EUROPEAN CENTRAL BANK
EUROSYSTEM

WORKING PAPER SERIES
NO 1040 / MARCH 2009

THE EXTERNAL AND DOMESTIC SIDE OF MACROECONOMIC ADJUSTMENT IN CHINA

by Roland Straub
and Christian Thimann

EUROPEAN CENTRAL BANK

EUROSYSTEM

WORKING PAPER SERIES

NO 1040 / MARCH 2009

THE EXTERNAL AND DOMESTIC SIDE OF MACROECONOMIC ADJUSTMENT IN CHINA[1]

by Roland Straub

and Christian Thimann[2]

In 2009 all ECB publications feature a motif taken from the €200 banknote.

1 The opinions expressed are those of the authors and do not necessarily reflect views of the European Central Bank. Any remaining errors are the sole responsibility of the authors. We would like to thank, without implicating, Jin Zhongxia, Zheng Hong, Liu Bin and other colleagues of the People's Bank of China, as well as colleagues at the ECB and an anonymous referee for helpful comments.

2 European Central Bank, Kaiserstrasse 29, D-60311 Frankfurt am Main, Germany; e-mails: roland.straub@ecb.europa.eu; christian.thimann@ecb.europa.eu

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Website
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

ISSN 1725-2806 (online)

CONTENTS

Abstract

This paper sheds new light on the external and domestic dimension of China's exchange rate policy. It presents an open economy model to analyse both dimensions of macroeconomic adjustment in China under both flexible and fixed exchange rate regimes. The model-based results indicate that persistent current account surpluses in China cannot be rationalized, under general circumstances, by the occurrence of permanent technology or labour supply shocks. As a result, the understanding of the macroeconomic adjustment process in China requires to mimic the effects of potential inefficiencies, which induce the subdued response of domestic absorption to permanent income shocks causing thereby the observed positive unconditional correlation of trade balance and output. The paper argues that these inefficiencies can be potentially seen as a by-product of the fixed exchange rate regime, and can be approximated by a stochastic tax on domestic consumption or time varying transaction cost technology related to money holdings. Our results indicate that a fixed exchange regime with financial market distortions, as defined above, might induce negative effects on GDP growth in the medium-term compared to a more flexible exchange rate regime.

Keywords: DSGE modelling, China, current account

JEL Classification: E32, E62

Non-technical Summary

China's economic transformation at the turn of the 21st century will mark economic history for its astounding domestic success and important global impact. The rising interest in China has also spurred an academic debate that provided numerous contributions on various aspects of China's exchange rate reform (for an overview of the key issues see ECB, 2007; for an overview of the literature see Lafrance, 2008). A large number of contributions address the issue of valuation of the Chinese renminbi, mostly pointing to a large undervaluation and advising a significant nominal appreciation (e.g., Dunaway and Li, 2005; Dunaway, Leigh and Li, 2006; Goldstein, 2007; Roubini, 2007). The findings are, however, not unanimous, and neither is the recommendation to appreciate the nominal exchange rate (e.g., McKinnon, 2007; Dooley et al., 2004). This is not surprising given that the challenges, which are already considerable when it comes to assess equilibrium exchange rates of advanced economies that are traded in deep and liquid markets, are manifold in the context of an emerging economy with a short data record that is engaged in a fundamental transition process, underlying rapid technological adaptation and characterised by massive regional inequalities. Moreover, in China's case the economy is opening rapidly, with trade being driven by foreign direct investment and regional integration, and with financial markets being highly regulated.

This paper sheds new light on the external and domestic dimension of China's exchange rate policy based on DSGE model with a rigorous microfoundation. First, it argues that in a state-of-the-art DSGE, the observed accumulation of net foreign asset positions and corresponding persistent current account surpluses cannot be rationalized under general circumstance by the occurrence of permanent technology and labour supply shocks. Permanent technology shocks imply a positive wealth shock to the domestic households, which triggers due to consumption smoothing a rise in private consumption inducing thereby a current account deficit. Even if the latter channel is missing, for example due to limited asset market participation or myopia, the rise in the marginal product of capital will imply a current account deficit driven by a rise in domestic investment. Although permanent labour supply shocks, one of the main drivers of potential output growth in China, do have

different macro implications, the implications for the current account remain similar.

Therefore for understanding the macroeconomic adjustment process in China, one has to mimic the effects of potential inefficiencies that cause a dampening response of domestic absorption to permanent income shocks that otherwise predicted by an intertemporal DSGE model. In particular, for assessing the macroeconomic implications of the fixed exchange rate regime, it is crucial to go beyond its potential implication for international relative prices, and try to introduce features that are able to approximate its potential implication for the internal macroeconomic adjustment process.

An implication of China's exchange rate regime is its potential harmful impact on the intertemporal decision of domestic households. The latter is modeled in the paper as (i) a temporary, but persistent shock to consumption taxes or alternatively (ii) as a time-varying costs of changes in money holdings. In a scenario analysis, permanent technology shock and temporary shocks to consumption taxes are able to mimic the observed positive correlation between GDP and trade balance in China. Comparing the results of the latter scenario to the impulse response functions following a scenario under flexible exchange rates, the model-based results indicate that a fixed exchange rate regime implies, by having deleterious effects on domestic absorption, negative effects on GDP growth dynamics in the medium-term.

