomes desirable in terms of welfare and macroeconomic stability in the process of financial market integration.

The results of the paper show that financial market integration does alter the welfare ranking of alternative exchange rate rules in a small open economy. This follows from the fact that financial market integration creates a monetary policy trade-off between the stability of domestic goods prices as opposed to the stability of the terms of trade. In segmented financial markets, it is desirable from a welfare perspective to stabilise domestic goods prices and to let the nominal exchange rate, and, hence, the terms of trade vary freely. However, when financial markets are integrated, a welfare oriented monetary policy should allow domestic goods prices to vary. This mitigates the exchange rate volatility and, hence, terms of trade volatility.

This policy trade-off in the process of financial market integration is the result of a risk premium, which is demanded by sticky price goods producers. These producers would prefer to adjust their prices whenever the economy is hit by an economic disturbance. However, they are not allowed to do so and therefore require a risk premium as compensation. The higher the risk premium, the higher the price of overall consumption and the smaller the welfare.

In segmented international financial markets, this risk premium positively depends on the volatility of flexible goods prices only. A float which prevents inflation of domestic goods prices eliminates the risk premium and is therefore desirable. Thus, domestic goods prices need to be

stabilised and the nominal exchange rate and, hence, the terms of trade should vary freely to maximise welfare.

When asset markets are internationally integrated, sticky-price goods producers can hedge against their inability to adjust prices, which reduces the risk premium. In order to use financial market hedges, both domestic goods prices and the terms of trade have to be variable. A welfare oriented monetary policy would therefore lead to variable domestic goods prices. A floating exchange rate regime which allows for domestic price stability prevents sticky-price goods producers from utilising financial market hedges since domestic goods prices are not variable. This creates welfare costs for the economy. An intermediate or fixed exchange rate regime allow for some volatility of domestic goods prices and the terms of trade and therefore make it easier for fixed price goods producers to draw on the financial market hedge. The two exchange rate regimes perform better than a float in terms of welfare when the economy is open to trade and expenditure switching from relatively more expensive to relatively cheaper goods is possible. Thus, a change in the monetary authority's nominal target, a switch from a floating exchange rate towards nominal exchange rate stabilisation can become desirable in terms of welfare in the process of financial market integration.

Nicht-technische Zusammenfassung

Das vorliegende Papier untersucht, ob die Wohlfahrtsrangfolge verschiedener Wechselkursregime in einer kleinen offenen Volkswirtschaft durch die internationale Verflechtung der Finanzmärkte verändert wird. Insbesondere in einer Reihe von Schwellenländern wird die Diskussion geführt, welches Wechselkursregime für sie das beste ist und ob sich die Vorteile verschiedener Wechselkursregime über die Zeit verändert haben. Das traditionelle Argument zugunsten frei beweglicher Wechselkurse folgt der Formalisierung Friedmans (1953), wonach flexible Wechselkurse in einer kleinen offenen Ökonomie unter international segmentierten Finanzmärkten als Schockabsorbierer fungieren. Bei einem realen externen Schock und trägen Güterpreisen ist es leichter, den nominalen Wechselkurs anzupassen als zu warten, bis die Ungleichgewichte am Güter- und Arbeitsmarkt die relativen Preise in die gewünschte Richtung lenken. Folglich schirmt ein frei schwankender Wechselkurs die Wirtschaft gegen externe Schocks ab. Mundell (1968) bestätigte die Gültigkeit dieses Arguments in einer Welt hoher internationaler Kapitalmobilität und zeigte auf, dass ein frei schwankender Wechselkurs vorzuziehen ist, wenn die kleine offene Volkswirtschaft von realen Störungen getroffen wird.

In dieser Studie wird der Hypothese von Friedman und Mundell nachgegangen, die besagt, dass flexible Wechselkurse alternativen Wechselkurssystemen während des Prozesses der Globalisierung der Finanzmärkte überlegen sind. Genauer gesagt wird hier untersucht, ob im Prozess der internationalen Finanzmarktintegration eine Änderung des Wechselkurspolitik der Währungsbehörde (wie beispielsweise ein Wechsel von einem flexiblen Wechselkurs hin zu eine einer Wechselkursanbindung) unter Wohlfahrts- und gesamtwirtschaftlichen Stabilitätsaspekten als erstrebenswert anzusehen ist.

Die Ergebnisse dieser Forschungsarbeit zeigen, dass in einer kleinen offenen Volkswirtschaft die Finanzmarktintegration den Wohlfahrtsvergleich alternativer Wechselkursregelungen durchaus verändert. Auf segmentierten Finanzmärkten ist es unter Wohlfahrtsaspekten erstrebenswert, die inländischen Güterpreise zu stabilisieren und den nominalen Wechselkurs – und damit die Terms of Trade – frei schwanken zu lassen. Wenn Finanzmärkte aber integriert sind, sollte eine wohlfahrtsorientierte Geldpolitik einen gewissen Grad an Variabilität der Güterpreise ermöglichen. Dies mildert die Wechselkursvolatilität und damit die Volatilität der Terms of Trade ab. Damit existiert ein geldpolitischer Zielkonflikt zwischen Güterpreis- und Wechselkursstabilität im Zuge der internationalen Finanzmarktintegration.

Dieser geldpolitische Zielkonflikt im Prozess der internationalen Finanzmarktintegration hat seine Ursache in einer Risikoprämie, die die Produzenten von Gütern mit trägen Preisen verlangen, weil sie ihre Preise nicht immer dem Wert anpassen können, der bei flexiblen Preisen gelten würde, wenn eine Marktstörung auftritt. Je höher die Risikoprämie, umso höher ist der Preis des gesamtwirtschaftlichen Konsums und umso geringer der Wohlstand.

In segmentierten internationalen Finanzmärkten hängt diese Risikoprämie ausschließlich von der Volatilität der flexiblen Güterpreise ab. Ein Floaten, das die Inflation inländischer Güterpreise verhindert, beseitigt die Risikoprämie, so dass die trägen und flexiblen Preise übereinstimmen. Zur Maximierung der Wohlfahrt sollten daher die inländischen Güterpreise stabilisiert werden und der nominale Wechselkurs, und folglich auch die Terms of Trade, frei schwanken.

Sind die Märkte für Vermögenswerte international integriert, so können sich die Hersteller von Gütern mit trägen Preisen gegen ihre Unfähigkeit, die Preise anzupassen, absichern, so dass sich die Risikoprämie reduziert. Somit folgt, dass aus Wohlfahrtsgesichtspunkten entwickelte internationale Finanzmärkte wohlfahrtssteigernd sind. Die Nutzung der Absicherungsgeschäfte am internationalen Finanzmarkt setzt voraus, dass die inländischen Güterpreise wie auch die Terms of Trade variabel sind. Im Optimum lässt eine wohlfahrtsmaximierende Geldpolitik daher eine gewisse Schwankung der inländischen Güterpreise und der Terms of Trade zu, um den Produzenten von Gütern mit trägen Preisen die Risikoabsicherung auf dem internationalen Finanzmarkt zu ermöglichen. Ein intermediäres Wechselkursregime oder ein Festkurssystem lassen eine gewisse Volatilität der inländischen Güterpreise und der Terms of Trade zu. Beide Wechselkurssysteme schneiden daher unter Wohlfahrtsaspekten besser ab als ein flexibles Wechselkursregime, wenn die Volkswirtschaft für den Handel offen ist und eine Verschiebung der Ausgaben von relativ teureren Produkten hin zu vergleichsweise billigeren Produkten möglich ist. Somit kann eine Umstellung von einem flexiblen Wechselkursregime hin zu einer Politik der nominalen Wechselkursstabilisierung, im Prozess der Finanzmarktintegration unter Wohlfahrtsgesichtspunkten wünschenswert werden.

Contents

List of Tables

List of Figures

International Financial Markets' Influence on the Welfare Performance of Alternative Exchange Rate Regimes[1]

1 Introduction

Over the last two decades, the globalisation of financial markets has become an important feature of the world economy. The scale of transactions in international capital markets has grown faster than world GDP since the early 1970s. One major reason for this development is that countries have progressively dismantled barriers to cross-border capital flows. In parallel, financial diversification has deepened through the high number of financial instruments with different risk and liquidity characteristics, which expands the scope of potential risk sharing (see Lane and Milesi-Ferretti (2008)). The sophistication of international financial markets does not take place in an otherwise frictionless world. In contrast to the integration of international financial markets, international trade in goods and services remains relatively less integrated, due to a home-product bias in spending and imperfect competition, which makes financial market structures an important aspect of exchange rate policy. In the context of integrated international asset markets and segmented commodity markets, this paper examines whether international financial market integration alters the welfare ranking of alternative exchange rate regimes in a small open economy within the new open economy macroeconomics framework.[2]

The traditional argument in favour of flexible exchange rates follows Friedman's (1953) formalisation that flexible exchange rates act as a shock absorber in a small open economy in internationally segmented financial markets. In case of a real external shock and sticky goods prices it is easier to adjust the nominal exchange rate than to wait until imbalances in the goods and labour market push the relative prices into the desired direction. Consequently, a floating exchange rate insulates the economy against external shocks. Mundell (1968) confirmed this argument in a world of high international capital mobility by showing that a floating exchange rate is preferable when the small open economy is hit by real disturbances.[3]

In this study Friedman and Mundell's hypothesis that flexible exchange rates are superior to alternative exchange rate regimes during the process of international financial integration is investigated. More precisely, it is assessed whether a change in the exchange rate policy (e.g.

[1] Authors' affiliation: Mathias Hoffmann: Deutsche Bundesbank, Economic Research, 60431 Frankfurt/Main, Germany. The views expressed in this paper are those of the author but not necessarily those of the Bundesbank. E-mail: mathias.hoffmann@bundesbank.de

[2] For an overview of the new open economy literature see Lane (2001).

[3] Other authors question the advantage of floating exchange rates in the process of financial market integration, see Calvo and Reinhart (2002) and Obstfeld (2004) among others.

a switch from a float to a dirty float or an exchange rate peg) becomes desirable in terms of welfare and macroeconomic stability in the process of financial market integration. International asset market integration corresponds to a movement from segmented towards complete financial markets. In segmented financial markets, internationally traded assets do not exist. When financial markets are integrated, sufficient financial market instruments are available to facilitate consumption risk sharing.

The paper focuses on three exchange rate regimes in the process of financial market integration, namely a fixed, an intermediate and a flexible exchange rate rule. The last two rules are a monetary policy of CPI inflation targeting and a policy of targeting a subset of CPI, which consists of home produced goods prices. The rule which focuses on the subset of CPI reflects the optimal rule of price stability illustrated in numerous closed economy sticky-price models (King and Wolman (1999), Woodford (2003)) and corresponds to a float. The CPI-rule reflects an intermediate exchange rate regime and is the most common index used in practise by countries which follow a policy of explicit inflation targeting. It is assumed that all three exchange rate regimes are equally credible. The paper therefore abstracts from credibility issues and assesses the properties of the alternative exchange rate regimes in terms of economic stabilisation and welfare in the process of financial market integration.

The results of the paper show that financial market integration does alter the welfare ranking of alternative exchange rate rules in a small open economy. This follows from the fact that financial market integration creates a monetary policy trade-off between the stability of domestic goods prices as opposed to the stability of the terms of trade. In segmented financial markets, it is desirable from a welfare perspective to stabilise domestic goods prices and to let the nominal exchange rate, and, hence, the terms of trade vary freely. However, when financial markets are integrated, a welfare oriented monetary policy should allow domestic goods prices to vary. This mitigates the exchange rate volatility and, hence, terms of trade volatility.

This policy trade-off in the process of financial market integration is the result of a risk premium, which is demanded by sticky-price goods producers. These producers would prefer to adjust their prices whenever the economy is hit by an economic disturbance. However, they are not allowed to do so and therefore require a risk premium as compensation. The higher the risk premium, the higher the price of overall consumption and the smaller the welfare.

In segmented international financial markets, this risk premium positively depends on the volatility of flexible goods prices only. A float which prevents inflation of domestic goods prices eliminates the risk premium and is therefore desirable. Thus, domestic goods prices need to be stabilised and the nominal exchange rate and, hence, the terms of trade should vary freely to maximise welfare.

When asset markets are internationally integrated, sticky-price goods producers can hedge against their inability to adjust prices, which reduces the risk premium. In order to use financial market hedges, both domestic goods prices and the terms of trade have to be variable. A welfare oriented monetary policy would therefore lead to variable domestic goods prices. A floating exchange rate regime which allows for domestic price stability prevents sticky-price goods producers from utilising financial market hedges since domestic goods prices are not variable. This creates welfare costs for the economy. Monetary policies of stabilising CPI inflation (intermediate exchange rate regime) or the nominal exchange rate allow for some volatility of domestic goods prices and the terms of trade and therefore make it easier for fixed price goods producers to draw on the financial market hedge. The CPI-rule and an exchange rate peg perform better than a policy of domestic price stabilisation in terms of welfare when the economy is open to trade and expenditure switching from relatively more expensive to relatively cheaper goods is possible. Thus, a change in the monetary authority's nominal target, a switch from a floating exchange rate towards nominal exchange rate stabilisation, in form of CPI targeting or an exchange rate peg can become desirable in terms of welfare in the process of financial market integration.

International financial integration affects the macroeconomic variability of the open economy. More specifically, financial market integration leads to larger macroeconomic volatility when the expenditure switching effect exists, regardless of the monetary policy rule. In segmented financial markets, the flexible exchange rate acts as a shock absorber so that output volatility is the lowest under a monetary policy that stabilises domestic prices. However, in complete financial markets, the amplified volatility of the nominal exchange rate induces too much output variability, so that a fixed exchange rate regime scores better in stabilising domestic output. With respect to consumption variability, the results are less clear cut and depend on the relative size of the economic disturbances and the degree of goods market integration.

Several recent studies discuss monetary policy regimes utilising micro-founded models with goods market imperfections (e.g. Benigno and Benigno (2003), Corsetti and Pesenti (2005), Devereux and Engel (2003), Gali and Monacelli (2005), Obstfeld and Rogoff (2000a), Sutherland (2006)). However, this research is undertaken within a given financial market structure and does not take into account the consequences of international capital market integration. Contributions by Benigno (2007), Engel (2001), Sutherland (2004) and Tille (2005) are exceptions in this respect. Benigno (2007) analyses the role of financial market frictions and its implications for price stability in a two-country world. He shows that asymmetries in the cross-country asset positions can create substantial welfare costs for the global economy when the two countries focus on stabilising domestic goods prices. Engel (2001) and Tille (2005) analyse financial market integration in the context of producer and consumer currency pricing. Engel shows that the choice of the asset markets affects the exchange rate regime choice when the exchange rate pass-through is incomplete. However, he does not compare welfare under different asset market structures. Tille illustrates that financial market integration is welfare neutral in the polar cases of zero or complete pass-through. Sutherland (2004) abstracts from local currency pricing and assumes that purchasing power holds. He assesses how the structure of asset markets affects the gains from policy coordination between countries.

None of the contributions analyse how international financial integration affects an economy's welfare given certain exchange rate regimes. Furthermore, the welfare implications of financial market integration for a small open economy have not been assessed, since the focus so far has only been on international financial integration for two equally sized countries or the welfare effects on a global level. This work investigates the welfare and macroeconomic stability implications of international financial integration for different exchange rate regimes from a small open economy's point of view. Moreover, in this paper the results are compared with the optimal monetary policy in the process of international financial market integration. This study abstracts from endogeneity of the portfolio choice and its effect on international capital markets and monetary policy. Devereux and Sutherland (2008) have assessed this aspect in the context of two equally sized countries. Thus, the approach of this paper should be understood as showing the welfare performance of alternative exchange rate regimes conditional on the structure of international financial markets.

The paper is structured as follows: Section 2 outlines the model, highlights the differences of segmented and complete financial markets and illustrates the monetary policy trade-off. Section 3 describes the exchange rate regimes and discusses the interplay of goods and financial market integration under the different exchange rate rules and their implication for welfare and macroeconomic stability. Finally, section 4 concludes with a summary of the key findings.

2 The model

In the stochastic two-economy world, which structure is based on Obstfeld and Rogoff (2000a) and Sutherland (2006), agents of the home, H, and foreign, F, country produce traded goods. Home agents are indexed by numbers in the interval $[0,1]$ and foreign agents reside on $[0,\mathcal{P}^*]$, where $\mathcal{P}^*$ corresponds to the population size of the foreign country. The share of the home population in the world population equals $\mathcal{P} = 1/(1+\mathcal{P}^*) > 0$. Agents in the domestic economy consume a basket consisting of home and foreign produced goods. There is a continuum of flexible-price goods denoted by 1 with $C_{J,1}$, $J = H, F$, and a continuum of sticky-price goods denoted by 2 with $C_{J,2}$. Households consume both type of goods. Household i provides labour supply to producers of flexible and fixed price goods. Producers of type 1 goods supply their products to a market where prices are set flexibly each period. Fixed-price goods are supplied in a market where prices are set prior to the realisation of shocks. It follows that producers meet the demand at the pre-set price. The proportion of flexible-price firms equals $0 < \alpha < 1$ so that $(1 - \alpha)$ is the measure of price rigidity. Foreign country conditions, indicated by an asterisk, are defined analogously. There is only one period. At the beginning of the period, households trade if international capital markets are not segmented in a world market in state-contingent assets *after* exchange rate rules are set, knowing that the state-dependent security payoffs occur at the realised exchange rate. Producers in the fixed-price sector set their prices before supply shocks, production and consumption are realised. Households decide about money balances and consumption while firms supply the goods that consumers demand once uncertainty is revealed.[4]

2.1 Individual preferences and prices

Preferences of the representative home agent i in state s are given by the utility

$$U = \sum_s \pi_s \left(\ln C(i)_s + \chi \ln \left(\frac{M(i)_s}{P_s} \right) - KL(i)_s \right). \tag{1}$$

Utility is a function of consumption index $C(i)$, real money balances, $M(i)/P$, and of disutility of work effort, $KL(i)$. The consumption index equals

$$C(i)_s = \left(n^{\frac{1}{\eta}} C(i)_{H,s}^{\frac{\eta-1}{\eta}} + (1-n)^{\frac{1}{\eta}} C(i)_{F,s}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}, \text{ where } C(i)_{J_s} = \frac{C(i)_{J,1}^{\alpha} C(i)_{J,2}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}, \tag{2}$$

in which case the home consumer price index becomes

$$P_s = \left(n P_{H,s}^{1-\eta} + (1-n) P_{F,s}^{1-\eta} \right)^{\frac{1}{1-\eta}}, \text{ with } P_J = P_{J,1}^{\alpha} P_{J,2}^{1-\alpha}. \tag{3}$$

The elasticity of substitution between home and foreign goods, η, captures the sensitivity of allocation between home and foreign goods with respect to relative price changes. For $\eta > 1$, home and foreign goods are substitutes. Consequently, relative price changes lead to expenditure switching effects towards the relatively cheaper good. The parameter $n = 1-(1-\mathcal{P})\gamma$, measures the overall share of home goods in the home consumption basket (see Sutherland, 2005). Trade openness is measured by the parameter $0 \leq \gamma \leq 1/2$. This formulation accounts for the empirical consumption bias towards tradeable goods produced locally. Households give a higher weight to local than to foreign goods and purchasing power parity (PPP) does not hold. The price and

[4] A static version is assessed in order to focus on the static distortions introduced by sticky prices and home bias in consumption and their interference with international financial integration.

consumption indices for the flexible-price composite goods are defined as

$$P_{H,1_s}=\left(\frac{1}{\alpha}\int_0^{\alpha}P_{H,1_s}(z)^{1-\theta}dz\right)^{\frac{1}{1-\theta}}, \qquad C(i)_{H,1_s}=\left(\left(\frac{1}{\alpha}\right)^{\frac{1}{\theta}}\int_0^{\alpha}C_{H,1_s}(i,z)^{\frac{\theta-1}{\theta}}dz\right)^{\frac{\theta}{\theta-1}},$$
$$P_{F,1_s}=\left(\frac{1}{\alpha\mathcal{P}^*}\int_0^{\alpha\mathcal{P}^*}P_{F,1_s}(z)^{1-\theta}dz\right)^{\frac{1}{1-\theta}}, \quad C(i)_{F,1_s}=\left(\left(\frac{1}{\mathcal{P}^*\alpha}\right)^{\frac{1}{\theta}}\int_0^{\alpha\mathcal{P}^*}C_{F,1_s}(i,z)^{\frac{\theta-1}{\theta}}dz\right)^{\frac{\theta}{\theta-1}}.$$

Similar conditions hold for the fixed-price composites. The elasticity of substitution between any two heterogeneous goods is reflected by $\theta > 1$. The shift parameter in money demand equals χ. The parameter K can be seen as a random shift in the marginal disutility of work effort with a mean value of $E_{-1}(\ln K) = 0$ and a variance σ_k^2, where E_{-1} is the expectation operator across states of natures s and $\ln K\ \epsilon[-\varepsilon, \varepsilon]$. A negative supply shock, a rise in K, causes the household to produce less in a given amount of time. Total labour effort L_s is given by

$$\begin{aligned} L_s(i) &= \int_0^{\alpha}L_{H,1_s}(z)\,dz+\int_{\alpha}^{1}L_{H,2_s}(z)\,dz, \text{ with } Y_{H,1_s}(z)=L_{H,1_s}(z),\ Y_{H,2_s}(z)=L_{H,2_s}(z) \quad (4)\\ Y_{H,1_s}(z) &= \int_0^1 C_{H,1_s}(i,z)di+\int_0^{\mathcal{P}^*}C^*_{H,1_s}(i,z)di,\ Y_{H,2_s}(z)=\int_0^1 C_{H,2_s}(i,z)di+\int_0^{\mathcal{P}^*}C^*_{H,2_s}(i,z)di. \end{aligned}$$

The commodity demand functions for flexible price goods (and similarly for the fixed-price goods) are derived by minimising the expenditure for the composite goods z and are given by

$$\frac{C_{H,1_s}(i,z)}{C_s}=n\left(\frac{P_{H,1,s}(z)}{P_{H,1_s}}\right)^{-\theta}\frac{P_{H_s}}{P_{H,1s}}\frac{P_s^{\eta}}{P_{H_s}^{\eta}}, \quad \frac{C_{F,1_s}(i,z)}{C_s}=\frac{(1-n)}{\mathcal{P}^*}\left(\frac{P_{F,1_s}(z)}{P_{F,1_s}}\right)^{-\theta}\frac{P_{F_s}}{P_{F,1s}}\frac{P_s^{\eta}}{P_{F_s}^{\eta}}.$$

Foreign agents preferences and resource constraints take on similar form, except that K^* and L^* may differ from K and L. It is assumed that K and K^* are uncorrelated. Foreign agents hold their own money, M^*, and their general price level equals $P_s^*=\left(n^*P_{F_s}^{*1-\eta}+(1-n^*)P_{H,s}^{*1-\eta}\right)^{\frac{1}{1-\eta}}$, with $n^*=1-\mathcal{P}\gamma$.

2.2 Households optimality conditions and money supply

The home agent i has a budget constraint specific to the state s, where $\Sigma\Gamma_s$ denotes the financial asset term of the budget constraint, W_s the nominal wage rate, and Π_s the total profits of the firms, which are owned by the households:

$$\Pi(i)_s+W_sL(i)_s+P_s\Sigma\Gamma(i)_s=P_sC(i)_s+M(i)_s-M_0+T(i)_s, \text{ with} \quad (5)$$

$$\begin{aligned} \Pi(i)_s &= (1+\tau)\{\int_0^{\alpha}P_{H,1_s}(z)C_{H,1_s}(i,z)dz+\int_{\alpha}^{1}P_{H,2_s}(z)C_{H,2_s}(i,z)dz \quad (6)\\ &\quad +S_s[\int_0^{\alpha\mathcal{P}^*}P^*_{H,1_s}(z)C^*_{H,1_s}(i,z)dz+\int_{\alpha\mathcal{P}^*}^{\mathcal{P}^*}P^*_{H,2_s}(z)C^*_{H,2_s}(i,z)dz]\}-W_sL(i)_s. \end{aligned}$$

To offset the distortions on overall output caused by the monopolistic competition, the government pays a production subsidy τ on production sales. The equilibrium taxes by the government are given by $T_s = \tau\{.\} - (M_s - M_0)$. The equilibrium revenue from producing goods equals

$$
\begin{aligned}
REV_s &= \Pi_s + W_s L_s = n\left(\frac{P_{H_s}}{P_s}\right)^{1-\eta} P_s C_s + (1-n)\, S_s \left(\frac{P^*_{H_s}}{P^*_s}\right)^{1-\eta} P^*_s C^*_s \text{ and} \\
REV^*_s &= \Pi^*_s + W^*_s L^*_s = n^*\left(\frac{P^*_{F_s}}{P^*_s}\right)^{1-\eta} P^*_s C^*_s + (1-n^*)\,\frac{1}{S_s}\left(\frac{P_{F_s}}{P_s}\right)^{1-\eta} P_s C_s.
\end{aligned} \tag{7}
$$

The optimality conditions for consumption, real balances and labour effort for agent i are derived from the objective function (1) and the budget constraint (5). In equilibrium they equal

$$
\lambda_s = \frac{C_s^{-1}}{P_s},\ \lambda_s = \chi\left(M_s\right)^{-1},\ \lambda_s = \frac{K}{W_s},\ \text{with}\ \frac{M_s}{P_s} = \chi C_s \text{ and } \frac{W_s}{P_s} = KC_s, \tag{8}
$$

where λ reflects the Lagrange multiplier. The foreign country has similar first order conditions. The money supply in each country is determined by the national monetary authorities. It is assumed that each country decides on a policy rule for setting the money supply. These rules depend on the realisation of the supply disturbances

$$
M_s = M_0 K^{\delta^K_{fms}} K^{*\delta^{K^*}_{fms}} \text{ and } M^*_s = M^*_0 K^{*\delta^{*K^*}_{fms}} K^{\delta^{*K}_{fms}}, \tag{9}
$$

in which case the feedback parameters δ^K_{fms}, $\delta^{K^*}_{fms}$, $\delta^{*K^*}_{fms}$, and δ^{*K}_{fms} depend on the financial market structure, fms, and the precise exchange rate rule specified below.

2.3 Firms' optimal price setting

Firms are monopolistic competitive and set their price for their good z. Flexible-price producers set prices after shocks have been realised and monetary policy has been set. For flexible goods prices it holds that $P^*_{H,1_s}(z) = \frac{P_{H,1}(z)}{S_s}$ and $P_{F,1_s}(z) = P^*_{F,1_s}(z)S_s$. It follows that flexible price producers require prices that equal in equilibrium

$$
P_{H,1_s} = \Phi KPC \text{ and } P^*_{F,1_s} = \Phi K^* P^* C^*, \text{ where } \Phi = \theta/((\theta-1)(1+\tau)). \tag{10}
$$

The production subsidy τ is set in a way that monopolistic distortion is corrected, implying $\Phi = 1$. Flexible-goods producers set prices so that the marginal costs, $\frac{K}{P_{H,1}}$, from a price reduction equate to the marginal utility from income, $\frac{C^{-1}}{P}$. For the goods in the fixed-price sector, households at home and abroad pay the following ex post price for their requested foreign good: $P^*_{H,2_s}(z) = \frac{P_{H,2}(z)}{S_s}$ and $P_{F,2_s}(z) = P^*_{F,2}(z)S_s$. Firms set their price before the realisation of the shock and maximise the expected real discounted value of their profits. In equilibrium it holds that

$$
P_{H,2} = E_{-1}(P_{H,1}\frac{P_H}{P}\frac{Y_H}{C})/E_{-1}(\frac{P_H}{P}\frac{Y_H}{C}) \text{ and } P^*_{F,2} = E_{-1}(P^*_{F,1}\frac{P^*_F}{P^*}\frac{Y^*_F}{C^*})/E_{-1}(\frac{P^*_F}{P^*}\frac{Y^*_F}{C^*}) \tag{11}
$$

For example, the expected marginal gains from sales, $P_{H,2}E_{-1}\left(C^{-1}\cdot\frac{P_H Y_H}{P}\right)$, equal the marginal costs, i.e. the expected value of the price set by flexible price producers adjusted by the marginal gains from sales $E_{-1}\left(P_{H,1}C^{-1} \cdot \frac{P_H Y_H}{P}\right)$. Expectational prices contain a form of risk premiums, defined as $\mathcal{R}^{fms}_{p_{H,2}}$ and $\mathcal{R}^{fms}_{p^*_{F,2}}$, because fixed-price producers cannot adjust their prices when the economy is hit by an economic disturbance. To be compensated for this they require a risk premium. The premiums depend on variances and covariances of the variables displayed in the equations above, which are affected by the financial market structure and monetary policy.

2.4 International asset markets

The different financial market structures are outlined below. Incomplete financial markets are reflected by financial autarky. Under international financial autarky, ex ante trade in state-contingent assets is not possible. When financial markets are integrated, sufficient contingent financial market instruments are available, which allow households to diversify idiosyncratic risk, so that a sharing of consumption risk is possible. Financial market integration corresponds to a movement from segmented towards complete financial markets.

2.4.1 Segmented financial markets

If there is no ex ante trade in state-contingent assets, $\Sigma\Gamma_s = 0$ in any state of nature, international financial markets are segmented, denoted with *seg*. Home and foreign households cannot trade in any security with each other. Thus, they can neither borrow nor lend and the current account needs to be in balance. The nominal value of the domestic goods consumed abroad $\mathcal{P}^* S_s P^*_{Hs} C^*_{Hs}$ needs to equal the amount of foreign goods consumed at home in nominal terms, $P_{Fs}C_{Fs}$. Thus, there is balanced trade across countries

$$Y_{Hs}P_{Hs} = P_s C_s, Y^*_{Fs}P^*_{Fs} = P^*_s C^*_s \text{ and, hence, } \frac{C_s}{C^*_s} = \left(\frac{P_{Hs}}{P_{Fs}}\right)^{1-\eta}\left(\frac{S_s P^*_s}{P_s}\right)^{\eta}. \tag{12}$$

Relative consumption needs to equal the relative prices, i.e. the real exchange rate, $\frac{S_s P^*_s}{P_s}$ and the terms of trade, $\frac{P_{Hs}}{P_{Fs}}$. The responsiveness of the real exchange rate [terms of trade] is affected by η. The higher η, the less [more] accentuated need to be shifts in the real exchange rate [terms of trade] for a given change in the relative consumption pattern.

2.4.2 Complete financial markets

In complete financial markets, defined as *comp*, attention will be confined to the case where asset trade takes place *after* policy decisions are made (see Senay and Sutherland, 2007).[5] An asset is traded for each state s of the world, reflected by the term $\Sigma\Gamma_s = (B_{H,s}REV_s + B_{F,s}S_s REV^*_s)/P_s - \sum_{\mathcal{S}}\left((q_{H,\mathcal{S}}B_{H,\mathcal{S}} + q^*_{F,\mathcal{S}}B_{F,\mathcal{S}})S_{\mathcal{S}}P^*_{\mathcal{S}}/P_{\mathcal{S}}\right)$. The same applies in the foreign

[5] Appendixes 5.4.3 and 5.5 discuss the opposite case.

country. The quantity of securities paying one unit of country H currency in state $\mathcal{S}$ purchased by the household in country H equals $B_{H,\mathcal{S}}$ and $B_{F,\mathcal{S}}$, respectively, while the pay-offs equal $(B_{H,s}REV_s + B_{F,s}S_sREV_s^*)$. The price for one unit of a security paying off in country H currency in state $\mathcal{S}$ is equal to $q_{H,\mathcal{S}}$, while $q^*_{F,\mathcal{S}}$ is the price of the security in the foreign country paying off in state $\mathcal{S}$. State-contingent assets are in zero net supply. The appendix shows that the risk-sharing condition ensures that contrary to the segmented market case, relative consumption has to equal the real exchange rate adjusted by the relative security prices

$$\frac{C_s}{C_s^*} = \frac{q_{Hs}}{q^*_{Fs}} \frac{S_s P_s^*}{P_s}. \tag{13}$$

If, for example, $q_H / q_F^* < 1$ it must hold that $C_s^{-1}/P_s > C_s^{*-1}/S_sP_s^*$ for (13) to be valid ex ante. An additional unit of consumption is more valuable to the domestic household. The domestic household needs to compensate the foreign household for providing insurance to the domestic economy when $q_H / q_F^* < 1$ via higher purchasing power so that $S_sP_s^* > P_s$.

Having described the international financial market structures, this section continues and illustrates their general implication for macroeconomic volatility and welfare. Since welfare will depend on the ex ante expected level of consumption and labour, it is necessary to solve the model in ex ante expected terms, which depend on the second moments of the variables. Those are determined by the model's ex post solution.

2.4.3 Economic variability (ex post solution)

The realised deviations of the endogenous variables are conditional on the financial market structure, fms. To see this, a first order approximation around the deterministic symmetric equilibrium for $\bar{K} = \bar{K}^*$ is taken. It is defined for any variable X that $\mathsf{x} = \ln\left(\frac{X}{\bar{X}}\right)$ and $\frac{X-\bar{X}}{\bar{X}} \approx \mathsf{x} + O\left(\varepsilon\right)^2$, where $\bar{X}$ is the value in the deterministic equilibrium. Note that terms of order $O\left(\varepsilon\right)^2$ and higher are ignored in the solution. Financial markets come into play via relative consumption and the nominal exchange rate. From (12) and (13), we derive relative consumption as equal to

$$(\mathsf{c}_s - \mathsf{c}_s^*)^{seg} = -\left(\Delta - (2 - n - n^*)\right) \mathsf{ToT}_s^{seg}, \;\; (\mathsf{c}_s - \mathsf{c}_s^*)^{comp} = -\left(n + n^* - 1\right) \mathsf{ToT}_s^{comp}, \tag{14}$$

up to a first order expansion, whereby $\Delta = 1 - (1-\eta)(n^* + n)$.[6] The different financial market structures imply that consumption differentials need to be adjusted via the terms of trade, ToT_s^{fms}. Consider the case where $\mathsf{c}_s > \mathsf{c}_s^*$. To be compensated for the lower relative consumption, foreign households require more purchasing power. The terms of trade decline. Thus, the terms of trade adjustment is a vehicle of wealth distribution. To ensure the relatively higher

[6] To ensure that $\Delta > 0$, it is assumed that η is at least greater than $1/(1+n)$, see proposition 1.

consumption, the home economy has to produce more goods, as shown by the output equation under the different financial market structures,

$$\mathsf{l}_s^{seg} = \mathsf{y}_{Hs}^{seg} = -(1-n)\,\mathsf{ToT}_s^{seg} + \mathsf{c}_s^{seg},\ \mathsf{l}_s^{comp} = \mathsf{y}_{Hs}^{comp} = -(1-n)\,\Delta\mathsf{ToT}_s^{comp} + \mathsf{c}_s^{comp}, \tag{15}$$

which follows from the resource constraints at home, equation (4), in conjunction with (14). The fall of the terms of trade causes c.p. output to increase. As long as $\Delta > 1$, domestic output will be more responsive to terms of trade changes in complete than in segmented international financial markets. Thus, a deterioration of the terms of trade raises domestic output more strongly in complete international financial markets. The terms of trade are low when the domestic goods price [nominal exchange rate] is low [high],

$$\mathsf{ToT}_s^{fms} = \mathsf{p}_{Hs} - \mathsf{p}_{Fs}^* - \mathsf{s}_s^{fms}. \tag{16}$$

Terms of trade are affected by the financial market structure via the nominal exchange rate, s_s^{fms}. From (12), (13) and the relative money demand the nominal exchange rate becomes

$$\mathsf{s}_s^{seg} = \frac{1-\alpha(1-\Delta)}{\Delta}\left(\mathsf{m}_s - \mathsf{m}_s^*\right)^{seg} - \frac{\alpha(1-\Delta)}{\Delta}\left(\mathsf{k}-\mathsf{k}^*\right) \text{ and } \mathsf{s}_s^{comp} = \left(\mathsf{m}_s - \mathsf{m}_s^*\right)^{comp}. \tag{17}$$

In segmented financial markets, in comparison to the complete financial markets situation, the nominal exchange rate depends not only on the relative money supplies but also on the relative supply disturbances at home and abroad, k and k^*. When the elasticity of substitution is $\eta > 1$, nominal exchange rate movements in segmented financial markets are mitigated by the factor $\Delta > 1$, and so are the terms of trade. From the money supply relationship (8), consumption is affected by movements of the terms of trade and money supply,

$$\mathsf{c}_s = \mathsf{m}_s^{fms} + (1-n)\,\mathsf{ToT}_s^{fms} - \mathsf{p}_{Hs} \text{ and } \mathsf{c}_s^{*fms} = \mathsf{m}_s^{*fms} - (1-n^*)\,\mathsf{ToT}_s^{fms} - \mathsf{p}_{Fs}^*. \tag{18}$$

Realised domestic [foreign] consumption increases [decreases] the higher the terms of trade, due to higher [smaller] purchasing power, and the higher is the domestic [foreign] money supply. Foreign and domestic prices depend on the supply shocks, the respective money supplies as well as the nominal exchange rate

$$\begin{aligned} \mathsf{p}_s^{fms} &= -(1-n)\,\mathsf{ToT}_s^{fms} + \mathsf{p}_{Hs}, \quad \mathsf{p}_{Hs} = \alpha\left(\mathsf{m}_s^{fms} + \mathsf{k}\right), \quad \mathsf{p}_{Hs}^* = \mathsf{p}_{Hs} - \mathsf{s}_s^{fms}, \\ \mathsf{p}_s^{*fms} &= (1-n^*)\,\mathsf{ToT}_s^{fms} + \mathsf{p}_{Fs}^*, \quad \mathsf{p}_{Fs}^* = \alpha\left(\mathsf{m}_s^{*fms} + \mathsf{k}^*\right), \quad \mathsf{p}_{Fs} = \mathsf{p}_{Fs}^* + \mathsf{s}_s^{fms}. \end{aligned} \tag{19}$$

Overall, financial market integration induces a higher macroeconomic volatility when the expenditure switching effect and, hence, $\Delta > 1$, exists.