The latter findings are particularly important in the context of the international policy debate on China. In this debate, several economists have argued that an exchange rate change will have no impact on the current account surplus, which is essentially driven by high domestic savings. This paper argues that the choice of the exchange rate regime is more than the choice of a nominal anchor for monetary policy. In the case of China, to the extent that the exchange rate regime is linked to inefficiencies in the financial sector - stemming from factors such as interest rate regulations, massive reserve requirements or obligations to banks to purchase large volumes of sterilisation bills - this regime itself is a factor contributing to the observed current account surpluses. Therefore, to the extent that a more flexible exchange rate regime would allow to advance in financial liberalisation and development, this might well contribute to higher domestic absorption and thus a less inflated current account surplus.

1 Introduction

China's economic transformation at the turn of the 21st century will mark economic history for its astounding domestic success and important global impact. Economic policy was characterized by immense efforts from the side of authorities to spur economic growth, driven mainly by a productivity upsurge through sectoral change, by mobilising labour supply through internal migration and fostering technological adaptation via foreign direct investment. The nominal anchor of Chinese economic policy has been provided thereby by a fixed exchange rate regime towards the US dollar.

China's exchange rate policy has, however, changed over recent years. Since the long-standing peg to the dollar was formally abandoned in July 2005, the currency appreciated by about twenty percent against the US dollar over the three subsequent years. Due to the overall decline of the dollar, and compounded by the rise of a number of currencies in emerging Asia, however, China's exchange rate rose only by about half this amount in nominal effective, trade-weighted terms. In real effective terms, this rise was only marginally higher since China's inflation rate was for a long time comparable to that of its trading partners and picked up only recently. At the same time, strong productivity growth implies that also the equilibrium real exchange rate rises through catching up effects. It is not implausible to assume that this equilibrium increase is in the order of no less than 3 percent per year.[1] This would imply that the China's real effective exchange rate rose broadly in line with the equilibrium increase but hardly caught up to the latter, if at all. This reflects the exchange rate management, in which intra-day volatility against the dollar is not even making full use of the narrow 0.5 percent band and in which inter-day exchange rate changes, although theoretically not restricted, have been minimal as well.

At the same time, the current account surplus rose to above 11 percent of GDP in 2007, three times the ratio five years earlier. Foreign exchange interventions resulting from trade surpluses and capital inflows continue to be unmatched in economic history in terms of volume and persistence, amounting to USD 2.5 billion on average every working day in 2007. China displays the world's largest balance of payments surplus, consisting of a

[1] See Chudik (2008).

current account and a financial account surplus with economic growth rates that have for many years continuously exceeded expectations. In the Monetary Policy Report published in early 2008, the People's Bank of China (PBC) speaks of "excess liquidity" in the banking system, "huge pressures on money and credit expansion" and notes with concern the increase in inflation to about 8 percent in the first quarter of 2008 (PBC, 2008). As a result, also a few years after the formal currency reform of 2005, the question of how to manage the exchange rate appropriately is as topical as it has ever been.

The rising policy interest has also spurred the academic debate that provided numerous contributions on various aspects of China's exchange rate reform (for an overview of the key issues see ECB, 2007; for an overview of the literature see Lafrance, 2008). A large number of contributions address the issue of valuation of the Chinese renminbi, mostly pointing to a large undervaluation and advising a significant nominal appreciation (e.g., Dunaway and Li, 2005; Dunaway, Leigh and Li, 2006; Goldstein, 2007; Roubini, 2007). The findings are, however, not unanimous, and neither is the recommendation to appreciate the nominal exchange rate (e.g., McKinnon, 2007; Dooley et al., 2004). This is not surprising given that the challenges, which are already considerable when it comes to assess equilibrium exchange rates of advanced economies that are traded in deep and liquid markets, are manifold in the context of an emerging economy with a short data record that is engaged in a fundamental transition process, underlying rapid technological adaptation and characterised by massive regional inequalities. Moreover, in China's case the economy is opening rapidly, with trade being driven by foreign direct investment and regional integration, and with financial markets being highly regulated.

For the same reasons, also the assessment of the implications of a further change in China's exchange rate policy, in particular a more significant appreciation, is difficult. Parts of the literature are assessing the external implications of a more significant exchange rate change, focusing on trade flows (Sun and Ma, 2005; Ji and Wang, 2006; Devereux and Genberg, 2007) or focusing on the linkages with capital account liberalisation (Prasad et al., 2005; Goodfriend and Prasad, 2006; Ma and McCauley, 2007; Capiello and Ferrucci, 2008). Other strands of the literature are considering the domestic implications, discussing

in particular the questions on growth and inflation (McKinnon and Schnabl, 2006; Shi, 2006; Yu, 2007).

The divide between external and internal analysis in the literature seems to have a mirror image in the policy debate. External parties are focusing on the external implications of an exchange rate change, while China's authorities are obviously more concerned with the domestic implications. As a result, there is no coherent framework to study both the external and the domestic implications of a more significant exchange rate change.