2.4.4 Welfare (ex ante solution)

The main focus of attention is on the welfare performance of alternative exchange rate regimes when the domestic economy is small ($\mathcal{P}^* \to \infty$ and $n^* \to 1$) and moves towards internationally integrated financial markets. Before assessing the exchange rate regimes it is instructive to assess the foreign and domestic welfare functions in more detail and to discuss how financial market integration affects welfare. The model described above provides an exact second-order solution to welfare which can be derived from the utility of agents. It is assumed that the utility of real balances is small enough to be neglected. Ex ante welfare can therefore be expressed as

$$E_{-1}\left(\mathcal{W}^{fms}\right) = E_{-1}\left(\ln C^{fms}\right) - E_{-1}\left(KL^{fms}\right),$$

and similarly for the foreign country. Welfare is increasing in expected consumption and decreasing in expected disutility of work effort. The model outlined above is not log-linear so that it becomes necessary to solve the model by a second order approximation around a non-stochastic steady state, whereby $E_{-1}\left(\frac{X-\bar{X}}{\bar{X}}\right) \approx E_{-1}\left(\mathsf{x}\right) + \frac{E_{-1}\left(\mathsf{x}^2\right)}{2} + O\left(\varepsilon\right)^3$, with $E_{-1}\left(\mathsf{x}^2\right) + O\left(\varepsilon\right)^3 = E_{-1}\left(\left(\ln X - E_{-1}\left(\ln X\right)\right)^2\right) = \sigma_x^2$ and $\bar{K} = \bar{K}^*$ holds. The appendix shows that taking a second-order approximation of the welfare function yields

$$E_{-1}\left(\mathsf{w}^{fms}\right) = E_{-1}(\mathsf{c}^{fms}) \text{ and } E_{-1}\left(\mathsf{w}^{*fms}\right) = E_{-1}(\mathsf{c}^{*fms}), \tag{20}$$

in which case terms of order $O\left(\varepsilon\right)^3$ are ignored. Since welfare depends on the ex ante expected level of consumption it is necessary to solve the model in ex ante expected terms, which depend on the financial market structure and the monetary policy chosen by the home and foreign country. To assess the effects of international financial market integration on the domestic economy, it is necessary to specify the behaviour of the foreign monetary authority.

Foreign welfare From the money demand equation (8) expected consumption abroad equals

$$E_{-1}\left(\mathsf{c}^{*fms}\right) = -\left(1-\alpha\right)\mathcal{R}_{p^*_{F,2}}, \text{ for } n^* \to 1. \tag{21}$$

Taking a second-order approximation of the foreign pricing equation (11) it follows that

$$\mathcal{R}_{p^*_{F,2}} = E_{-1}(\overset{*}{\mathsf{p}}_{F,2}) = \frac{E_{-1}[(\overset{*}{\mathsf{p}}_{F,1})^2]}{2} = \frac{\sigma^2_{p^*_{F,1}}}{2}. \tag{22}$$

Foreign prices are increasing in the variability of flexible goods prices, $\sigma^2_{p^*_{F,1}}$. Then from (21), (20) and (22) welfare in the foreign country can be simply expressed as

$$E_{-1}\left(\mathsf{w}^*\right) = -\left(1-\alpha\right)\frac{\sigma^2_{p^*_{F,1}}}{2}, \tag{23}$$

regardless of the financial market structure. From (23) it follows that an inflation rule that stabilises foreign prices is a natural benchmark for the foreign economy. To ensure such a target, the foreign economy sets its money supply so that deviations from foreign inflation, induced by movements of the foreign price level, equate to zero, $\pi^*_{FIs} - E_{-1}(\pi^*_{FIs}) = 0$, and, hence

$$\mathsf{m}^*_s = -\mathsf{k} + O(\varepsilon)^2, \text{ with } \pi^*_{FI_s} = \mathsf{p}^*_{Fs} - \mathsf{p}^*_{F_{-1}} \text{ and } \mathsf{p}^*_{Fs} = \alpha(\mathsf{m}^{*fms}_s + \mathsf{k}^*) + O(\varepsilon)^2. \tag{24}$$

The feedback coefficients are $\delta^{*K^*}_{seg} = \delta^{*K^*}_{comp} = 1$, and $\delta^{*K}_{seg} = \delta^{*K}_{comp} = 0$. The foreign monetary policy rule ensures that $\sigma^2_{p^*_{F,1}}$ and, hence, the risk premium $\mathcal{R}_{p^*_{F,2}}$ equals zero.[7]

Domestic welfare On this basis, the domestic welfare can now be assessed. International financial markets affect home welfare via their impact on domestic consumption. From (12), expected consumption in segmented international financial markets simply equals

$$E_{-1}(\mathsf{c}^{seg}) = E_{-1}(\mathsf{y}^{seg}_H) + E_{-1}(\mathsf{p}^{seg}_H - \mathsf{p}^{seg}). \tag{25}$$

Expected consumption and, hence, welfare is increasing in the real value of domestic revenue. In complete international financial markets it follows from (13) that

$$E_{-1}(\mathsf{c}^{comp}) = E_{-1}(\mathsf{y}^{comp}_H) + E_{-1}(\mathsf{p}^{comp}_H - \mathsf{p}^{comp}) + \frac{E_{-1}\left[\left((\mathrm{Re}\,\mathsf{v} - \mathrm{Re}\,\mathsf{v}^* - \mathsf{s})^{comp}\right)^2\right]}{2}. \tag{26}$$

In complete financial markets, expected consumption increases not only in the real revenue but also in the variability of revenue between the home and foreign country. When the revenues between the home and foreign country are not perfectly correlated, the two countries are able to provide insurance among each other. The benefit of the insurance equals

$$(\mathrm{Re}\,\mathsf{v} - \mathrm{Re}\,\mathsf{v}^* - \mathsf{s})^{comp} + O(\varepsilon)^2 = (\mathsf{y}^{comp}_H + \mathsf{p}^{comp}_H) - (\mathsf{y}^{*comp}_F + \mathsf{p}^{comp}_F) = (1-n)(1-\Delta)\,\mathsf{ToT}^{comp}.$$

Note that an increase in the relative revenue term represents a rise in the insurance value of home assets. This causes expected consumption and, hence, welfare to increase in complete financial markets. In segmented financial markets there is no trade in international financial assets and therefore no such insurance possibility. This insurance possibility in complete financial markets will be relevant when evaluating the risk premiums under the different financial market structures. The risk premium depends on the financial market structure and equals

$$\mathcal{R}^{fms}_{p_{H,2}} = \frac{E_{-1}[[(\mathsf{p}_{H,1} + (\mathsf{p}_H - \mathsf{p}) + (\mathsf{y}_H - \mathsf{c}))^2 - ((\mathsf{p}_H - \mathsf{p}) + (\mathsf{y}_H - \mathsf{c}))^2]^{fms}]}{2}$$

[7] It is optimal from a perspective of a global planner to stabilise the population-weighted domestic inflation rates in both countries. Since the foreign economy is large relative to the rest of the world, the foreign monetary policy rule (24) coincides with that of the global social planner.

$$\mathcal{R}^{seg}_{p_{H,2}} = \frac{\sigma^2_{p^{seg}_{H,1}}}{2} \text{ and} \tag{27}$$

$$\mathcal{R}^{comp}_{p_{H,2}} = \frac{\sigma^2_{p^{comp}_{H,1}}}{2} - (\Delta - 1)(1-n)\,\sigma^{comp}_{ToT,p_{H,1}}, \tag{28}$$

where a second-order approximation of (11) has been taken and (15) as well as (19) are utilised. The risk premiums reflect the fact that prices need to be set before shocks are realised. The risk premium increases with the volatility of flexible goods prices, $\sigma^2_{p^{fms}_{H,1}}$. Fixed-price producers would like to adjust their prices as the variability of flexible goods prices increases, due to the supply shock K. However, they are not allowed to do so and require a higher risk premium to be compensated. The difference between the two risk premiums (27) and (28) under the considered financial market structures is reflected by the covariance between terms of trade and flexible goods prices, $\sigma^{comp}_{ToT,p_{H,1}} \geq 0$. Fixed-price producers can utilise financial markets as hedge against the uncertain realisation of the supply shock, which is reflected by the term $\sigma^{comp}_{ToT,p_{H,1}}$, when trade in state-contingent assets is possible. Terms of trade tend to be high when domestic goods prices are high. Higher terms of trade imply higher prices for exports, which reduces foreign demand for $\Delta > 1$. This reduces the goods supply to the foreign country and, hence, costs of work effort. As a consequence, the domestic risk premium declines under complete financial markets when $\sigma^{comp}_{ToT,p_{H,1}} > 0$, with implications for welfare.

Expected consumption and, hence, welfare increases with expected output. Given the resource constraint (4) and the realised relative consumption levels (14), expected output equals

$$E_{-1}\left(\mathsf{y}^{seg}_H\right) = -(1-\alpha)\,\mathcal{R}^{seg}_{p_{H,2}}, \tag{29}$$

$$E_{-1}\left(\mathsf{y}^{comp}_H\right) = -(1-\alpha)\,\mathcal{R}^{comp}_{p_{H,2}} - (1-n)^2(1-\Delta)^2\frac{\sigma^2_{ToT^{comp}}}{2}. \tag{30}$$

The risk premium $\mathcal{R}^{fms}_{p_{H,2}}$ enters the expected output negatively, regardless of the financial market structure. A lower risk premium makes domestic goods cheaper. This increases demand and, hence, the output of the home country. The more volatile the terms of trade, $\sigma^2_{ToT^{comp}}$, the higher is the demand variability for domestic goods. This negatively affects the expected output in complete financial markets. Thus, consumption rises via expected output and ,therefore, when the risk premium or terms of trade volatility is low.

Expected consumption also increases by the relative price of domestic goods, which induces a higher purchasing power for domestic households. From (3) and (11), this can be expressed as

$$E_{-1}\left(\mathsf{p}^{seg}_H - \mathsf{p}^{seg}\right) = \frac{(1-n)\left((1-\alpha)\,\mathcal{R}^{seg}_{p_{H,2}} + n(\eta-1)(\Delta + (\eta-1)(1-n))\frac{\sigma^2_{ToT^{seg}}}{2}\right)}{\Delta} \tag{31}$$

$$E_{-1}\left(\mathsf{p}^{comp}_H - \mathsf{p}^{comp}\right) = \frac{(1-n)\left((1-\alpha)\,\mathcal{R}^{comp}_{p_{H,2}} + (\eta-1)(n\Delta + (\eta-1)(1-n)(1+2n))\frac{\sigma^2_{ToT^{comp}}}{2}\right)}{\Delta}.$$

The variability of the terms of trade, $\sigma^2_{ToT^{fms}}$, brings about relative price changes. The relative price change improves the purchasing power of domestic households and is reflected in a higher expected relative price of domestic goods. In other words, when home and foreign goods are substitutes, $\eta > 1$, households would like to switch between goods for a given relative price change. Relative price changes are generated by the volatility of the terms of trade, $\sigma^2_{ToT^{fms}}$, which allow to keep the price of the consumption basket at the desired level. Thus, $\sigma^2_{ToT^{fms}}$ increases expected consumption when $\eta > 1$. The expected relative price of domestic goods increases as the risk premium for domestic goods becomes higher. This provides domestic households with more purchasing power because foreign goods are relatively cheaper for domestic agents than home goods are for foreign households. This has a positive effect on expected consumption.

Equations (29)-(31) show that there are opposing effects of $\mathcal{R}^{fms}_{p_{H,2}}$ and $\sigma^2_{ToT^{fms}}$ on expected output and relative prices with implications for the country's monetary policy and welfare. If the monetary authority reduces the risk premium on domestic prices, this increases expected output but decreases the expected relative prices and, hence, purchasing power. The opposite effects occur if the monetary authority minimises terms of trade volatility. Thus, the monetary authority has to consider competing objectives, namely stabilising the prices of domestically produced goods as opposed to the terms of trade.

2.4.5 Trade-off between stabilising domestic prices and terms of trade

The size of this trade-off depends on the financial market structure. To see this more clearly, domestic welfare will be expressed by the risk premium and the terms of trade volatility. From equations (25) and (26) in conjunction with (29)-(31), welfare in segmented and complete international financial markets can be simply expressed as

$$E_{-1}\left(\mathsf{w}^{fms}\right) = -(\Upsilon^{fms}_{p_{H,1}}(1-\alpha)\frac{\sigma^2_{p^{fms}_{H,1}}}{2} + \Upsilon^{fms}_{ToT}\frac{\sigma^2_{ToT^{fms}}}{2} + \Upsilon^{fms}_{ToT,p_{H,1}}(1-\alpha)\,\sigma^{fms}_{ToT,p_{H,1}}). \tag{32}$$

Thus, domestic welfare depends on the variability of domestic prices and terms of trade. Their impact on welfare depends on the weights in the welfare function, $\Upsilon^{fms}_{p_{H,1}}$, Υ^{fms}_{ToT}, and $\Upsilon^{fms}_{ToT,p_{H,1}}$, respectively. The welfare weights are defined in more detail in equations (33)-(36). Their sign and value are affected by the financial market structure, home bias in consumption, n, and the expenditure switching effect, η:

$$\Upsilon^{seg}_{p_{H,1}} = \Upsilon^{comp}_{p_{H,1}} = \left(\frac{n-(1-\Delta)}{\Delta}\right), \tag{33}$$

$$\Upsilon^{seg}_{ToT} = (1-\eta)(1-n)\left(\frac{\Delta n-(1-\eta)(1-n)\,n}{\Delta}\right), \tag{34}$$

$$\Upsilon_{ToT}^{comp} = (1-\eta)(1-n)\left(\frac{\Delta n - (1-\eta)(1-n)(1+2n)}{\Delta}\right), \tag{35}$$

$$\Upsilon_{ToT,p_{H,1}}^{comp} = (1-\Delta)(1-n)\Upsilon_{p_{H,1}}^{comp} \text{ and } \Upsilon_{ToT,p_{H,1}}^{seg} = 0. \tag{36}$$

To interpret the welfare weights in more detail, the following proposition can be stated:

Proposition 1: *When the domestic economy is open to trade, $n < 1$,*

a) $\Upsilon_{p_{H,1}}^{seg} = \Upsilon_{p_{H,1}}^{comp}$ *are strictly positive for $\eta > 1/(1+n)$ and decreasing in $(1-n)$.*

Proof The claim made in proposition 1 follows from (33)-(36).■

The implication of proposition 1a) is that in the extreme case when $\eta = 1/(1+n)$, the weights $\Upsilon_{p_{H,1}}^{seg} = \Upsilon_{p_{H,2}}^{comp}$ are zero and welfare depends only on the volatility of the terms of trade. To ensure that both the volatility of the terms of trade and the risk premium on domestic goods prices are arguments in the welfare function, attention will be confined to parameter sets which ensure that the weights $\Upsilon_{p_{H,1}}^{seg} = \Upsilon_{p_{H,1}}^{comp}$ are positive. Proposition 1a) illustrates that the need to stabilise domestic goods prices becomes less important the smaller the home bias in consumption, i.e. the smaller n is.

Proposition 1: *When the domestic economy is open to trade, $n < 1$,*

b) $\Upsilon_{ToT}^{seg} > \Upsilon_{ToT}^{comp}$ *for $1 > \eta > 1/(1+n)$, $\Upsilon_{ToT}^{seg} = \Upsilon_{ToT}^{comp}$ for $\eta = 1$ and $\Upsilon_{ToT}^{seg} < \Upsilon_{ToT}^{comp}$ for $\eta > 1$ in absolute terms.*

Proof The claim made in proposition 1 follows from (33)-(36).■

Proposition 1b) shows that the financial market structure has a direct impact on the terms of trade weight Υ_{ToT}^{fms}. The weight of the terms of trade variability in the welfare function is higher in complete than in segmented markets when $\eta > 1$.

Proposition 1: *When the domestic economy is open to trade, $n < 1$,*

c) Υ_{ToT}^{seg} *and* Υ_{ToT}^{comp} *are strictly positive for $1 > \eta > 1/(1+n)$, zero for $\eta = 1$ and strictly negative for $\eta > 1$ and increasing in $(1-n)$ in absolute terms;*

d) $\Upsilon_{ToT,p_{H,1}}^{comp}$ *is strictly positive for $1 > \eta > 1/(1+n)$, zero for $\eta = 1$ and strictly negative for $\eta > 1$ and increasing in $(1-n)$ in absolute terms.*

Proof The claim made in proposition 1 follows from (33)-(36).■

In a closed economy, $n = 1$, the variance of the terms of trade and its covariance with domestic goods prices are irrelevant. In this case, monetary policy needs to concentrate only on stabilising the variability of domestic goods prices, regardless of the financial market structure.

When $\eta = 1$, it is clear from (33)-(36) that welfare depends only on the volatility of domestic goods prices $\sigma^2_{p_{H,1}^{fms}}$. Furthermore, the structure of the financial markets will be irrelevant. A welfare-oriented monetary policy only needs to stabilise the domestic producer price index. This result has been frequently analysed in the literature. Therefore, the remaining part will assess the case where $\eta > 1$.[8] Consequently, the volatility of the terms of trade and the covariance with domestic goods prices contribute positively to welfare. However, the positive contribution of the covariance between domestic goods prices and the terms of trade on welfare will only occur when financial markets are complete, see (36) and proposition 1d).

When financial markets are segmented, equation (36) shows that domestic welfare is unaffected by the interplay between domestic prices and the terms of trade. Only the coefficient Υ_{ToT}^{seg} in addition to $\Upsilon_{p_{H,1}}^{seg}$ affects welfare. The lower the variability of domestic goods prices, the higher is the volatility of the terms of trade. Consequently, a welfare-oriented monetary policy should therefore stabilise domestic goods prices, letting the nominal exchange rate and, hence, the terms of trade variable, when financial markets are segmented.

In the case of complete financial markets, proposition 1c) and 1d) illustrates that both a higher volatility in the terms of trade and a higher covariance between the terms of trade and flexible goods prices make a positive contribution to domestic welfare when $\eta > 1$. The covariance term provides a financial market hedge against the uncertain realisation of the supply shock. Consequently, sticky-price goods producers require a lower risk premium.

The covariance increases when domestic goods prices are high, leading to higher terms of trade. This allows home agents to consume relatively more goods for a given level of work effort, due to higher purchasing power. Therefore, the covariance between terms of trade and flexible goods prices makes a positive contribution to expected welfare. Since the covariance is proportional to the variability of domestic goods prices a higher covariance can be obtained only when domestic goods prices are allowed to fluctuate. Consequently, a welfare-oriented monetary policy needs to allow for variation in domestic goods prices in complete financial markets. This causes the terms of trade volatility to decline. Thus, the following proposition can be formulated:

Proposition 2: *When the domestic economy is open to trade, $n < 1$ and $\eta > 1$ international financial market integration causes a monetary policy trade-off between stabilising domestic goods prices as opposed to stabilising the terms of trade.*

Proof The claim made in proposition 2 follows from the optimal monetary policy, which is derived in detail in appendix 5.6.■

In segmented financial markets, a welfare-oriented monetary policy needs only to stabilise domestic goods prices, letting the terms of trade vary freely. When financial markets are com-

[8] Obstfeld and Rogoff (2000b) survey the literature on the elasticity of substitution and quote estimates of between 1.2 and 21.4 for individual goods. The real business cycle literature uses values of around 1.5 (Chari, Kehoe and Mc Gratten, 2002). Adolfson et al. (2007) provide estimates of η of around 11.

plete, the monetary authority should allow domestic goods prices to fluctuate, which reduces the terms of trade variability. Figure 1 illustrates this in more detail. The implications of this trade-off will be discussed in the next section, where the analysis concentrates on the different exchange rate regimes and contrasts the results to the optimal monetary policy, which is based on maximising the welfare (32) of the domestic country.

3 International asset markets and exchange rate regimes

The exchange rate regimes analysed include a fixed exchange rate regime and two different types of inflation targeting rules. When the monetary authority aims at targeting domestic producer price inflation (DI-rule hereafter), $\pi_{DI} = \mathsf{p}_{Hs} - \mathsf{p}_{H_{-1}}$, it will adjust the domestic money supply to ensure that $\sigma^2_{p_{H,1}} = 0$. Consequently, the risk premium on domestic goods prices $\mathcal{R}_{p_{H,2}}$ equals zero. Such a policy stabilises domestic producer prices but leaves the nominal exchange rate free to float. The consequence is that the terms of trade (16) are highly volatile. In the case of a CPI-rule the home monetary authority varies the home money supply to ensure that the rate of CPI inflation, $\pi_{CPIs} = \mathsf{p}_s - \mathsf{p}_{-1}$, achieves a target rate of zero and $\sigma^2_p = 0$. Movements in the price level are due to deviations in $\mathsf{p}_{H,1s}$, as well as s_s. The domestic monetary authority needs to account for differing nominal exchange rate movements under segmented and complete financial market structures, see (17), to ensure its CPI inflation target. A CPI-rule neither stabilises domestic goods prices nor the nominal exchange rate completely. Thus, it can be seen as an intermediate exchange rate regime. Given an exchange rate peg, the home monetary authority is assumed to vary the domestic money supply in order to maintain the exchange rate at a target rate $\bar{S}$, so that $\sigma^2_s = 0$. It follows that the terms of trade volatility is reduced while the variability of domestic goods prices is amplified.

Table 1 illustrates the monetary feedback coefficients δ^K_{fms} and $\delta^{K^*}_{fms}$ of (9), which ensure the exchange rate targets. Table 1 shows that only a float (DI-rule) leaves the money supply unaffected by a movement towards financial markets. This result is due to the fact that domestic flexible goods prices are not influenced by exchange rate movements and, hence, are unaffected by financial market integration. Thus, a monetary policy rule of stabilising domestic goods prices is completely inward-looking. There is no need for monetary policy to react to international financial market integration. This is in clear contrast to the other two exchange rate rules. Table 1 shows that a peg as well as an intermediate exchange rate regime (CPI-rule) require the money supply to respond differently to supply disturbances in the process of financial market integration when $\alpha > 0$. When international financial markets are integrated the monetary authority puts a higher weight on foreign than domestic supply disturbances, $\delta^K_{CPI^{seg}} > \delta^K_{CPI^{comp}}$

($\delta^K_{Peg^{seg}} > \delta^K_{Peg^{comp}}$) and $\delta^{K^*}_{CPI^{seg}} < \delta^{K^*}_{CPI^{comp}}$ ($\delta^{K^*}_{Peg^{seg}} < \delta^{K^*}_{Peg^{comp}}$) in absolute terms.

From Table 1 in conjunction with (9) and (15)-(19) the model's endogenous variables under the different monetary policy rules are derived. Table 2 summarises the expressions. Table 3 shows that the variances of terms of trade, the nominal exchange rate as well as domestic goods prices are symmetrically affected by home and foreign supply shocks while consumption and output are not.

3.1 Trade-off between stability of domestic prices and terms of trade

The (relative) prices depend on the financial market structures and their interplay with the monetary policy rules.

Proposition 3: *When the domestic economy is open to trade, $n < 1$, and prices are partially flexible, $0 < \alpha < 1$,*

a) *terms of trade volatility is higher in complete financial markets than in segmented financial markets for $\eta > 1$, identical for $\eta = 1$ and smaller for $1 > \eta > 1/(1+n)$, regardless of the exchange rate regime while $\sigma^2_{ToT^{DI}} > \sigma^2_{ToT^{CPI}} > \sigma^2_{ToT^{Peg}}$, regardless of the financial market structure;*

b) *$\sigma^2_{ToT^{CPI}}$ is decreasing in $(1-n)$ while $\sigma^2_{ToT^{DI}}$ and $\sigma^2_{ToT^{Peg}}$ are unaffected by trade openness in complete financial markets;*

c) *domestic price volatility is higher in complete financial markets than in segmented financial markets for $\eta > 1$, identical for $\eta = 1$ and smaller for $1 > \eta > 1/(1+n)$, given a peg or CPI-rule while $\sigma^2_{p^{Peg}_{H,1}} > \sigma^2_{p^{CPI}_{H,1}} > \sigma^2_{p^{DI}_{H,1}}$, regardless of the financial market structure;*

d) *$\sigma^2_{p^{CPI}_{H,1}}$ is increasing in $(1-n)$ while $\sigma^2_{p^{DI}_{H,1}}$ and $\sigma^2_{p^{Peg}_{H,1}}$ are unaffected by trade openness in complete financial markets.*

Proof The claim made in proposition 3 follows from Table 3.■

The implication of proposition 3a) and c) is, that financial market integration leads to higher terms of trade and domestic price variability when the expenditure switching effect exists, $\eta > 1$. However, the strength of this effect depends on the exchange rate rules. A fixed exchange rate regime [DI-rule] will always mitigate [amplify] the terms of trade volatility but increases [dampens] the response of domestic goods prices. Figure 2 illustrates this. Figure 2 also shows the optimal monetary policy response (solid line). The optimal monetary policy ensures very little domestic price variability when financial markets are not integrated (see column (1)). As a consequence, there are highly volatile terms of trade, as illustrated by column (2). Compared to the optimal monetary policy, a peg and a CPI-rule produce too much price and too little terms of trade variability when financial markets are segmented (see columns (1) and (2), respectively). Columns (1) and (2) of Figure 2 show that the DI-rule best fits the optimal monetary policy.

When international financial markets are integrated, the picture looks different. Proposition 1c) and d) have shown that when there is some degree of trade openness, $n < 1$, terms of trade volatility and the covariance $\sigma^{comp}_{ToT,p_{H,1}}$ are important for welfare and monetary policy needs to account for this. The optimal monetary policy will place a relatively higher weight on stabilising domestic price than on terms of trade variability when financial markets are integrated. This will be more accentuated the more open the economy becomes, i.e. the larger $(1 - n)$ is. Columns (3) and (4) of Figure 2 illustrate the optimal domestic price and terms of trade responses (solid lines). Proposition 3b) and d) shows that a CPI-rule comes closest to this pattern (see Columns (3) and (4) of Figure 1).

In summary, the optimal monetary policy responses show that financial market integration causes a policy trade-off. When financial markets are not internationally integrated, the domestic goods price should be stabilised and the terms of trade vary freely. However, when financial markets are integrated, the optimal monetary policy should let the domestic goods price vary relative to the terms of trade. In segmented financial markets, a float (DI-rule) comes closest to this pattern while in complete financial markets, the intermediate exchange rate regime (CPI-rule) best matches the optimal monetary policy responses.

3.2 Welfare

Proposition 3 has direct implications for domestic welfare. Equation (32) in conjunction with Table 3 allow to state the following proposition.

Proposition 4: *When the domestic economy is open to trade, $n < 1$, and prices are partially flexible, $0 < \alpha < 1$,*

a) *domestic welfare will be always higher in complete financial markets than in segmented financial markets regardless of the exchange rate regime;*

b) *domestic welfare will be the highest under a DI-rule and the lowest under a peg when financial markets are segmented;*

c) *domestic welfare can be the highest under any of the exchange rate regimes when financial markets are complete, depending on the interplay between the expenditure switching effect, η, and the degree of home bias, n.*

Proof The claim made in proposition 4 follows from equations (32)-(36), Table 3.■

Proposition 4a) shows that financial market integration will be always welfare-improving, regardless of the monetary policy rule. This is due to the fact that in complete international financial markets households are able to trade in state-contingent assets with each other to insure against the uncertain occurrence of supply shocks at home and abroad.

In international segmented financial markets, trade in state-contingent assets is not possible. Cole and Obstfeld (1991) have shown that in such a financial environment, a freely floating nominal exchange rate can provide a risk-sharing role because it can be used as a vehicle of wealth distribution by allocating production efficiently across countries when they are hit by supply disturbances. A DI-rule allows the nominal exchange rate to float freely. Consequently, in segmented financial markets, welfare will be the highest under the DI-rule as shown by proposition 4b). Column (1) of Figure 3 illustrates this for varying values of η.

In complete financial markets, households can trade in state-contingent assets. Fluctuations in the nominal exchange rate are not exclusively necessary to allocate production and consumption efficiently across countries. The state contingent assets are also a vehicle of wealth distribution. Financial markets allow fixed-price producers to hedge against their inability to adjust prices when $\sigma_{ToT,p_{H,1}}^{comp} > 0$, which makes a positive contribution to welfare. A monetary policy that stabilises domestic goods prices eliminates this financial market hedge. This creates relative welfare costs to the economy. Monetary policies of stabilising CPI-inflation or the nominal exchange rate allow for volatility of domestic goods prices and terms of trade and, therefore, facilitate fixed price goods producers to draw on the financial market hedge. This can be welfare improving in integrated financial markets. As a result, the latter rules perform better than a policy of domestic price stabilisation in welfare terms when the economy is open to trade and the expenditure switching effect exists, see proposition 4c) and Figure 3.

Figure 3 illustrates the discussion by comparing the welfare performance of the three exchange rate rules in segmented and complete financial markets. A DI-rule which reflects a flexible exchange rate regime provides the highest welfare and comes closest to the optimal monetary policy rule (solid line) when financial markets are segmented (see column (1)). When financial markets are integrated, the financial market hedge, $\sigma_{ToT,p_{H,1}}^{comp}$, plays an important role in the evaluation of welfare. When $\sigma_{ToT,p_{H,1}}^{comp} > 0$, home agents can consume relatively more goods for a given level of work effort. This makes a positive contribution to welfare. This effect will be amplified the higher the expenditure switching effect, $\eta > 1$, is and the more open the economy is to trade. Column (2) shows that relative welfare under an intermediate exchange rate regime (i.e. CPI-rule) and a peg increases compared to a float (DI-rule), the larger is η and the smaller is n. For intermediate values of η welfare is the highest under a CPI-rule. If the expenditure switching effect is large and home bias small welfare is the lowest under a DI-rule. This is true regardless of the relative size of the domestic and foreign supply disturbances.

3.3 Domestic output and consumption volatility

From Table 3, it follows that no single monetary policy rule dominates in stabilising both domestic output and consumption variability. Proposition 5 shows that the variability of the macroeconomic variables clearly depends on the degree of financial market integration.

Proposition 5: *When the domestic economy is open to trade, $n < 1$, prices are partially flexible, $0 < \alpha < 1$, and $\sigma_k^2 = \sigma_{k^*}^2$,*

a) *output volatility is higher in complete financial markets than in segmented financial markets for $\eta > 1$, identical for $\eta = 1$ and smaller for $1 > \eta > 1/(1+n)$, regardless of the exchange rate regime, while $\sigma^2_{y_H^{DI}} < \sigma^2_{y_H^{CPI}} < \sigma^2_{y_H^{Peg}}$ $[\sigma^2_{y_H^{DI}} > \sigma^2_{y_H^{CPI}} > \sigma^2_{y_H^{Peg}}]$ when financial markets are segmented [complete];*

b) *consumption volatility is higher in complete financial markets than in segmented financial markets for $\eta > 1$, identical for $\eta = 1$ and smaller for $1 > \eta > 1/(1+n)$, regardless of the exchange rate regime. Consumption volatility can be the highest under any of the monetary policy rules, depending on the interplay between the expenditure switching effect, η, and the degree of home bias, n.*

Proof The claim made in proposition 5 follows from Table 3■

Financial market integration leads to higher output and consumption variability when the expenditure switching effect exists, $\eta > 1$, as shown in proposition 5a) and 5b). However, monetary policy is able to influence the variability. Proposition 5a) and 5b) shows that a DI-rule will always mitigate the output volatility when financial markets are segmented. Columns (1) and (2) of Figure 4 illustrate that the output and consumption responses of a DI-rule are closest to those chosen under optimal monetary policy (solid line). This is due to the fact that, in segmented markets, the nominal exchange rate acts as a shock absorber and mitigates the responses of output and consumption given domestic and foreign supply disturbances. Columns (3) and (4) of Figure 4 show that this does not hold when financial markets are integrated. In complete financial markets, the nominal exchange rate induces too much volatility. Consequently, output volatility will be the lowest under an exchange rate peg. The intermediate exchange rate regime (CPI-rule) almost replicates the optimal output response in complete financial markets. This is also true with respect to consumption volatility. However, the exchange rate peg provides the lowest variability in consumption when the economy is not too open to trade. The top row of Figure 5 shows that the results also hold when domestic supply shocks are relatively higher, i.e. $\sigma_k^2 > \sigma_{k^*}^2$. When $\sigma_k^2 < \sigma_{k^*}^2$ the output volatility ranking as discussed in proposition 5a) remains unchanged. However, consumption volatility of an exchange rate peg can be either the lowest or the highest in segmented financial markets, depending on the degree of home bias, (see bottom row of Figure 5). When international financial markets are integrated and $\sigma_k^2 < \sigma_{k^*}^2$, the consumption volatility ranking is reversed. The volatility of consumption is the highest under a fixed exchange rate regime and the lowest under a float (DI-rule).

4 Conclusion

In this paper the effects of international financial market integration on the welfare ranking and macroeconomic volatility of alternative exchange rate regimes in small open economies is examined.

The first key finding of this paper is that financial market integration introduces a monetary policy trade-off between stabilising domestic goods prices as opposed to the terms of trade. When international financial markets are segmented it is preferable from a welfare perspective of a small open economy to stabilise domestic goods prices and to let the nominal exchange rate float freely. However, when financial markets are integrated, a welfare oriented monetary policy should allow domestic goods prices to vary. This mitigates the exchange rate volatility and, hence, terms of trade volatility.

The second key finding of this paper is that the welfare ranking of different exchange rate regimes in a small open economy will change in the process of international financial integration, which can be explained as follows: A float which prevents domestic goods price inflation is superior to alternative exchange rate arrangements when international capital markets are segmented. By contrast, when international capital markets are integrated, an intermediate exchange rate arrangement and a peg can perform better than a float in terms of welfare, as they allow for domestic price variability and mitigated terms of trade movements.

The third key finding is that no single exchange rate regime outperforms in stabilising both domestic consumption and output variability in the process of international asset market integration. In segmented financial markets output and consumption responses are the lowest under a float. This is due to the fact that, in segmented markets, the nominal exchange rate acts as a shock absorber and mitigates the responses of output and consumption given domestic and foreign supply disturbances. This does not hold when financial markets are integrated. In complete financial markets, the nominal exchange rate induces too much volatility. Consequently, output volatility will be the lowest under an exchange rate peg.

In conclusion, a change in the monetary authority's nominal target, a switch from a floating exchange rate towards exchange rate stabilisation, can become desirable in terms of welfare in the process of international financial integration. Consequently, it is not necessarily true that giving up the possibility of nominal exchange rate adjustment is costly, as outlined by Friedman (1953) and Mundell (1968), even if the small open economy is hit by real shocks which require relative price adjustments. On the basis of an explicit welfare comparison the advantage of flexible exchange rates does not necessarily hold in the process of international asset market integration.

References

[1] Adolfson, M., S. Laseen, J. Linde and M. Villani (2007): "Bayesian Estimation of an Open Economy DSGE Model with Incomplete Pass-Through", *Journal of International Economics* forthcoming.

[2] Anderson, J. and E. van Wincoop (2003): "Trade Costs", unpublished manuscript, Boston College and University of Virginia.

[3] Benigno, P. (2007): "Price Stability with imperfect Financial Integration", unpublished manuscript, University of LUISS Guido Carli, Rome.

[4] Benigno G. and P. Benigno (2003): "Price Stability in Open Economies", *Review of Economic Studies* 70, 743-764.

[5] Brandt, M.W., J.H. Cochrane and S.-C. Pedro (2006): "International Risk Sharing is better than you think, or Exchange Rates are to smooth", *Journal of Monetary Economics* 53, 671-698.

[6] Calvo, G.A. and C.M. Reinhart (2002): "Fear of Floating", *Quarterly Journal of Economics* 117, 379-408.

[7] Chari, V. V., P. J. Kehoe and E. R. McGratten (2002): "Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rates?", *Review of Economic Studies* 69, 533-564.

[8] Cole, H. and M. Obstfeld (1991): "Commodity Trade and International Risk Sharing: How much do Financial Markets matter?", *Journal of Monetary Economics* 28, 3-24.

[9] Corsetti, G. and P. Pesenti (2005): "The International Dimension of Optimal Monetary Policy", *Journal of Monetary Economics* 52, 281-305.

[10] Devereux, M. B. and C. Engel (2003): "Monetary Policy in an Open Economy Revisited: Price Setting and Exchange Rate Flexibility", *Review of Economic Studies* 70, 765-783.

[11] Devereux, M. B. and A. Sutherland (2008): "Financial Globalization and Monetary Policy", mimeo.

[12] Friedman, M. (1953): The Case for Flexible Exchange Rates. In: *Essays in Positive Economics*, Chicago, University of Chicago.

[13] Engel, C. (2001): "Optimal Exchange Rate Policy: The Influence of Price-Setting and Asset Markets", *Journal of Money, Credit and Banking* 33, 518-541.

[14] Gali, J. and T. Monacelli (2005): "Monetary Policy and Exchange Rate Volatility in a Small Open Economy", *Review of Economic Studies* 72, 707-734.

[15] King, R. and A. L.Wolman (1999): "What Should the Monetary Authority Do When Prices Are Sticky?", in John B. Taylor (ed.): *Monetary Policy Rules,* University of Chicago Press: Chicago.

[16] Lane, P.R. (2001): "The New Open Macroeconomics: A Survey", *Journal of International Economics*, 54, 235-266.

[17] Lane, P. R. and G. M. Milesi-Ferretti (2008): "International Investment Patterns", *Review of Economics and Statistics* forthcoming.

[18] Mundell, R.A. (1968): International Economics, New York, MacMillan.

[19] Obstfeld, M. (2004): "Globalization, Macroeconomic Performance, and the Exchange rates of Emerging Economies", *Monetary and Economic Studies* 22, 29-56.

[20] Obstfeld, M. and K. Rogoff (2000a): "New Directions in New Open Economy Macroeconomics", *Journal of International Economics* 50, 117-154.

[21] Obstfeld, M. and K. Rogoff (2000b): "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?", *NBER Macroeconomics Annual* 15, 339-390.

[22] Senay, O. and A. Sutherland (2007): "Optimal Monetary Policy and the Timing of Asset Trade in Open Economies", *Economic Letters* 95, 297-302.

[23] Sutherland, A. (2004): "International Monetary Policy Coordination and Financial Market Integration", unpublished manuscript, University of St. Andrews.