This is the gap which the present paper aims to fill. The paper presents a multi-country framework, based on a DSGE model with rigorous microfoundation that enables to assess jointly the domestic and external implications of an exchange rate change in China. Since the model distinguishes between tradable and non-tradable sectors and includes various types of final goods as well as real and nominal rigidities, it is able to capture in some detail, possible adjustment mechanisms in China and in its trading partners from an exchange rate change.

First, the paper shows that in a state-of-the-art DSGE model, the accumulation of net foreign asset positions and corresponding persistent current account surpluses cannot be rationalized, under general circumstances, by a permanent technology shocks. Permanent technology shocks imply a positive wealth shock to domestic households, which in turn triggers due to consumption smoothing a rise in private consumption, inducing thereby a current account deficit. Even if the latter channel is missing, for example due to limited asset market participation or myopia, the rise in the marginal product of capital will imply a current account deficit driven by a rise in domestic investment and corresponding net inflow of capital, in particular FDI. Although labour supply shocks, one of the main drivers of potential output growth in China, induce partly different macro dynamics, implications for the current account remain similar. It is sometimes argued that China's surplus is due to abundant labour supply or simply reflects the value-added involved in processing trade (see Su, 2004). Our findings refute these views, since the fundamental mechanics to lead to a current account deficit through the income channel or marginal product of capital channel should also work in these cases. Hence, while these factors may play a role, they are not

sufficient to explain a current account surplus. [2]

In what follows, we argue therefore that in order to understand the macroeconomic adjustment process in China, we have to mimic the effects of potential inefficiencies that cause a dampened response of domestic absorption to permanent income shocks that an otherwise intertemporal model would predict. In particular, for assessing the macroeconomic implications of the fixed exchange rate regime, it is crucial to go beyond its potential implication for international relative prices, and try to introduce features that are able to approximate its potential implication for the internal macroeconomic adjustment process. Prasad et al. (2005) have pointed out that China's fixed exchange rate regime has generated specific costs; in particular that it has required domestic financial repression that entails large distortions and efficiency losses. Aziz and Dunaway (2007) point out that liquidity injections from massive foreign exchange interventions have contributed to real costs of investment of only about 1-2 percent and have implied that the cost of capital has not only been low but also fallen relative to wages. As a result, despite real growth rates of about 10 percent in China, the economy generates only about 1 percent of employment growth; this compares with other economies that generate 2-3 percent employment growth out of GDP growth rates of 3-4 percent. The ultimate consequence of the fixed exchange rate regime is thus a subdued response in consumption and employment. Lardy (2007) draws a similar link between the exchange rate regime, the ensuing lack of monetary policy independence and inappropriate interest rates that favour investment over consumption. In his view, a shift towards a more consumption-driven path will require changes in exchange rate policy. This link has recently been taken up also in the official response that sees exchange rate adjustment as part of a more comprehensive strategy that includes also financial liberalisation (Zhou, 2006).

As a result, we argue that the inefficiencies created by China's exchange rate regime can be approximated by (i) a temporary shock to domestic consumption tax and/or (ii) as a time varying transaction cost technology related to money holdings. Both factors imply a wedge between the price of domestic and future consumption, a mechanism that is necessary

[2] More recently, Cui (2007) has challenged the view that China is dominated by processing trade, also on the basis that China's international integration has considerably upgraded its domestic capabilities.

to break the wealth effect implied by the discussed positive shocks to permanent income. The model based results indicate that the latter channel is indeed helpful for reproducing some salient features of Chinese macroeconomic development. Using that set up, we further conduct a scenario analysis for assessing the domestic and external implications of a change in China's exchange rate regime.

The paper is structured as follows: Section II will provide an overview of key features of China's macroeconomic development; Section III will present the overall model. Section IV discusses its calibration, while section V will present our scenario analysis. Section VI concludes.

2 Key macroeconomic elements in China's economic development and integration

A profound sectoral transformation, exorbitant investment and savings rates, and fast-rising openness are three salient features of China's economic success and global impact. These three features have been underpinned by policies in many ways, including a long-standing education programme, encouragement of capital accumulation and saving, and an active support of technology adaptation from abroad through trade opening and foreign direct investment. This section reviews China's economic development in the light, and terminology, of the model that will be presented subsequently.

2.1 Sectoral transformation

China turned from an agricultural economy to one dominated by industry over one generation. Since the 1980s, the share of the labour force in agriculture dropped from 70 percent to about 45 percent today. Given that the value added per worker in industry is seven times that in agriculture, this shift entailed a tremendous boost to overall productivity (Jefferson et al., 2006).

Today, industry accounts for the largest share of China's output with 46 percent of GDP, followed by services with 41 percent and agriculture with 13 percent. The long-standing concern of the services sector being underdeveloped in an economy excessively relying on industry was attenuated when in a historic GDP revision at end-2005, the share of services

was revised up by almost ten percentage points. China's unparalleled share of industry in output - it is 2.5 times the share of industry in US output, roughly twice the average share of industry in Brazil, Russia and India, and 1.5 times the share in Germany - underscores China's trading capability in global markets. Classifying agricultural goods as de facto non-traded (given China's virtual self-sufficiency in most agricultural products) and considering that about two tenths of services are tradable, yields a tradeable/non-tradeable sectoral composition for China of about 50 percent each.