[24] Sutherland, A. (2005): "Incomplete Pass-Through and the Welfare Effects of Exchange Rate Variability", *Journal of International Economics* 65, 375-399.

[25] Sutherland, A. (2006): "The Expenditure Switching Effect, Welfare and Monetary Policy in a Small Open Economy", *Journal of Economic Dynamics and Control* 30, 1159-1182.

[26] Tille, C. (2005): "The Welfare Effect of International Asset Market Integration under Nominal Rigidities", *Journal of International Economics* 65, 221-247.

[27] Woodford, M. (2003): "Interest and Prices: Foundations of a Theory of Monetary Policy", *Princeton University Press*, Princeton.

5 Appendix

5.1 Risk sharing condition

To derive equation (13) notice that from the equilibrium budget constraint, it follows that consumption levels in state s are equal to

$$C = \frac{q_H(\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})SP^*}{(\frac{q_H}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* q_F^*}{1+\mathcal{P}^*})P} \text{ and } C^* = \frac{q_F^*(\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})}{(\frac{q_H}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* q_F^*}{1+\mathcal{P}^*})}. \tag{37}$$

The no-arbitrage conditions imply the security prices across different states of natures

$$q_{Hs} = \frac{E_{-1}\left(\frac{\frac{REV}{SP^*}}{(\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})}\right)}{E_{-1}\left((\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})^{-1}\right)} \text{ and } q_{Fs}^* = \frac{E_{-1}\left(\frac{\frac{REV^*}{P^*}}{(\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})}\right)}{E_{-1}\left((\frac{REV/(SP^*)}{1+\mathcal{P}^*} + \frac{\mathcal{P}^* REV^*/(P^*)}{1+\mathcal{P}^*})^{-1}\right)}. \tag{38}$$

Utilising (37) and (38), the risk sharing condition equates to

$$\frac{C_s}{C_s^*} = \frac{q_{Hs}}{q_{Fs}^*}\frac{S_s P_s^*}{P_s},$$

which is equation (13) in the main text.

5.2 Ex ante solution

A second-order approximation around the deterministic symmetric equilibrium for $\bar{K} = \bar{K}^*$ is taken. It is defined for any variable X that $E_{-1}(\mathsf{x}) = E_{-1}\left(\ln\left(\frac{X}{\bar{X}}\right)\right)$ and $E_{-1}\left(\frac{X-\bar{X}}{\bar{X}}\right) \approx E_{-1}(\mathsf{x}) + \frac{E_{-1}(\mathsf{x}^2)}{2} + O(\varepsilon)^3$, where $\bar{X}$ is the value in the deterministic equilibrium. Furthermore, $E_{-1}(\mathsf{x}^2) + O(\varepsilon)^3 = E_{-1}\left((\ln X - E_{-1}(\ln X))^2\right) = \sigma_x^2$, in which case terms of order $O(\varepsilon)^3$ are ignored. Given the definition of the price indices, equation (3), the following is true under the different financial market structures:

$$E_{-1}\left(\mathsf{p}^{fms}\right) = ([(1-\alpha)E_{-1}(n\mathsf{p}_{H,2} + (1-n)\mathsf{p}_{F,2}) + (1-n)E_{-1}(\alpha\mathsf{s} + n(1-\eta)\frac{(\mathsf{ToT})^2}{2})]^{fms}).$$

A similar condition holds in the foreign country. For the expectational prices, the following risk premiums are derived:

$$\begin{aligned} E_{-1}\left(\mathsf{p}_{H,2}^{fms}\right) &= \mathcal{R}_{p_{H,2}}^{fms} \text{ and } E_{-1}\left(\mathsf{p}_{H,2}^{*fms}\right) = \mathcal{R}_{p_{H,2}}^{fms} - E_{-1}\left(\mathsf{s}^{fms}\right) \text{ as well as} \\ E_{-1}\left(\mathsf{p}_{F,2}^{*fms}\right) &= \mathcal{R}_{p_{F,2}^*}^{fms} \text{ and } E_{-1}\left(\mathsf{p}_{F,2}^{fms}\right) = \mathcal{R}_{p_{F,2}^*}^{fms} + E_{-1}\left(\mathsf{s}^{fms}\right). \end{aligned}$$

The volatility of the terms of trade is defined as

$$\frac{E_{-1}[(\mathsf{ToT}^{fms})^2]}{2} = \frac{\sigma_{ToT^{fms}}^2}{2} = \frac{\sigma_{p_H^{fms}}^2 + \sigma_{p_F^{*fms}}^2 + \sigma_{s^{fms}}^2 - 2\left(\sigma_{s,p_H}^{fms} + \sigma_{p_F^*,p_H}^{fms} - \sigma_{p_F^*,s}^{fms}\right)}{2}.$$

From the relative money demand (8) and the determination of relative consumption levels under segmented markets (12) one can establish

$$E_{-1}\left(\mathsf{s}^{seg}\right)=\frac{\left(1-\Delta\right)\left(1-\alpha\right)\left(\mathcal{R}^{seg}_{p^*_{F,2}}-\mathcal{R}^{seg}_{p_{H,2}}\right)+\left(1-\eta\right)^2\left(n^*\left(1-n^*\right)-n\left(1-n\right)\right)\frac{\left(\mathsf{ToT}^{seg}\right)^2}{2}}{\Delta}. \tag{39}$$

In complete financial markets, it follows from (8) and (13) that $E_{-1}\left(\mathsf{s}^{comp\_before}\right)=0$ and

$$\begin{aligned} E_{-1}\left(\mathsf{s}^{comp}\right) &= \frac{\left(1-\Delta\right)\left(1-\alpha\right)\left(\mathcal{R}^{comp}_{p^*_{F,2}}-\mathcal{R}^{comp}_{p_{H,2}}\right)}{\Delta} \\ &+\frac{\left(1-\eta\right)^2\left(\left(2n^*+1\right)\left(1-n^*\right)-\left(2n+1\right)\left(1-n\right)\right)\frac{\left(\mathsf{ToT}^{comp}\right)^2}{2}}{\Delta}. \end{aligned} \tag{40}$$

The above expressions can be used to derive expected consumption for the two countries. From the money demand equation (8), it follows that expected consumption equals $E_{-1}\left(\mathsf{c}\right)=-E_{-1}\left(\mathsf{p}\right)$ for $E_{-1}\left(\mathsf{m}\right)=0$. Hence,

$$\begin{aligned} E_{-1}\left(\mathsf{c}^{fms}\right) &= \left(1-n\right)\left(E_{-1}(\mathsf{ToT}^{fms})-n\left(1-\eta\right)\frac{\left(\mathsf{ToT}^{fms}\right)^2}{2}\right)-\left(1-\alpha\right)\mathcal{R}^{fms}_{p_{H,2}}, \\ E_{-1}\left(\mathsf{c}^{*fms}\right) &= -\left(1-n^*\right)\left(E_{-1}(\mathsf{ToT}^{fms})+n^*\left(1-\eta\right)\frac{\left(\mathsf{ToT}^{fms}\right)^2}{2}\right)-\left(1-\alpha\right)\mathcal{R}^{fms}_{p^*_{F,2}}. \end{aligned} \tag{41}$$

The expected terms of trade depend on whether the economies allow for trade in state-contingent assets. From the relative money demand (8) and the determination of relative consumption levels in segmented markets (12), one can establish

$$E_{-1}\left(\mathsf{ToT}^{seg}\right)=\frac{\left(1-\alpha\right)\left(\mathcal{R}^{seg}_{p_{H,2}}-\mathcal{R}^{seg}_{p^*_{F,2}}\right)+\left(1-\eta\right)^2\left(n\left(1-n\right)-n^*\left(1-n^*\right)\right)\frac{\left(\mathsf{ToT}^{seg}\right)^2}{2}}{\Delta}. \tag{42}$$

In complete financial markets, it follows from (8) and (13) that

$$E_{-1}\left(\mathsf{ToT}^{comp\_before}\right)=\left(1-\alpha\right)\left(\mathcal{R}^{comp}_{p_{H,2}}-\mathcal{R}^{comp}_{p^*_{F,2}}\right)\text{ and} \tag{43}$$

$$\begin{aligned} E_{-1}\left(\mathsf{ToT}^{comp}\right) &= \frac{\left(1-\alpha\right)\left(\mathcal{R}^{comp}_{p_{H,2}}-\mathcal{R}^{comp}_{p^*_{F,2}}\right)}{\Delta} \\ &+\frac{\left(1-\eta\right)^2\left(\left(2n+1\right)\left(1-n\right)-\left(2n^*+1\right)\left(1-n^*\right)\right)\frac{\left(\mathsf{ToT}^{comp}\right)^2}{2}}{\Delta}. \end{aligned} \tag{44}$$

These equations form the basis for the derivations of section 2.4.4.

5.3 Price setting and demand relationship

Equation (11) has been derived on the basis of (4). From (4) in equilibrium, the labour supply to the flexible and fixed-price goods firms equals

$$\begin{aligned} L_{H,1} &= Y_{H,1} = 1/\alpha(C_{H,1} + \mathcal{P}^* C^*_{H,1}), && (45) \\ L_{H,2} &= Y_{H,2} = 1/(1-\alpha)(C_{H,2} + \mathcal{P}^* C^*_{H,2}), \text{ respectively.} && (46) \end{aligned}$$

The demand equations yield

$$\begin{aligned} C_{H,1} + C^*_{H,1} &= \alpha(\frac{P_{H,1}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H), && (47) \\ C_{H,2} + C^*_{H,2} &= (1-\alpha)(\frac{P_{H,2}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H). && (48) \end{aligned}$$

Overall market clearing requires that total output equals total demand, so that

$$Y_H = (C_H + \mathcal{P}^* C^*_H). \tag{49}$$

Hence, (45) and (46) become

$$\begin{aligned} C_{H,1} + C^*_{H,1} &= \alpha(\frac{P_{H,1}}{P_H})^{-1} Y_H \text{ and } Y_{H,1} = (\frac{P_{H,1}}{P_H})^{-1} Y_H, \\ C_{H,2} + C^*_{H,2} &= (1-\alpha)(\frac{P_{H,2}}{P_H})^{-1} Y_H \text{ and } Y_{H,2} = (\frac{P_{H,2}}{P_H})^{-1} Y_H. \end{aligned}$$

5.4 Disutility of work effort

From (47) and (48), equations (45) and (46) can be written as

$$\begin{aligned} L_{H,1} &= (\frac{P_{H,1}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H), \\ L_{H,2} &= (\frac{P_{H,2}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H). \end{aligned}$$

Multiplying the above equation with K and taking expectations yields

$$\begin{aligned} E_{-1}(KL_{H,1}) &= E_{-1}\left[K(\frac{P_{H,1}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H)\right], \\ E_{-1}(KL_{H,2}) &= E_{-1}\left[K(\frac{P_{H,2}}{P_H})^{-1} (C_H + \mathcal{P}^* C^*_H)\right]. \end{aligned}$$

Utilising the price equations (10) and (11) results in

$$\begin{aligned} E_{-1}(KL_{H,1}) &= E_{-1}\left[\frac{P_H}{PC}(C_H + \mathcal{P}^* C^*_H)\right], && (50) \\ E_{-1}(KL_{H,2}) &= E_{-1}\left[\frac{P_H}{PC}(C_H + \mathcal{P}^* C^*_H)\right]. && (51) \end{aligned}$$

Multiplying the constraint (4) with K and taking expectations yields

$$E_{-1}(KL) = E_{-1}\left[\alpha L_{H,1} + (1-\alpha)L_{H,2}\right]. \tag{52}$$

Utilising (50) and (51), the disutility of labour equals

$$E_{-1}(KL) = E_{-1}\left[\frac{P_H}{PC}\left(C_H + \mathcal{P}^* C_H^*\right)\right]. \tag{53}$$

From the total demand equations

$$C_H = n\left(\frac{P_H}{P}\right)^{-\eta} C \text{ and } C_H^* = (1-n^*)\left(\frac{P_H^*}{P^*}\right)^{-\eta} C^*,$$

equation (53) becomes

$$E_{-1}(KL) = E_{-1}\left[\frac{n\left(\frac{P_H}{P}\right)^{1-\eta} PC + (1-n)\left(\frac{P_H^*}{P^*}\right)^{1-\eta} SP^*C^*}{PC}\right]. \tag{54}$$

5.4.1 Segmented financial markets

From the financial market condition (12), the disutility of labour (54) equals

$$\begin{aligned}
E_{-1}(KL) &= n\left(\frac{P_H}{P}\right)^{1-\eta} + (1-n)\left(\frac{P_H^*}{P^*}\right)^{1-\eta}\left(\frac{SP^*}{P}\right)^{(1-\eta)}\left(\frac{P_H}{P_F}\right)^{-(1-\eta)} \\
&= n\left(\frac{P_H}{P}\right)^{1-\eta} + \frac{(1-n)\left(\frac{P_H^*}{P^*}\right)^{1-\eta}}{\left(\frac{P_H^*}{P^*}\right)^{1-\eta}}\left(\frac{P_F}{P}\right)^{1-\eta}
\end{aligned}$$

$$\begin{aligned}
E_{-1}(KL) &= n\left(\frac{P_H}{P}\right)^{1-\eta} + (1-n)\left(\frac{P_F}{P}\right)^{1-\eta}. \text{ From (3), it follows that} \\
1 &= n\left(\frac{P_H}{P}\right)^{1-\eta} + (1-n)\left(\frac{P_F}{P}\right)^{1-\eta}, \text{ so that} \\
E_{-1}(KL) &= 1 \text{ in segmented financial markets.} \qquad (55)
\end{aligned}$$

Consequently, a second-order expansion of (55) yields

$$E_{-1}\left[(\mathsf{l} + \frac{(\mathsf{l}+\mathsf{k})^2}{2})^{seg}\right] = 0.$$

5.4.2 Complete financial markets: after

From (53), we have

$$\begin{aligned}
E_{-1}(KL) &= E_{-1}\left[\frac{P_H}{PC}\left(C_H + \mathcal{P}^* C_H^*\right)\right] \\
E_{-1}(KL) &= E_{-1}\left[\frac{P_H}{PC} Y_H\right].
\end{aligned}$$

We start with the case of the small open economy, $\mathcal{P}^* = \infty$ and, hence, $n^* \to 1$. Then the case of two equally sized countries, $\mathcal{P}^* = 1$ and, hence, $n = n^*$, is illustrated.

For $\mathcal{P}^* = \infty$ in conjunction with (7) and the financial market condition (13), the disutility of labour equation (53) can be utilised to arrive at

$$\begin{aligned} E_{-1}(KL) &= E_{-1}\left[\frac{P_H}{PC}Y_H\right] \\ &= E_{-1}\left[\frac{P_H Y_H}{SP^*}\frac{SP^*}{PC}\right] \\ &= E_{-1}\left[\frac{REV}{SP^*}C^{*-1}\frac{q_F}{q_H}\right] \\ E_{-1}(KL) &= E_{-1}\left[\frac{REV}{SP^*}C^{*-1}\frac{\frac{REV^*}{P^*}}{\frac{REV}{SP^*}}\right] \end{aligned}$$

For $n^* \to 1$, it follows that $P^*C^* = P_F^* Y_F^* = REV^*$ so that

$$\begin{aligned} E_{-1}(KL) &= E_{-1}\left[\frac{REV}{SP^*}C^{*-1}\frac{\frac{P^*C^*}{P^*}}{\frac{REV}{SP^*}}\right] \\ E_{-1}(KL) &= 1, \end{aligned} \tag{56}$$

in complete financial markets when asset trade takes place after monetary policy rules are set, the economy is small relative to the rest of the world. Hence, a second-order expansion of (56) yields

$$E_{-1}\left[(\mathsf{l} + \frac{(\mathsf{l}+\mathsf{k})^2}{2})^{comp}\right] = 0.$$

For $\mathcal{P}^* = 1$ in conjunction with (7) and the financial market condition (13), the disutility of labour equation (53) can be utilised to arrive at

$$E_{-1}(KL) = E_{-1}\left[\frac{REV}{PC}\right]. \tag{57}$$

Now a second order expansion of (57) is taken, which yields

$$E_{-1}(\mathsf{l} + \frac{(\mathsf{l}+\mathsf{k})^2}{2}) = E_{-1}(\mathrm{Re}\,\mathsf{v}) + \frac{(\mathsf{p}_H + \mathsf{y}_H - (\mathsf{p}+\mathsf{c}))^2}{2}.$$

Labour supply is convex in the deviations of l and k by Jensen's inequality. Therefore, the expected value of $E_{-1}(KL)$ must be increasing in the variability of l and k. This fact is reflected by the quadratic labour supply relationship. From (15) and (19)

$$(\mathsf{p}_H + \mathsf{y}_H - (\mathsf{p}+\mathsf{c}))^2 = ((1-n)(1-\Delta)\,\mathsf{ToT})^2.$$

From (7) expected revenue equals

$$\begin{aligned} E_{-1}(\mathrm{Re}\,\mathsf{v}) &= (1-n)(1-\Delta)E_{-1}(\mathsf{ToT}) + (1-n)E_{-1}(\mathsf{s}) \\ &\quad + (1-n)n(1-\Delta)^2\frac{(\mathsf{ToT})^2}{2} \\ &\quad -2(1-n)n(1-\Delta)(1-\eta)\frac{(\mathsf{ToT})^2}{2}. \end{aligned}$$

Thus

$$E_{-1}(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2})=E_{-1}\left(\mathrm{Re}\,\mathsf{v}\right)+\frac{(\mathsf{p}_H+\mathsf{y}_H-(\mathsf{p}+\mathsf{c}))^2}{2}.$$

equals

$$\begin{aligned}E_{-1}(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2}) &= (1-n)\,(1-\Delta)\,E_{-1}\,(\mathsf{ToT})+(1-n)\,E_{-1}\,(\mathsf{s}) \\ &\quad +(1-n)\,(1-\Delta)^2\,\frac{(\mathsf{ToT})^2}{2} \\ &\quad -2\,(1-n)\,n\,(1-\Delta)\,(1-\eta)\,\frac{(\mathsf{ToT})^2}{2}\end{aligned}$$

$$\begin{aligned}E_{-1}(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2}) &= (1-n)\,(1-\Delta)\,E_{-1}\,(\mathsf{ToT})+(1-n)\,E_{-1}\,(\mathsf{s}) \\ &\quad +(1-n)\,(1-\Delta)\,((1-\Delta)-2n\,(1-\eta))\,\frac{(\mathsf{ToT})^2}{2}.\end{aligned}$$

Since $(1-\Delta)-2n\,(1-\eta)=0$ we have

$$E_{-1}(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2})=(1-n)\,(1-\Delta)\,E_{-1}\,(\mathsf{ToT})+(1-n)\,E_{-1}\,(\mathsf{s})$$

From (40) and (44) it follows that

$$E_{-1}\left[(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2})^{comp}\right]=0, \tag{58}$$

in complete financial markets when asset trade takes place after monetary policy rules are set, the economy is equally large relative to the rest of the world.

5.4.3 Complete financial markets: before

From the financial market condition (13), the disutility of labour equation (54) can be utilised to write

$$\begin{aligned}E_{-1}\left(KL\right) &= E_{-1}\left[\frac{n\left(\frac{P_H}{P}\right)^{1-\eta}PC+(1-n)\left(\frac{P_H^*}{P^*}\right)^{1-\eta}SP^*C^*}{PC}\right] \\ &= E_{-1}\left[n\left(\frac{P_H}{P}\right)^{1-\eta}+(1-n)\left(\frac{P_H^*}{P^*}\right)^{1-\eta}\right],\ \text{for}\ \frac{q_F}{q_H}=1.\end{aligned} \tag{59}$$

Taking a second-order expansion of (59) yields

$$\begin{aligned}E_{-1}\left[(\mathsf{l}+\frac{(\mathsf{l}+\mathsf{k})^2}{2})^{comp\_before}\right] &= +(1-n)\,(1-\Delta)\,E_{-1}(\mathsf{ToT}) \\ &\quad +(1-n)\,(1-\eta)^2\left(\left(n(1-n)-n^2\right)-\left(n^*(1-n^*)-n^{*2}\right)\right)\frac{(\mathsf{ToT})^2}{2}.\end{aligned} \tag{60}$$

The more volatile the terms of trade, $\frac{(\mathsf{ToT})}{2}^2$, the higher is the demand variability for domestic goods. This negatively affects the expected disutility of labour. The lower the expected terms of trade $E_{-1}(\mathsf{ToT})$ the cheaper are domestic relative to foreign goods. This increases the demand for home products and raises the expected disutility of labour for $\eta > 1$. The ex post solution of section 2.4.3 does not change when asset trade takes place before monetary policy rules are chosen.

5.5 Welfare under complete financial markets: before

Equations (41) and (60) allow to express welfare of the small open economy in complete financial markets simply by the risk premium $\mathcal{R}_{p_H}$ demanded by domestic fixed-price producers,

$$\mathcal{R}_{p_{H,2}} = \frac{\sigma^2_{p_{H,1}}}{2} - (\Delta - 1)(1-n)\,\sigma^{comp\_before}_{ToT,p_{H,1}},$$

and the volatility of the terms of trade,

$$E_{-1}(\mathsf{w}) = -(\Upsilon^{comp\_before}_{p_{H,1}}(1-\alpha)\frac{\sigma^2_{p_{H,1}}}{2} + \Upsilon^{comp\_before}_{\mathcal{R}_{ToT}}\frac{\sigma^2_{ToT}}{2} + \Upsilon^{comp\_before}_{ToT,p_{H,1}}\sigma_{ToT,p_{H,1}}), \quad (61)$$

given

$$\begin{aligned}
\Upsilon^{comp_before}_{p_{H,1}} &= 1 - \Delta(1-n), && (62)\\
\Upsilon^{comp_before}_{\mathcal{R}_{ToT}} &= (1-\eta)(1-n)\big(n + (1-\eta)\big(1 + n(1-n) - n^2\big)\big) && (63)\\
\Upsilon^{comp_before}_{ToT,p_{H,1}} &= (1-\Delta)(1-n)(1-\Delta(1-n)). && (64)
\end{aligned}$$

The implication of (62) is that in the extreme case when $\eta = (1+n(1-n))/(1-n^2)$, the coefficient $\Upsilon^{comp\_before}_{p_{H,1}}$ is zero and welfare depends only on the volatility of the terms of trade. To ensure that both the volatility of the terms of trade and the risk premium of domestic goods prices are arguments in the welfare function, attention will be confined to parameter sets which ensure that the coefficient $\Upsilon^{comp\_before}_{p_{H,1}}$ is positive. It is assumed that $\eta < (1+n(1-n))/(1-n^2)$. This is qualitatively similar to proposition 1a). The term $\Upsilon^{comp\_before}_{p_{H,1}}$ is decreasing in n. The terms of trade variability enters welfare positively, $\Upsilon^{comp\_before}_{\mathcal{R}_{ToT}} < 0$, when $1 < \eta < (1+n(1-n))/(1-n^2)$. As discussed in proposition 1b), the weight $\Upsilon^{comp\_before}_{\mathcal{R}_{ToT}}$ is increasing in $(1-n)$ in absolute terms. The same is true for the weight $\Upsilon^{comp\_before}_{ToT,p_{H,1}}$. The weight $\Upsilon^{comp\_before}_{ToT,p_{H,1}}$ is strictly positive for $1 > \eta$, zero for $\eta = 1$ and strictly negative for $1 < \eta < (1+n(1-n))/(1-n^2)$ and increasing in $(1-n)$ in absolute terms.

Consequently, the implications for a welfare-oriented monetary policy are the same as for the case where asset trade takes place after monetary policy rules are chosen. An optimal monetary policy would always allow for domestic price variability when the economy is open to trade.

However, when asset trade takes place before monetary policy rules are chosen, an optimal monetary policy will be more active. It follows that the volatility of domestic goods prices will be higher than in financial markets where asset trade takes place after monetary policy rules are chosen. It follows that, in contrast to the case where asset trade takes place after monetary policy rules are set, a CPI-rule will always outperform a DI-rule under financial market integration in terms of welfare for $1 < \eta < (1 + n(1 - n))/(1 - n^2)$.

5.6 Optimal monetary policy rules

A welfare-oriented monetary policy aims at maximising welfare of the small open economy,

$$E_{-1}\left(\mathsf{w}^{fms}\right) = -(\Upsilon^{fms}_{p_{H,1}}\left(1-\alpha\right)\frac{\sigma^2_{p^{fms}_{H,1}}}{2} + \Upsilon^{fms}_{ToT}\frac{\sigma^2_{ToT^{fms}}}{2} + \Upsilon^{fms}_{ToT,p_{H,1}}\left(1-\alpha\right)\sigma^{fms}_{ToT,p_{H,1}}). \quad (65)$$

More precisely, the monetary authority needs to choose the optimal feedback parameters δ^K_{fms} and $\delta^{K^*}_{fms}$, given the foreign monetary policy rule. To find the optimal feedback parameter, domestic goods prices and the terms of trade are expressed in terms of δ^K_{fms} and $\delta^{K^*}_{fms}$. From (9) and (19) domestic goods prices equal

$$\begin{aligned} \mathsf{p}^{seg}_H &= \left(1+\delta^K_{seg}\right)\mathsf{k} + \delta^{K^*}_{seg}\mathsf{k}^* \text{ and} \\ \mathsf{p}^{comp}_H &= \left(1+\delta^K_{comp}\right)\mathsf{k} + \delta^{K^*}_{comp}\mathsf{k}^*. \end{aligned} \quad (66)$$

Utilising equation (9) and (16), the terms of trade under the different financial market structures are written as

$$\begin{aligned} \mathsf{ToT}^{seg} &= -\frac{\delta^K_{seg} - \alpha\left(1+\delta^K_{seg}\right)}{\Delta}\mathsf{k} - \frac{\left(1-\alpha\right)\delta^{K^*}_{seg}+1}{\Delta}\mathsf{k}^* \text{and} \\ \mathsf{ToT}^{comp} &= -\left(\left(1-\alpha\right)\delta^K_{comp} - \alpha\right)\mathsf{k} - \left(1 + \left(1-\alpha\right)\delta^{K^*}_{comp}\right)\mathsf{k}^*. \end{aligned} \quad (67)$$

Lastly, in complete financial markets, the covariance between domestic goods prices and the terms of trade are needed. Therefore, the following expression needs to be utilised:

$$\begin{aligned} & \mathsf{p}^{comp}_H \cdot \left(1-\Delta\right)\left(1-n\right)\mathsf{ToT}^{comp} \quad (68) \\ = \; & -\left(1-\Delta\right)\left(1-n\right)[\left(\left(1-\alpha\right)\left(1+\delta^K_{comp}\right)\delta^K_{comp} - \alpha\left(1+\delta^K_{comp}\right)\right)\mathsf{k}^2 \\ & \qquad + \left(\left(1-\alpha\right)\delta^{K^*}_{comp} + \delta^{K^*}_{comp}\right)\mathsf{k}^{*2}]. \end{aligned}$$

From (66)-(68) the variances and covariances can be derived, given that $E_{-1}\left(\mathsf{x}^2\right) + O\left(\varepsilon\right)^3 = E_{-1}\left(\left(\ln X - E_{-1}\left(\ln X\right)\right)^2\right) = \sigma^2_x$. Plugging them back into (65) the optimal monetary feedback coefficients can be defined. In segmented financial markets, it follows that

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{seg}\right)}{\partial \delta_{seg}^{K}} &= 0 \Rightarrow \\ \delta_{seg}^{K} &= -\frac{\Delta^{2}\Upsilon_{p_{H,1}}^{seg}-\alpha\Upsilon_{ToT}^{seg}}{\Delta^{2}\Upsilon_{p_{H,1}}^{seg}+(1-\alpha)\Upsilon_{ToT}^{seg}}, \qquad (69)\end{aligned}$$

and

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{seg}\right)}{\partial \delta_{seg}^{K^{*}}} &= 0 \Rightarrow \\ \delta_{seg}^{K^{*}} &= -\frac{\Upsilon_{ToT}^{seg}}{\Delta^{2}\Upsilon_{p_{H,1}}^{seg}+(1-\alpha)\Upsilon_{ToT}^{seg}}. \qquad (70)\end{aligned}$$

When financial markets are complete, we have

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{comp}\right)}{\partial \delta_{comp}^{K}} &= 0 \Rightarrow \\ \delta_{comp}^{K}|_{comp} &= -\frac{\left(1-(1-\Delta)(1-n)(1-2\alpha)\right)\Upsilon_{p_{H,1}}^{comp}-\alpha\Upsilon_{ToT}^{comp}}{\left(1-2(1-\alpha)(1-\Delta)(1-n)\right)\Upsilon_{p_{H,1}}^{comp}+(1-\alpha)\Upsilon_{ToT}^{comp}}, \qquad (71)\end{aligned}$$

and

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{comp}\right)}{\partial \delta_{comp}^{K^{*}}} &= 0 \Rightarrow \\ \delta_{comp}^{K^{*}}|_{comp} &= -\frac{(1-\Delta)(1-n)\Upsilon_{p_{H,1}}^{comp}-\Upsilon_{ToT}^{comp}}{\left(1-2(1-\alpha)(1-\Delta)(1-n)\right)\Upsilon_{p_{H,1}}^{comp}+(1-\alpha)\Upsilon_{ToT}^{comp}}. \qquad (72)\end{aligned}$$

Lastly, when asset trade takes place before monetary policy is set, the optimal feedback coefficients equate to

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{comp\_before}\right)}{\partial \delta_{comp}^{K}} &= 0 \Rightarrow \\ \delta_{comp}^{K}|_{comp\_before} &= -\frac{\left(1-(1-\Delta)(1-n)(1-2\alpha)\right)\Upsilon_{p_{H,1}}^{comp\_before}-\alpha\Upsilon_{ToT}^{comp\_before}}{\left(1-2(1-\alpha)(1-\Delta)(1-n)\right)\Upsilon_{p_{H,1}}^{comp\_before}+(1-\alpha)\Upsilon_{ToT}^{comp\_before}} \qquad (73)\end{aligned}$$

as well as

$$\begin{aligned}\frac{\partial E_{-1}\left(\mathsf{w}^{comp\_before}\right)}{\partial \delta_{comp}^{K^{*}}} &= 0 \Rightarrow \\ \delta_{comp}^{K^{*}}|_{comp\_before} &= -\frac{(1-\Delta)(1-n)\Upsilon_{p_{H,1}}^{comp\_before}-\Upsilon_{ToT}^{comp\_before}}{\left(1-2(1-\alpha)(1-\Delta)(1-n)\right)\Upsilon_{p_{H,1}}^{comp\_before}+(1-\alpha)\Upsilon_{ToT}^{comp\_before}} \qquad (74)\end{aligned}$$

These coefficients provide the basis for the derivation of the optimal monetary policy responses of the macroeconomic variables and welfare, as shown in Figures 1-5.

Table 1: Summary of the monetary feedback parameters

	Segmented Markets	Complete Markets
DI-rule:	$\delta^{K}_{DI^{seg}} = -1$	$\delta^{K}_{DI^{comp}} = -1$
	$\delta^{K^*}_{DI^{seg}} = \quad 0$	$\delta^{K^*}_{DI^{comp}} = \quad 0$
CPI-rule:	$\delta^{K}_{CPI^{seg}} = -\frac{(\Delta-(1-n))\alpha}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$\delta^{K}_{CPI^{comp}} = -\frac{n\alpha}{1-n(1-\alpha)}$
	$\delta^{K^*}_{CPI^{seg}} = -\frac{(1-n)}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$\delta^{K^*}_{CPI^{comp}} = -\frac{(1-n)}{1-n(1-\alpha)}$
Peg:	$\delta^{K}_{Peg^{seg}} = -\frac{\alpha(\Delta-1)}{1-\alpha(1-\Delta)}$	$\delta^{K}_{Peg^{comp}} = \quad 0$
	$\delta^{K^*}_{Peg^{seg}} = -\frac{1}{1-\alpha(1-\Delta)}$	$\delta^{K^*}_{Peg^{comp}} = -1$

Table 2: Summary of the endogenous variables

	Segmented Markets		Complete Markets
ToT^{seg}		ToT^{comp}	
$DI:$	$\frac{(\mathsf{k}-\mathsf{k}^*)}{\Delta}$	$DI:$	$\mathsf{k}-\mathsf{k}^*$
$CPI:$	$\alpha\frac{(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$CPI:$	$\alpha\frac{(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)}$
$Peg:$	$\alpha\frac{(\mathsf{k}-\mathsf{k}^*)}{1-\alpha(1-\Delta)}$	$Peg:$	$\alpha\left(\mathsf{k}-\mathsf{k}^*\right)$
s^{seg}		s^{comp}	
$DI:$	$-\frac{(\mathsf{k}-\mathsf{k}^*)}{\Delta}$	$DI:$	$-\left(\mathsf{k}-\mathsf{k}^*\right)$
$CPI:$	$\alpha\frac{-n(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$CPI:$	$\alpha\frac{-n(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)}$
$Peg:$	0	$Peg:$	0
$\mathsf{p}_{H,1}^{seg}$		$\mathsf{p}_{H,1}^{comp}$	
$DI:$	0	$DI:$	0
$CPI:$	$\frac{(1-n)(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$CPI:$	$\frac{(1-n)(\mathsf{k}-\mathsf{k}^*)}{1-n(1-\alpha)}$
$Peg:$	$\frac{(\mathsf{k}-\mathsf{k}^*)}{1-\alpha(1-\Delta)}$	$Peg:$	$\left(\mathsf{k}-\mathsf{k}^*\right)$
c^{seg}		c^{comp}	
$DI:$	$-\frac{(\Delta-(1-n))\mathsf{k}+(1-n)\mathsf{k}^*}{\Delta}$	$DI:$	$-n\mathsf{k}-(1-n)\,\mathsf{k}^*$
$CPI:$	$-\frac{(n-(1-\Theta))\alpha\mathsf{k}+(1-n)\mathsf{k}^*}{1-n(1-\alpha)-\alpha(1-\Delta)}$	$CPI:$	$-\frac{n\alpha\mathsf{k}+(1-n)\mathsf{k}^*}{1-n(1-\alpha)}$
$Peg:$	$-\frac{\alpha(n-(1-\Delta))\mathsf{k}+(1-n\alpha)\mathsf{k}^*}{1-\alpha(1-\Delta)}$	$Peg:$	$-\mathsf{k}^*-n\alpha\left(\mathsf{k}-\mathsf{k}^*\right)$
$\mathsf{l}^{seg}=\mathsf{y}_H^{seg}$		$\mathsf{l}^{comp}=\mathsf{y}_H^{comp}$	
$DI:$	$-\mathsf{k}$	$DI:$	$-\Theta\mathsf{k}-(1-\Theta)\,\mathsf{k}^*$
$CPI:$	$-\frac{\alpha\Delta\mathsf{k}+(1-n)(1-\alpha)\mathsf{k}^*}{1-\alpha(1-\Delta)-n(1-\alpha)}$	$CPI:$	$-\frac{\alpha\Theta\mathsf{k}+(\alpha(1-\Theta)+(1-\alpha)(1-n))\mathsf{k}^*}{1-n(1-\alpha)}$
$Peg:$	$-\frac{\alpha\Delta\mathsf{k}+(1-\alpha)\mathsf{k}^*}{1-\alpha(1-\Delta)}$	$Peg:$	$-\alpha\Theta\mathsf{k}-(1-\alpha\Theta)\,\mathsf{k}^*$
$\Theta=\Delta\,(1-n)+n>0$			

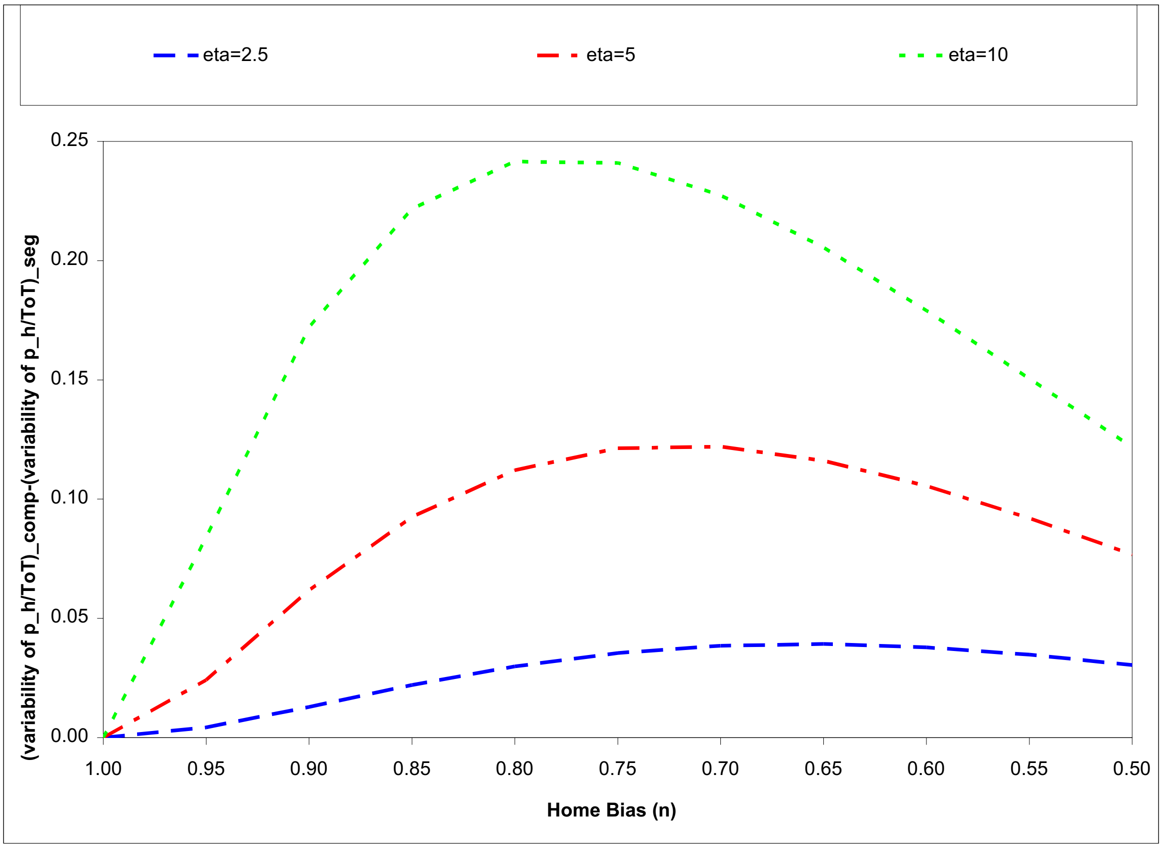
Note: Terms of order $O\left(\varepsilon\right)^2$ and higher are ignored.