Two essential elements in the sectoral transformation were the long-standing education programme and the acceptance of massive labour mobility within the country. The education programme focused particularly to attenuate gender differences in literacy and led to a female literacy rate that now reaches 73 percent, which is well above that of India (38 percent) as the other population giant. This proved essential in providing the labour force for mass assembly production, which became dominated by female workers, many of them from rural areas.

As a result, China's economic success is based upon two important features: (i) a rise in productivity due to improved education and adaptation of technology and (ii) mobilisation of labour forces through shift into higher valued added industries.

2.2 Investment and savings rates

The second salient feature of China's development relates to its high investment and savings rates. Throughout its reform process over the past two decades, China has invested over 40 percent of its annual income. Investment, growing by 25.2 percent over the past ten years on average in real terms, has outgrown GDP in every year and been the single most important driver of growth. In recent years, this has added to concerns that with incremental capital output ratio as low as 0.22, overinvestment is occurring in several sectors. Investment was fully financed by domestic savings for virtually all of the past thirty years. In 2007 China saved over 50 percent of its national income; gross national savings exceeded investment by about one quarter and contributed to a current account surplus of 11.4 percent of GDP.

For a long time, household saving has been the mainstay of domestic savings, but it was recently over taken by corporate savings, in turn fuelled by strong corporate earnings,

relatively low taxation and little pressure for state-owned companies to pay dividends. Research has revealed that Chinese households mainly save for precautionary purposes, to finance education, health and retirement expenditures, which are only partly provided by the government (Blanchard and Giavazzi, 2005; Kuijs, 2005). As a mirror image of high investment and savings ratio, consumption is remarkably low as percent of GDP at 41

2.3 Trade

China is the most open among the large emerging economies. Taken together, exports and imports amount to over two-thirds of its GDP. This is partly due to the heavy involvement of the manufacturing sector in international production chains, but also reflects policies of technology adaptation through international integration (Lemoine and Ünal-Kesenci, 2007; Tan and Khor, 2006; Bergsten et al., 2006). China's trade has risen tenfold over the past decade and nowadays every eighth unit value in global trade involves China. In terms of sectors, China runs a huge surplus in manufacturing goods, a small deficit in services and a considerable deficit in primary goods. This reflects the fact that China has developed an export-oriented manufacturing sector. It became the world's third largest exporter of manufacturing goods and is expected to become the world's largest, overtaking the United States and Germany in a few years. About 85 percent of China's total exports are manufacturing goods, 8.7 percent are services. As a result of movements in world trade prices and in particular the commodity price boom of 2007/08, China's terms of trade have worsened, given that the country's trade pattern is that of an industrial country with considerable imports of oil and other commodities.

A remarkable feature of Chinese macroeconomic data is the high correlation between output and the current account. As shown in Table 1, the correlation coefficient of the yearly HP-filtered GDP and current account time series from 1990-2007 for China is 0.81. For mature economies, with the remarkable exception of Japan, and also for other emerging economies the correlation is negative.

Taking all these features into account, in the next section we describe in a nutshell our modelling framework.

Table 1: Correlation between GDP and the Current Account

Mature Economies		Emerging Economies	
Australia	-0.82	China	0.81
Canada	-0.30	Hong Kong	-0.64
Japan	0.42	India	-0.85
United Kingdom	-0.35	Korea	-0.73
United States	-0.34	Malaysia	-0.55

Note: Calculated using yearly, HP filtered data on GDP and current account from 1990-2007 from the WEO database.

3 The Framework

In the following sections, we outline the features multi-country version of the NAWM model, as discussed in Jacquinot and Straub (2007) and present the calibration of the model. We provide a detailed description of key parts of the model in Appendix A. The reader that is not interested in modelling details can skip this section and can move immediately to section 5.

The multi-country version of the NAWM builds on recent advances in developing micro-founded Dynamic Stochastic General Equilibrium (DSGE) models suitable for quantitative policy analysis, as exemplified by the closed-economy model of the euro area by Smets and Wouters (2003), the International Monetary Fund's Global Economy Model (GEM; cf. Bayoumi, Laxton and Pesenti, 2004), the Federal Reserve Board's new open economy model named SIGMA (cf. Erceg, Guerrieri and Gust, 2005), and the two-country version of NAWM as discussed in Coenen, McAdam and Straub (2007). Thus, it incorporates a relatively large number of nominal and real frictions in an effort to improve its empirical fit regarding both the domestic and the international dimension.

The multi-country version of the NAWM consists of four symmetric countries of different size representing the euro area (EA), United States (US), China/emerging Asia, and a remaining countries (RW) block respectively. The focus in this paper is on the internal and external macroeconomic adjustment in China, so the features of the model are adjusted

accordingly.