Table 3: Summary of the endogenous variances

Segmented Markets	Complete Markets
$\sigma^2_{ToT^{seg}}$	$\sigma^2_{ToT^{comp}}$
$DI: \quad \frac{\left(\sigma_k^2+\sigma_{k^*}^2\right)}{\Delta^2}$	$DI: \quad \sigma_k^2+\sigma_{k^*}^2$
$CPI: \quad \frac{\alpha^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha)-\alpha(1-\Delta))^2}$	$CPI: \quad \frac{\alpha^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha))^2}$
$Peg: \quad \frac{\alpha^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-\alpha(1-\Delta))^2}$	$Peg: \quad \alpha^2\left(\sigma_k^2+\sigma_{k^*}^2\right)$
$\sigma^2_{s^{seg}}$	$\sigma^2_{s^{comp}}$
$DI: \quad \frac{\left(\sigma_k^2+\sigma_{k^*}^2\right)}{\Delta^2}$	$DI: \quad \sigma_k^2+\sigma_{k^*}^2$
$CPI: \quad \frac{(n\alpha)^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha)-\alpha(1-\Delta))^2}$	$CPI: \quad \frac{(n\alpha)^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha))^2}$
$Peg: \quad 0$	$Peg: \quad 0$
$\sigma^2_{p_{H,1}^{seg}}$	$\sigma^2_{p_{H,1}^{comp}}$
$DI: \quad 0$	$DI: \quad 0$
$CPI: \quad \frac{(1-n)^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha)-\alpha(1-\Delta))^2}$	$CPI: \quad \frac{(1-n)^2\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-n(1-\alpha))^2}$
$Peg: \quad \frac{\left(\sigma_k^2+\sigma_{k^*}^2\right)}{(1-\alpha(1-\Delta))^2}$	$Peg: \quad \sigma_k^2+\sigma_{k^*}^2$
$\sigma^2_{c^{seg}}$	$\sigma^2_{c^{comp}}$
$DI: \quad \frac{(\Delta-(1-n))^2\sigma_k^2+(1-n)^2\sigma_{k^*}^2}{\Delta^2}$	$DI: \quad n^2\sigma_k^2+(1-n)^2\sigma_{k^*}^2$
$CPI: \quad \frac{((n-(1-\Theta))\alpha)^2\sigma_k^2+(1-n)^2\sigma_{k^*}^2}{(1-n(1-\alpha)-\alpha(1-\Delta))^2}$	$CPI: \quad \frac{(n\alpha)^2\sigma_k^2+(1-n)^2\sigma_{k^*}^2}{1-n(1-\alpha)}$
$Peg: \quad \frac{(\alpha(n-(1-\Delta)))^2\sigma_k^2+(1-n\alpha)\sigma_{k^*}^2}{(1-\alpha(1-\Delta))^2}$	$Peg: \quad (n\alpha)^2\sigma_k^2+(1-n\alpha)^2\sigma_{k^*}^2$
$\sigma^2_{l^{seg}}=\sigma^2_{y_H^{seg}}$	$\sigma^2_{l^{comp}}=\sigma^2_{y_H^{comp}}$
$DI: \quad \sigma_k^2$	$DI: \quad \Theta^2\sigma_k^2+(1-\Theta)^2\sigma_{k^*}^2$
$CPI: \quad \frac{(\alpha\Delta)^2\sigma_k^2+((1-n)(1-\alpha))^2\sigma_{k^*}^2}{(1-\alpha(1-\Delta)-n(1-\alpha))^2}$	$CPI: \quad \frac{(\alpha\Theta)^2\sigma_k^2+(\alpha(1-\Theta)+(1-\alpha)(1-n))^2\sigma_{k^*}^2}{(1-n(1-\alpha))^2}$
$Peg: \quad \frac{(\alpha\Delta)^2\sigma_k^2+(1-\alpha)^2\sigma_{k^*}^2}{(1-\alpha(1-\Delta))^2}$	$Peg: \quad (\alpha\Theta)^2\sigma_k^2+(1-\alpha\Theta)^2\sigma_{k^*}^2$
$\Theta=\Delta(1-n)+n>0$	

Note: Terms of order $O(\varepsilon)^3$ and higher are ignored.

Figure 1: Optimal monetary policy trade-off

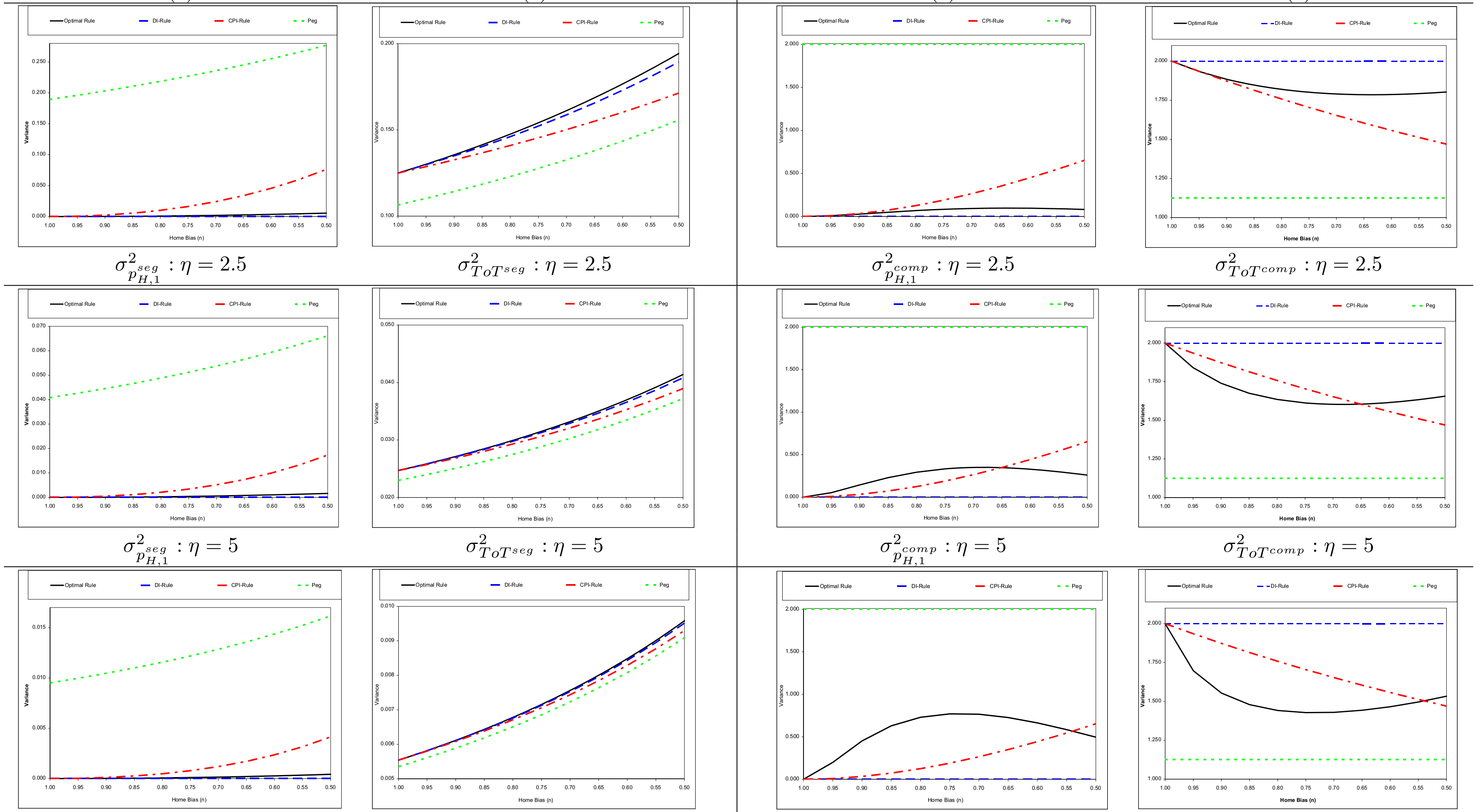


Note: International financial market's influence on the importance of the variability of domestic goods prices, $\sigma^2_{p_{H,1}}$, as opposed to the terms of trade variability, σ^2_{ToT}. Simulations for $\alpha = 0.5$, $\sigma^2_k = \sigma^2_{k^*}$. The solid line, the dashed line with dots and the dotted line reflect the difference of optimal domestic goods price variability relative to the terms of trade variability in complete and segmented financial markets, $(\sigma^2_{p_{H,1}}/\sigma^2_{ToT})^{comp} - (\sigma^2_{p_{H,1}}/\sigma^2_{ToT})^{seg}$, for varying values of η.

Figure 2: Variability of domestic prices and the terms of trade.

Domestic prices, $\sigma^2_{p_{H,1}^{fms}}$, and the terms of trade $\sigma^2_{ToT^{fms}}$

Segmented Markets		Complete Markets	
(1)	(2)	(3)	(4)

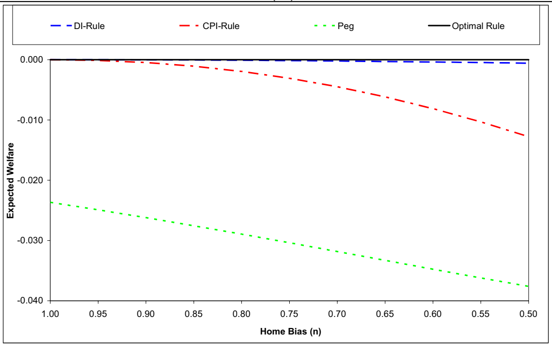


(1)	(2)	(3)	(4)
$\sigma^2_{p_{H,1}^{seg}} : \eta = 2.5$	$\sigma^2_{ToT^{seg}} : \eta = 2.5$	$\sigma^2_{p_{H,1}^{comp}} : \eta = 2.5$	$\sigma^2_{ToT^{comp}} : \eta = 2.5$
$\sigma^2_{p_{H,1}^{seg}} : \eta = 5$	$\sigma^2_{ToT^{seg}} : \eta = 5$	$\sigma^2_{p_{H,1}^{comp}} : \eta = 5$	$\sigma^2_{ToT^{comp}} : \eta = 5$
$\sigma^2_{p_{H,1}^{seg}} : \eta = 10$	$\sigma^2_{ToT^{seg}} : \eta = 10$	$\sigma^2_{p_{H,1}^{comp}} : \eta = 10$	$\sigma^2_{ToT^{comp}} : \eta = 10$

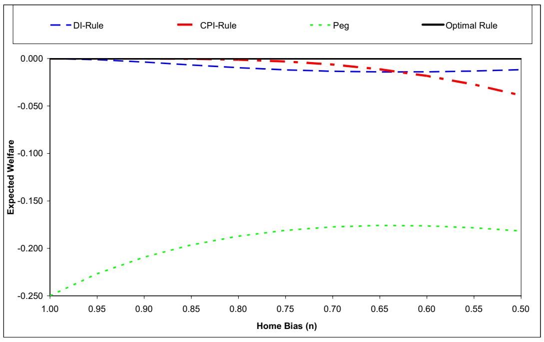
Note: Simulations for $\alpha = 0.5$, $\sigma_k^2 = \sigma_{k^*}^2$ and varying values of η. A solid line reflects the optimal monetary policy rule, a dashed line a float (DI-rule), a dashed line with dots the intermediate exchange rate regime (CPI-rule) and a dotted line reflects a peg.

Figure 3: Welfare performance: Exchange rate rules relative to optimal monetary policy

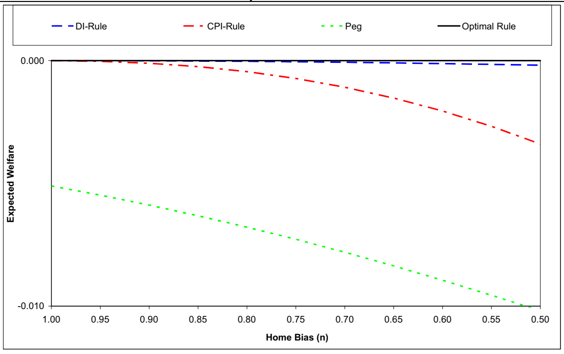
Segmented Markets	Complete Markets
(1)	(2)



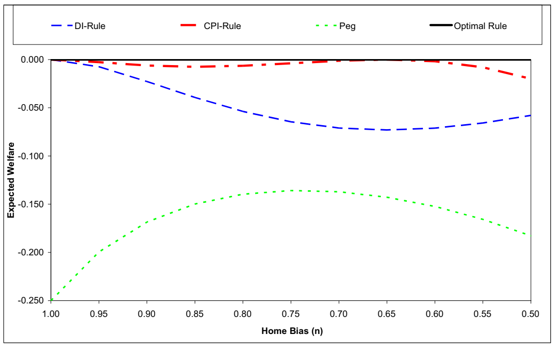
$\eta = 2.5$



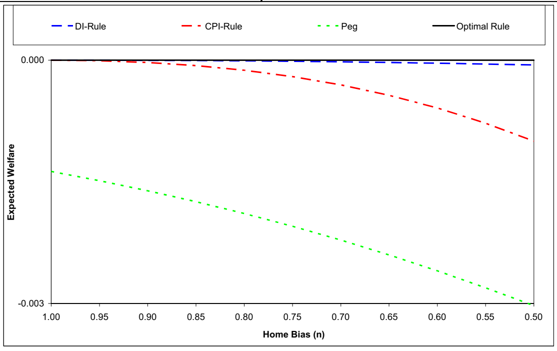
$\eta = 2.5$



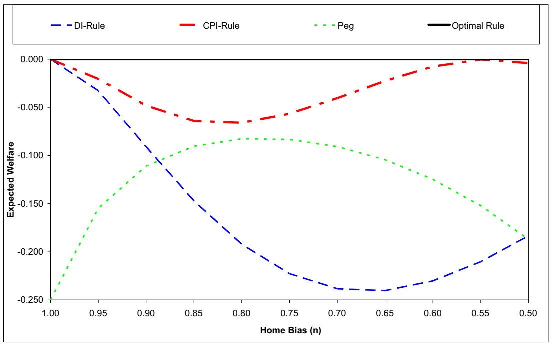
$\eta = 5$



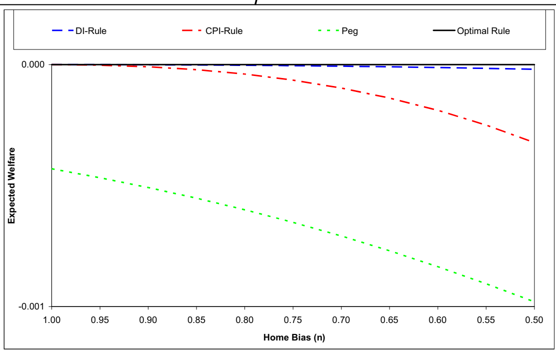
$\eta = 5$



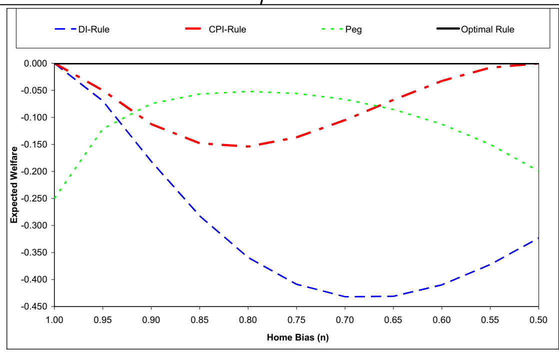
$\eta = 10$



$\eta = 10$



$\eta = 15$



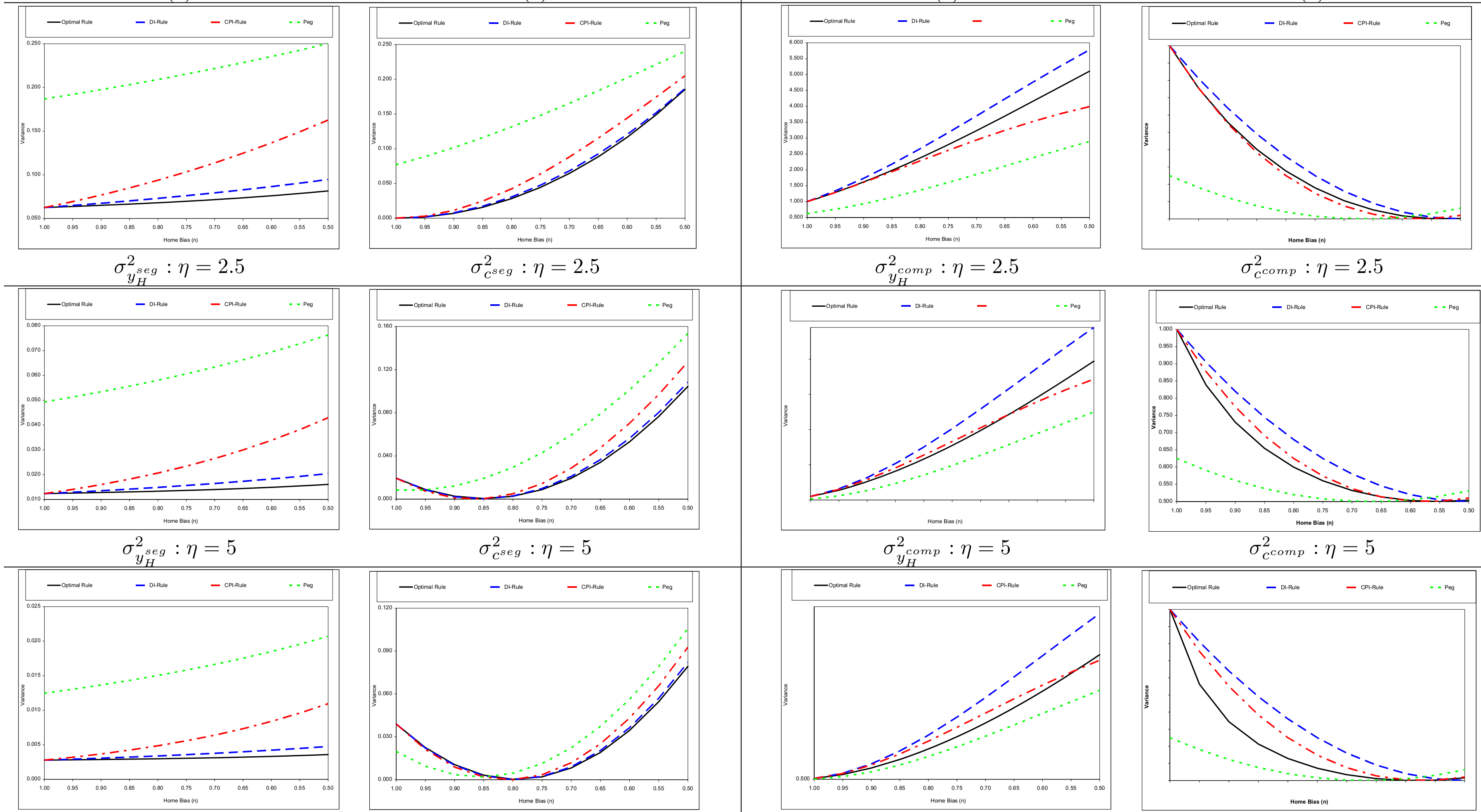
$\eta = 15$

Note: Simulations for $\alpha = 0.5$, $\sigma_k^2 = \sigma_{k^*}^2$ and varying values of η. A solid line reflects the optimal monetary policy rule, a dashed line a float (DI-rule), a dashed line with dots the intermediate exchange rate regime (CPI-rule) and a dotted line reflects a peg.