International linkages arise from the trade of goods and international assets, allowing for imperfect exchange-rate pass-through to consumer prices and imperfect risk sharing. In each country, there are four types of economic agents: households, firms, a fiscal and a monetary authority. Extending the setup in Coenen and Straub (2005), the NAWM features two distinct types of households which differ with respect to their ability to participate in asset markets, with one type of household only holding money as opposed to also trading bonds and accumulating physical capital. As a result, also households with limited ability to access asset markets can intertemporally smooth consumption by adjusting their holdings of money. Due to the existence of these two types of households, fiscal policies other than government spending—notably transfers—also have real effects even though both types of households are optimizing consumption and labour supply subject to intertemporal budget constraints. Further, it is assumed that both types of households supply differentiated labour services and act as wage setters in monopolistically competitive markets by charging a markup over their marginal rate of substitution. Specifically, wage setting is characterised by sticky nominal wages and indexation, eventually resulting in two separate wage Phillips curves. Moreover, in order to establish a more pronounced role of transfer payments made by the fiscal authority, we assume that transfers, in per-capita terms, are unevenly distributed across the two types of households, favouring the constrained households with limited asset-market participation over the unconstrained ones in a proportion of three to one. This also helps to guarantee that the levels of consumption and hours worked are not too dissimilar across households.

Regarding firms, the NAWM distinguishes between producers of tradable and nontradable differentiated intermediate goods and producers of three non-tradable final goods: a private consumption good, a private investment good, and a public consumption good. Final good producers in the consumption good and investment good sector utilize imported intermediate goods in their production process [3], while public consumption good is only

[3]Imported intermediate goods are a CES aggregate of imported intermediate goods from different regions. For example, the euro area imported intermediate good is an aggregate of US, China and remaining countries imported goods, see Jacquinot and Straub (2007) for details

consuming goods of domestic origin. Domestic tradable and nontradable intermediate-good producers sell their differentiated outputs under monopolistic competition, while the final-good producers operate under perfect competition and take prices as given. In the tradable and nontradable intermediate good sector, there is sluggish price adjustment due to staggered price contracts and indexation, yielding two separate price Phillips curves.

The fiscal authority purchases units of the public consumption good and makes transfer payments to the two types of households, in unevenly distributed amounts. These expenses are financed by different types of distortionary taxes, including taxes on consumption spending, labour and capital income, as well as profits. A simple feedback rule is assumed to stabilize the government debt-to-output ratio by appropriately adjusting a suitable fiscal instrument.

Finally, the monetary authority is assumed to follow in all economies but China, an inertial Taylor-type interest-rate rule with interest-rate smoothing, which is specified in terms of annual consumer-price inflation and quarterly output growth. In China the monetary authority is assumed to follow a fixed exchange rate regime.

4 Model Calibration

The parametrization of the US and euro area part of the model draws heavily on the results of estimated DSGE models such as Smets and Wouters (2003), Christiano, Eichenbaum and Evans (2005), and on the former version of the NAWM described in Coenen, McAdam and Straub (2007), and are only adjusted to ensure model consistency. In what follows, we will focus on the model features that concern the China block of the model, with particular emphasis on the calibration of the international dimension.

4.1 Domestic Dimension

What are the main features of the China block of our model? The parametrization of the model for China involves two interdependent steps. First, the calibration of the macro aggregates in the long-run "steady-state" of the model, and the implicit determination of parameters affecting the steady state of the model. Second, choosing appropriate values for the remaining parameters that govern the dynamics of the model. Naturally, in an

emerging economy as China, it is difficult to infer the long-run "steady-state" equilibrium of the economy. Nevertheless, the previous discussion on the Chinese economy helps us to make inference about the steady state.

The key macroeconomic aggregates in the model are presented in Table A. As in the data, we assume that in the steady state the Chinese output share in world output is around 10 percent. The Chinese economy is also characterized by a different distribution of the demand components of domestic GDP as the other two main economies in our model, namely the euro area and the United States. In particular, in line with the previously presented evidence, we assume that the steady state investment to GDP ratio in China is around 50 percent of GDP, while government spending to GDP ratio is around 16 percent. Difficulties arise in calibrating the steady state trade balance to GDP ratio. First, we would like to depart from the (unrealistic) standard assumption that the trade balance is zero in the long run. On the other hand, as the current account is required to be balanced in the steady state, any deviations form a balanced trade account must equal to a corresponding flow in the income account.

The current accumulation of foreign assets indicates that in the long-run Chinese income account will stay positive implying a trade balance deficit in the steady state. This is obviously in stark contrast to the current developments. Nevertheless, we will assume that the steady-state trade deficit as percentage of GDP is at 2 percent. As we assume that the subjective discount factor β is at 0.993 implying a real interest rate in the steady state of around 3 percent, the net foreign asset position of China is calibrated at 100 percent of domestic GDP.

Considering the parameters driving the households behavior, we assume that the degree of risk aversion in China is higher than in the rest of the world. As a result, we set the value of inverse of the intertemporal substitution σ at 4 percent. Furthermore, we assume that the share of households restricted from access to capital markets are at 50 percent compare to the assumes 25 percent in the United States and euro area.

In the labour market households have pricing power resulting in corresponding wage markups. The values for the US and the euro area markups of 16 percent and 30 percent

respectively, are borrowed from Bayoumi, Laxton and Pesenti (2004). We assume that the labour market in China, due to the lack of regulations and limited power of trade unions, is similarly competitive as the United States.

With regards to the production side, we parameterize the share of nontradable intermediate goods in value added in the consumption sector μ_C at 65 percent, while according to the international evidence, we assume that this share is lower in the investment good sector (around 30 percent).

The monetary authority is assumed to follow a modified Taylor-type interest-rate rule, (cf. Taylor, 1993), specified in terms of annual consumer-price inflation and quarterly output growth, and exchange rate:

$$R_t^4 = \phi_R R_{t-1}^4 + (1-\phi_R)\left[R^4 + \phi_\Pi\left(\frac{P_{C,t}}{P_{C,t-4}} - \Pi\right)\right] + \phi_{g_Y}\left(\frac{Y_t}{Y_{t-1}} - g_Y\right) + \phi_S\left(\frac{S_t}{S_{t-1}} - \Delta S^T\right) + \varepsilon_{R,t}, \tag{1}$$

where $R^4 = \beta^{-4}\,\Pi$ is the equilibrium nominal interest rate, Π denotes the monetary authority's inflation target and g_Y is the (gross) rate of output growth in steady state (assumed to equal one), ΔS^T is the exchange rate depreciation target. The term $\varepsilon_{R,t}$ represents a serially uncorrelated monetary policy shock. In the US, euro area, and the remaining countries blocks we will assume that $\phi_S = 0$, while China, as indicated above, will pursuit exclusive exchange rate targeting with $\phi_\Pi = 0$, $\phi_{g_Y} = 0, \phi_S = 10000000$.

Due to the lack of empirical evidence for China, we have decided to choose values for certain parameters that are common in the academic literature. We assume that the inverse of the Frisch elasticity of labour supply is 2. Furthermore, we assume for both households a Calvo parameter determining the persistence of wage adjustment of 0.75, roughly equivalent to a four-quarter contract length under Calvo-style pricing. In the production sector, the bias towards the use of capital in both sectors is calibrated to achieve a relatively high investment share of GDP in China, and a low share in US, in line with their respective historical averages. The latter calibration can be done by adjusting tax rates on capital or the technology parameter, currently we decided to choose the former, leaving the technology parameter α at 0.3. The depreciation rate is assumed to be 2.5 percent per quarter across all regions. Real rigidities in investment and import adjustment costs align with the

parametrization of the baseline NAWM.

4.2 International Dimension

The response of external variables in the model rely naturally upon the calibration of each region's external sector presented in Table G and H. As discussed in the previous section, for given steady-state net foreign asset positions for each region, it is straightforward to calculate the current account and trade balances consistent with long-term stock-flow equilibrium. Using the IMF's Direction of Trade Statistics on merchandise trade, the national accounts data on the imports of goods and services, and the United Nations' Commodity Trade Statistics (COMTRADE) data on each economic block's imports of consumer and capital goods, we derive a disaggregated steady-state matrix delineating the pattern and composition of trade for all regions' exports and imports. Note that the trade matrix is not based on the last data point, as it also incorporates medium term trends and corrects for potential inconsistencies in trade statistics. On the basis of this trade matrix, we derive all the weight coefficients in the demand function for imports and the regional composition of imports (see Table D).

For the long-run behavior of net foreign assets our prior is that a permanent increase in government debt by one percentage point of GDP is roughly associated with an increase in the net foreign liability position of the region by 0.5 percentage points of GDP [4]. Moreover, when the US expands its net foreign liabilities as a result of a permanent change in its public debt, the absorption of new issuance by each region is calibrated (on the basis of net foreign asset holdings in recent years) by assigning 24 percent of new issuance by US to China, and 38 percent to each of euro area and remaining countries. This calibration implies that for a one percent net foreign liabilities to GDP shock in the US, China's net-foreign-asset-to-GDP rises the most with around 0.8 percent of GDP, while euro area and the remaining countries see their ratios only rise by around 0.3 and 0.5 percent of GDP respectively.

Finally, for the corresponding trade elasticities, we assume that the elasticity of substitution between domestically-produced and imported tradable consumption goods and

[4] Overlapping generations models (particularly those which follow the Blanchard-Weil-Yaari formulation) provide theoretical underpinnings to evaluate this non-Ricardian behavior.

investment goods is 2.5. The elasticity of substitution between goods from different regions for imported consumption goods and imported investment goods is set at 1.5, consistent with existing estimates of import elasticities.

5 Scenario Analysis

5.1 Adjustment Path of Macroeconomic Aggregates

After calibrating our multi-country model, we turn to our simulation exercise, which aims at discussing the potential external and internal dimension of a change in China's exchange rate regime. In order to address this issue, we need to identify the source of the economic development in China. Thereby, we can extract from the key features of China's development, discussed in the previous section.