Figure 4: Variability of domestic output and consumption

Domestic output, $\sigma^2_{y_H^{fms}}$, and consumption, $\sigma^2_{c^{fms}}$

Segmented Markets (1) (2) | Complete Markets (3) (4)



(1): $\sigma^2_{y_H^{seg}} : \eta = 2.5$; $\sigma^2_{y_H^{seg}} : \eta = 5$; $\sigma^2_{y_H^{seg}} : \eta = 10$

(2): $\sigma^2_{c^{seg}} : \eta = 2.5$; $\sigma^2_{c^{seg}} : \eta = 5$; $\sigma^2_{c^{seg}} : \eta = 10$

(3): $\sigma^2_{y_H^{comp}} : \eta = 2.5$; $\sigma^2_{y_H^{comp}} : \eta = 5$; $\sigma^2_{y_H^{comp}} : \eta = 10$

(4): $\sigma^2_{c^{comp}} : \eta = 2.5$; $\sigma^2_{c^{comp}} : \eta = 5$; $\sigma^2_{c^{comp}} : \eta = 10$

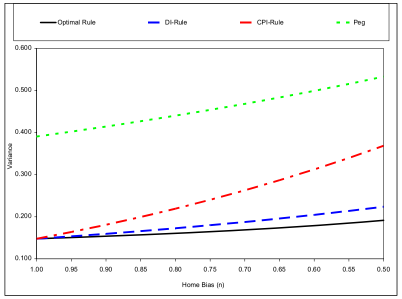
Note: Simulations for $\alpha = 0.5$, $\sigma^2_k = \sigma^2_{k^*}$ and varying values of η. A solid line reflects the optimal monetary policy rule, a dashed line a float (DI-rule), a dashed line with dots the intermediate exchange rate regime (CPI-rule) and a dotted line reflects a peg.

Figure 5: Variability of domestic output and consumption: asymmetric supply shocks

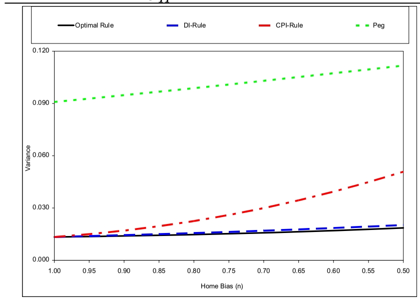
Domestic output, $\sigma^2_{y_H^{fms}}$, and consumption, $\sigma^2_{c^{fms}}$ $(\eta = 2.5)$

Segmented Markets

(1)

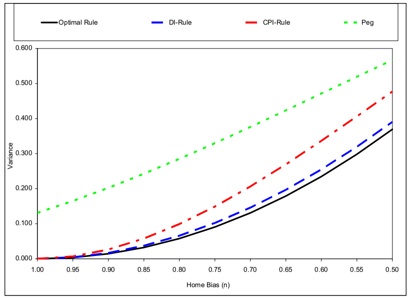


$\sigma^2_{y_H^{seg}} : \sigma^2_k > \sigma^2_{k^*}$

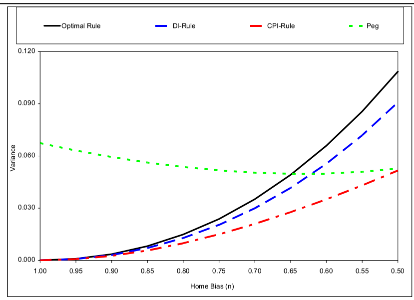


$\sigma^2_{y_H^{seg}} : \sigma^2_k < \sigma^2_{k^*}$

(2)



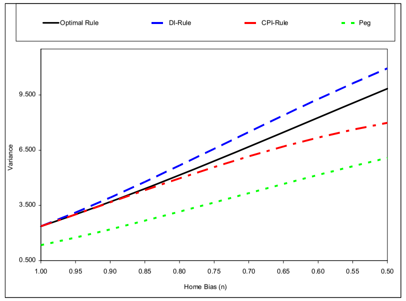
$\sigma^2_{c^{seg}} : \sigma^2_k > \sigma^2_{k^*}$



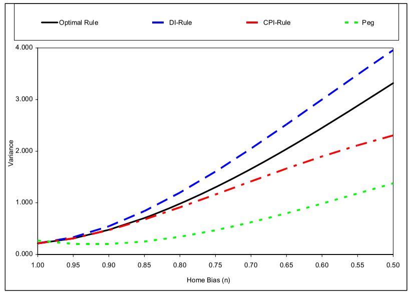
$\sigma^2_{c^{seg}} : \sigma^2_k < \sigma^2_{k^*}$

Complete Markets

(3)

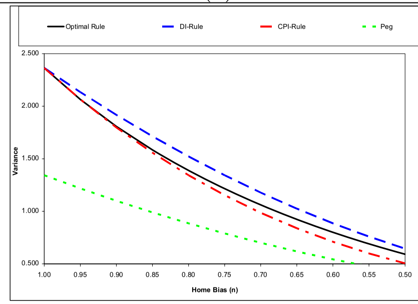


$\sigma^2_{y_H^{comp}} : \sigma^2_k > \sigma^2_{k^*}$

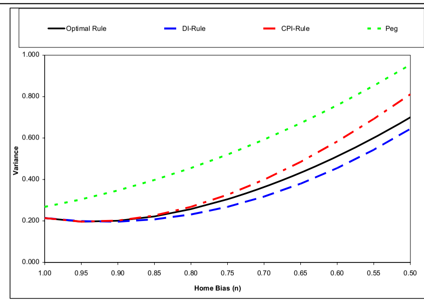


$\sigma^2_{y_H^{comp}} : \sigma^2_k < \sigma^2_{k^*}$

(4)



$\sigma^2_{c^{comp}} : \sigma^2_k > \sigma^2_{k^*}$



$\sigma^2_{c^{comp}} : \sigma^2_k < \sigma^2_{k^*}$

Note: Simulations for $\alpha = 0.5$ and varying values of η. A solid line reflects the optimal monetary policy rule, a dashed line a float (DI-rule), a dashed line with dots the intermediate exchange rate regime (CPI-rule) and a dotted line reflects a peg.

The following Discussion Papers have been published since 2007:

Series 1: Economic Studies

01	2007	The effect of FDI on job separation	Sascha O. Becker Marc-Andreas Mündler
02	2007	Threshold dynamics of short-term interest rates: empirical evidence and implications for the term structure	Theofanis Archontakis Wolfgang Lemke
03	2007	Price setting in the euro area: some stylised facts from individual producer price data	Dias, Dossche, Gautier Hernando, Sabbatini Stahl, Vermeulen
04	2007	Unemployment and employment protection in a unionized economy with search frictions	Nikolai Stähler
05	2007	End-user order flow and exchange rate dynamics	S. Reitz, M. A. Schmidt M. P. Taylor
06	2007	Money-based interest rate rules: lessons from German data	C. Gerberding F. Seitz, A. Worms
07	2007	Moral hazard and bail-out in fiscal federations: evidence for the German Länder	Kirsten H. Heppke-Falk Guntram B. Wolff
08	2007	An assessment of the trends in international price competitiveness among EMU countries	Christoph Fischer
09	2007	Reconsidering the role of monetary indicators for euro area inflation from a Bayesian perspective using group inclusion probabilities	Michael Scharnagl Christian Schumacher
10	2007	A note on the coefficient of determination in regression models with infinite-variance variables	Jeong-Ryeol Kurz-Kim Mico Loretan

11	2007	Exchange rate dynamics in a target zone - a heterogeneous expectations approach	Christian Bauer Paul De Grauwe, Stefan Reitz
12	2007	Money and housing - evidence for the euro area and the US	Claus Greiber Ralph Setzer
13	2007	An affine macro-finance term structure model for the euro area	Wolfgang Lemke
14	2007	Does anticipation of government spending matter? Evidence from an expectation augmented VAR	Jörn Tenhofen Guntram B. Wolff
15	2007	On-the-job search and the cyclical dynamics of the labor market	Michael Krause Thomas Lubik
16	2007	Heterogeneous expectations, learning and European inflation dynamics	Anke Weber
17	2007	Does intra-firm bargaining matter for business cycle dynamics?	Michael Krause Thomas Lubik
18	2007	Uncertainty about perceived inflation target and monetary policy	Kosuke Aoki Takeshi Kimura
19	2007	The rationality and reliability of expectations reported by British households: micro evidence from the British household panel survey	James Mitchell Martin Weale
20	2007	Money in monetary policy design under uncertainty: the Two-Pillar Phillips Curve versus ECB-style cross-checking	Günter W. Beck Volker Wieland
21	2007	Corporate marginal tax rate, tax loss carryforwards and investment functions – empirical analysis using a large German panel data set	Fred Ramb

22	2007	Volatile multinationals? Evidence from the labor demand of German firms	Claudia M. Buch Alexander Lipponer
23	2007	International investment positions and exchange rate dynamics: a dynamic panel analysis	Michael Binder Christian J. Offermanns
24	2007	Testing for contemporary fiscal policy discretion with real time data	Ulf von Kalckreuth Guntram B. Wolff
25	2007	Quantifying risk and uncertainty in macroeconomic forecasts	Malte Knüppel Karl-Heinz Tödter
26	2007	Taxing deficits to restrain government spending and foster capital accumulation	Nikolai Stähler
27	2007	Spill-over effects of monetary policy – a progress report on interest rate convergence in Europe	Michael Flad
28	2007	The timing and magnitude of exchange rate overshooting	Hoffmann Sondergaard, Westelius
29	2007	The timeless perspective vs. discretion: theory and monetary policy implications for an open economy	Alfred V. Guender
30	2007	International cooperation on innovation: empirical evidence for German and Portuguese firms	Pedro Faria Tobias Schmidt
31	2007	Simple interest rate rules with a role for money	M. Scharnagl C. Gerberding, F. Seitz
32	2007	Does Benford's law hold in economic research and forecasting?	Stefan Günnel Karl-Heinz Tödter
33	2007	The welfare effects of inflation: a cost-benefit perspective	Karl-Heinz Tödter Bernhard Manzke

34	2007	Factor-MIDAS for now- and forecasting with ragged-edge data: a model comparison for German GDP	Massimiliano Marcellino Christian Schumacher
35	2007	Monetary policy and core inflation	Michele Lenza
01	2008	Can capacity constraints explain asymmetries of the business cycle?	Malte Knüppel
02	2008	Communication, decision-making and the optimal degree of transparency of monetary policy committees	Anke Weber
03	2008	The impact of thin-capitalization rules on multinationals' financing and investment decisions	Buettner, Overesch Schreiber, Wamser
04	2008	Comparing the DSGE model with the factor model: an out-of-sample forecasting experiment	Mu-Chun Wang
05	2008	Financial markets and the current account – emerging Europe versus emerging Asia	Sabine Herrmann Adalbert Winkler
06	2008	The German sub-national government bond market: evolution, yields and liquidity	Alexander Schulz Guntram B. Wolff
07	2008	Integration of financial markets and national price levels: the role of exchange rate volatility	Mathias Hoffmann Peter Tillmann
08	2008	Business cycle evidence on firm entry	Vivien Lewis
09	2008	Panel estimation of state dependent adjustment when the target is unobserved	Ulf von Kalckreuth
10	2008	Nonlinear oil price dynamics – a tale of heterogeneous speculators?	Stefan Reitz Ulf Slopek

11	2008	Financing constraints, firm level adjustment of capital and aggregate implications	Ulf von Kalckreuth
12	2008	Sovereign bond market integration: the euro, trading platforms and globalization	Alexander Schulz Guntram B. Wolff
13	2008	Great moderation at the firm level? Unconditional versus conditional output volatility	Claudia M. Buch Jörg Döpke Kerstin Stahn
14	2008	How informative are macroeconomic risk forecasts? An examination of the Bank of England's inflation forecasts	Malte Knüppel Guido Schultefrankenfeld
15	2008	Foreign (in)direct investment and corporate taxation	Georg Wamser
16	2008	The global dimension of inflation – evidence from factor-augmented Phillips curves	Sandra Eickmeier Katharina Moll
17	2008	Global business cycles: convergence or decoupling?	M. Ayhan Kose Christopher Otrok, Ewar Prasad
18	2008	Restrictive immigration policy in Germany: pains and gains foregone?	Gabriel Felbermayr Wido Geis Wilhelm Kohler
19	2008	International portfolios, capital accumulation and foreign assets dynamics	Nicolas Coeurdacier Robert Kollmann Philippe Martin
20	2008	Financial globalization and monetary policy	Michael B. Devereux Alan Sutherland
21	2008	Banking globalization, monetary transmission and the lending channel	Nicola Cetorelli Linda S. Goldberg

22	2008	Financial exchange rates and international currency exposures	Philip R. Lane Jay C. Shambaugh
23	2008	Financial integration, specialization and systemic risk	F. Fecht, H. P. Grüner P. Hartmann
24	2008	Sectoral differences in wage freezes and wage cuts: evidence from a new firm survey	Daniel Radowski Holger Bonin
25	2008	Liquidity and the dynamic pattern of price adjustment: a global view	Ansgar Belke Walter Orth, Ralph Setzer
26	2008	Employment protection and temporary work agencies	Florian Baumann Mario Mechtel, Nikolai Stähler
27	2008	International financial markets' influence on the welfare performance of alternative exchange rate regimes	Mathias Hoffmann

Series 2: Banking and Financial Studies

01	2007	Granularity adjustment for Basel II	Michael B. Gordy Eva Lütkebohmert
02	2007	Efficient, profitable and safe banking: an oxymoron? Evidence from a panel VAR approach	Michael Koetter Daniel Porath
03	2007	Slippery slopes of stress: ordered failure events in German banking	Thomas Kick Michael Koetter
04	2007	Open-end real estate funds in Germany – genesis and crisis	C. E. Bannier F. Fecht, M. Tyrell
05	2007	Diversification and the banks' risk-return-characteristics – evidence from loan portfolios of German banks	A. Behr, A. Kamp C. Memmel, A. Pfingsten
06	2007	How do banks adjust their capital ratios? Evidence from Germany	Christoph Memmel Peter Raupach
07	2007	Modelling dynamic portfolio risk using risk drivers of elliptical processes	Rafael Schmidt Christian Schmieder
08	2007	Time-varying contributions by the corporate bond and CDS markets to credit risk price discovery	Niko Dötz
09	2007	Banking consolidation and small business finance – empirical evidence for Germany	K. Marsch, C. Schmieder K. Forster-van Aerssen
10	2007	The quality of banking and regional growth	Hasan, Koetter, Wedow
11	2007	Welfare effects of financial integration	Fecht, Grüner, Hartmann
12	2007	The marketability of bank assets and managerial rents: implications for financial stability	Falko Fecht Wolf Wagner

13	2007	Asset correlations and credit portfolio risk – an empirical analysis	K. Düllmann, M. Scheicher C. Schmieder
14	2007	Relationship lending – empirical evidence for Germany	C. Memmel C. Schmieder, I. Stein
15	2007	Creditor concentration: an empirical investigation	S. Ongena, G.Tümer-Alkan N. von Westernhagen
16	2007	Endogenous credit derivatives and bank behaviour	Thilo Pausch
17	2007	Profitability of Western European banking systems: panel evidence on structural and cyclical determinants	Rainer Beckmann
18	2007	Estimating probabilities of default with support vector machines	W. K. Härdle R. A. Moro, D. Schäfer
01	2008	Analyzing the interest rate risk of banks using time series of accounting-based data: evidence from Germany	O. Entrop, C. Memmel M. Wilkens, A. Zeisler
02	2008	Bank mergers and the dynamics of deposit interest rates	Ben R. Craig Valeriya Dinger
03	2008	Monetary policy and bank distress: an integrated micro-macro approach	F. de Graeve T. Kick, M. Koetter
04	2008	Estimating asset correlations from stock prices or default rates – which method is superior?	K. Düllmann J. Küll, M. Kunisch
05	2008	Rollover risk in commercial paper markets and firms' debt maturity choice	Felix Thierfelder
06	2008	The success of bank mergers revisited – an assessment based on a matching strategy	Andreas Behr Frank Heid

07	2008	Which interest rate scenario is the worst one for a bank? Evidence from a tracking bank approach for German savings and cooperative banks	Christoph Memmel
08	2008	Market conditions, default risk and credit spreads	Dragon Yongjun Tang Hong Yan
09	2008	The pricing of correlated default risk: evidence from the credit derivatives market	Nikola Tarashev Haibin Zhu
10	2008	Determinants of European banks' engagement in loan securitization	Christina E. Bannier Dennis N. Hänsel
11	2008	Interaction of market and credit risk: an analysis of inter-risk correlation and risk aggregation	Klaus Böcker Martin Hillebrand
12	2008	A value at risk analysis of credit default swaps	B. Raunig, M. Scheicher
13	2008	Systemic bank risk in Brazil: an assessment of correlated market, credit, sovereign and inter-bank risk in an environment with stochastic volatilities and correlations	Theodore M. Barnhill, Jr. Marcos Rietti Souto
14	2008	Regulatory capital for market and credit risk inter-action: is current regulation always conservative?	T. Breuer, M. Jandačka K. Rheinberger, M. Summer
15	2008	The implications of latent technology regimes for competition and efficiency in banking	Michael Koetter Tigran Poghosyan
16	2008	The impact of downward rating momentum on credit portfolio risk	André Güttler Peter Raupach
17	2008	Stress testing of real credit portfolios	F. Mager, C. Schmieder
18	2008	Real estate markets and bank distress	M. Koetter, T. Poghosyan

19	2008	Stochastic frontier analysis by means of maximum likelihood and the method of moments	Andreas Behr Sebastian Tente

Visiting researcher at the Deutsche Bundesbank

The Deutsche Bundesbank in Frankfurt is looking for a visiting researcher. Among others under certain conditions visiting researchers have access to a wide range of data in the Bundesbank. They include micro data on firms and banks not available in the public. Visitors should prepare a research project during their stay at the Bundesbank. Candidates must hold a PhD and be engaged in the field of either macroeconomics and monetary economics, financial markets or international economics. Proposed research projects should be from these fields. The visiting term will be from 3 to 6 months. Salary is commensurate with experience.

Applicants are requested to send a CV, copies of recent papers, letters of reference and a proposal for a research project to:

Deutsche Bundesbank
Personalabteilung
Wilhelm-Epstein-Str. 14

60431 Frankfurt
GERMANY