Accordingly, we identified two key features that are important for the understanding the rapid development in China (i) a rise in productivity in the tradable sector and (ii) the rapid growth of labour supply in the manufacturing and services industry associated with migration of labour from the hinterland to the coastal regions of China. In what follows, we present some simulation based analysis, which enable us to understand the conditional path of major macro aggregates following the discussed shocks. The general form of the exogenous state variable z_t follows:

$$z_t = (1 - \rho_z)\hat{z}_t + \rho_z z_{t-1} + \epsilon_t^z \tag{2}$$

where z_t is the exogenous autoregressive process, $\hat{z}_t$ is the long-run value of the shock process, and ϵ_t^z is a white noise term utilized in case of temporary shocks. We set the AR(1) coefficient ρ_z at 0.9 in all simulation exercises. Figure 1 and 2 present the results of this exercise. We calibrate the corresponding permanent shock to $\hat{z}_t$ to have a 5 percent impact on China's GDP in the long run. Under all baseline scenarios, we assume that China is following a fixed exchange rate regime towards the US dollar.

In our model a permanent productivity shock (presented in Figure 1) implies a substantial rise in GDP already on impact (around 3 percent) driven mainly by a boom in the tradable sector. The associated rise in permanent income leads to a substantial increase in consumption after one year (around 3.8 percent), while the boost to the marginal rate of

capital creates an investment boom. Note also that the corresponding rise in labor demand induces a rise in real wages. The permanent rise in tradable productivity implies, in line with economic theory, a trade balance deficit. First, the rise in permanent income has an immediate impact on the lifetime budget constraint of Ricardian households leading to an immediate impact on consumption and imports via wealth effects. Furthermore, productivity shocks also imply a fall in relative price of tradable goods via the rest of the world, as indicated by the overall rise in the terms of trade (defined as price of imports over price of exports). Also, the rise in the marginal product of capital also implies an investment boom. Interestingly, the real effective exchange rate of China appreciates in the model hinting towards the existence of a Balassa-Samuelson mechanism. The latter implies that the shock to productivity in the tradable sector, and the associated positive impact on real wages, leads to a substantial rise in non-tradable goods price inflation, which induces, due to the lack of inflation stabilization under the fixed exchange rate regime, a rise in relative inflation and a corresponding real exchange rate appreciation. Overall, the described mechanism implies a peak of the trade balance deficit of around 1 percent of GDP in the model[5].

A permanent rise in labour supply in China induces in most of the cases a similar impulse response of macroeconomic aggregates, as a permanent productivity shock. There are, however, some notable differences presented in Figure 2. First, labour supply shocks induce as expected a fall in real wages. Second, the response of investment is negative at the beginning. As demand is sluggish due to nominal rigidities, the potential rise in supply in goods triggered by the exogenous increase in labour supply, cannot be matched entirely implying a fall of investment into physical capital. Note also that labour supply shocks imply a positive conditional correlation between the terms of trade and the real effective exchange rate, as the rise in hours worked is contemporaneously affecting the marginal costs in both tradable and nontradable output.

The described scenarios are able to capture certain features of China's economic development, but fails to explain the substantial rise in trade balance in the recent years. Arguable, there is an important mechanism implied by the fixed exchange rate regime in

[5]Of course, this peak response depends very much on the calibration of the size of the permanent productivity shock.

China that is missing in our analysis. In particular, there is increasing evidence that the fixed exchange rate regime is introducing distortions into domestic demand that work effectively as a potential tax on current domestic consumption. The latter includes among others (i) the heavy burden on the development of a domestic banking sector implied by the sterilization of FX interventions and (ii) the accumulation of foreign exchange rate reserves by the state/ central bank instead of allowing the private financial sector to decide upon the optimal allocation of capital. Both factors imply that the intertemporal decision of private agents in China is distorted.

In our model, the intertemporal euler equation of households with respect to money holdings has the following form:

$$\beta \, \mathrm{E}_t \left[\left(\frac{(C_{I,t+1} - \kappa \, C_{i,t})^{-\sigma}}{(C_{i,t} - \kappa \, C_{I,t-1})^{-\sigma}} \, \frac{P_{C,t}}{P_{C,t+1}} \right) \frac{1 + \tau_t^C + \Gamma_v(v_{i,t}) + \Gamma_v'(v_{i,t}) \, v_{i,t}}{1 + \tau_{t+1}^C + \Gamma_v(v_{i,t+1}) + \Gamma_v'(v_{i,t+1}) \, v_{i,t+1}} \right] = 1/R_t \quad (3)$$

where C_t is household consumption, P_t is the price level, R_t is the nominal interest rate, β, σ and κ are parameters determining the time preference rate, the degree of risk aversion and habit persistence respectively, while E_t is an expectations operator. The purchases of the consumption good are subject to a proportional transaction cost, $\Gamma_v(v_{i,t})$ (defined below), which depends on consumption-based velocity, $v_{i,t} = (1 + \tau_t^C) P_{C,t} C_{i,t} / M_{i,t}$; that is, the inverse of the household member's money-to-consumption ratio. The time-varying transaction cost technology takes the form:

$$\Gamma_v(v_{h,t}) = \gamma_{v,1t} \, v_{h,t} + \gamma_{v,2t} \, v_{h_t}^{-1} - 2 \sqrt{\gamma_{v,1t} \, \gamma_{v,2t}} \quad (4)$$

where $\gamma_{v,1t}, \gamma_{v,2t} > 0$ (cf. Schmitt-Grohé and Uribe, 2006). We assume that both $\gamma_{v,1t}$ and $\gamma_{v,1t}$ are potentially time varying, which aims to capture the time varying degree of financial sector inefficiencies.

In particular, both the time varying transaction cost technology, as well as the stochastic consumption tax τ_t^C create a wedge to the standard intertemporal Euler equation, which under general circumstances relates expected real consumption growth to the interest rate and expected inflation.

It is important to emphasize that a fixed exchange rate regime might not necessary create a permanent wedge, but might be considered as an obstacle in the short run for

domestic financial development. As a result, in two separate scenarios we assume that the shock to consumption tax τ_t^C, and alternatively to the transaction technology $\gamma_{v,1t}$ and $\gamma_{v,1t}$, is persistent but not permanent[6]. The results are depicted in Figure 3 and 4.

A temporary rise in consumption tax has a negative impact on current GDP, consumption and investment. Interestingly, the impact on the trade balance is positive, as exports are boosted by a fall in domestic tradable prices (implied by the fall in domestic demand and home bias), while import growth is subdued due to a fall in consumption. In Figure 4, we show that the increase in the transaction cost technology has very similar impact on macro aggregates in the model. In the next section, we present the results of a scenario analysis, which investigates the potential impact of a change in exchange rate regime in China, taking into account the results presented above.

5.2 Fixed vs. Flexible Exchange Rates

In this section, we compare the dynamic path of macroeconomic aggregates in our model with fixed and flexible exchange rate regimes following a permanent technology shock in the tradable sector as presented in the previous section. The results are presented in Figure 5, 6 and 7.

In Figure 5, we assume that a fixed exchange rate regime is not only associated with rigidities in the adjustment of relative prices, but also introduces inefficiencies into the intertemporal consumption optimization of households via time-varying consumption taxes. The size and persistence of the rise in consumption taxes is calibrated to induce jointly with the permanent technology shock a positive correlation between GDP and current account[7]. The corresponding fiscal income, generated by the rise in consumption taxes, is spent on goods and services, but in contrast to the tax does not induce any direct wealth effect for consumers (i.e. government spending itself is not part of the utility function of households). Naturally, the latter effect is absent under a flexible exchange rate regime.

Under the fixed exchange rates, and in contrast to the flexible exchange rate scenario,

[6] The size of the shock and its persistence is calibrated to induce jointly with the positive technology shock in the tradable sector a positive correlation between GDP and current account in the short and medium run.

[7] In particular, we assume that consumption taxes increase from 7 percent (steady-state value) to 20 percent of consumption on impact with an AR(1) coefficient of 0.99.

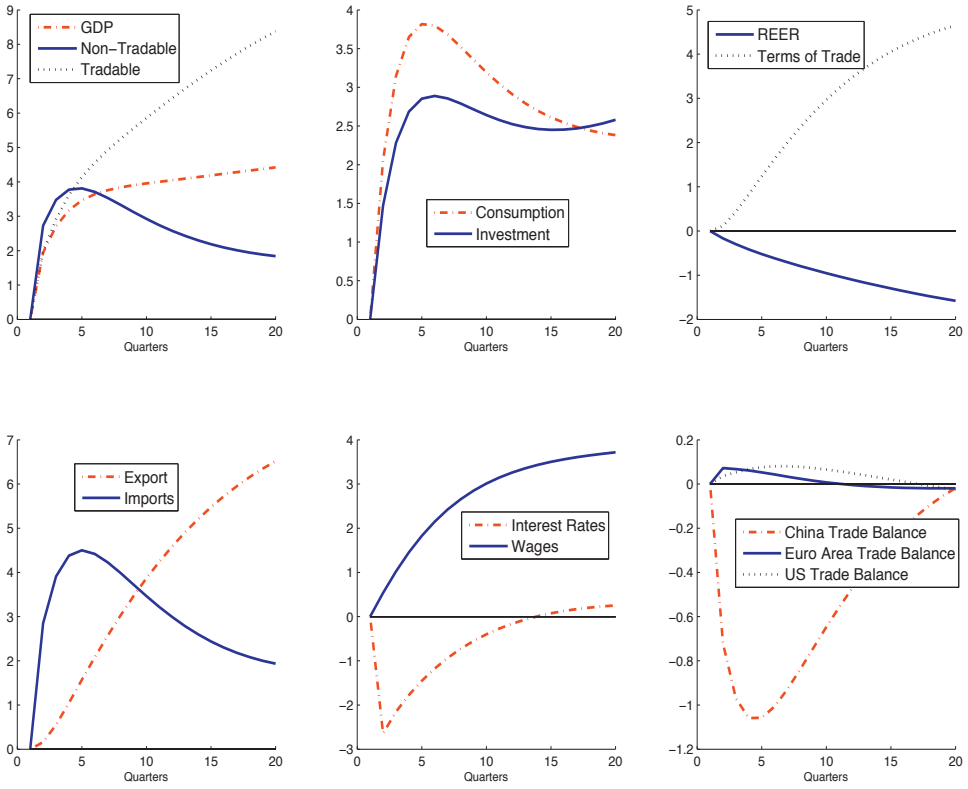

Figure 1: Impulse response functions following a permanent technology shock in the tradable sector (calibrated to induce a 5 percent increase in GDP in the long run.)

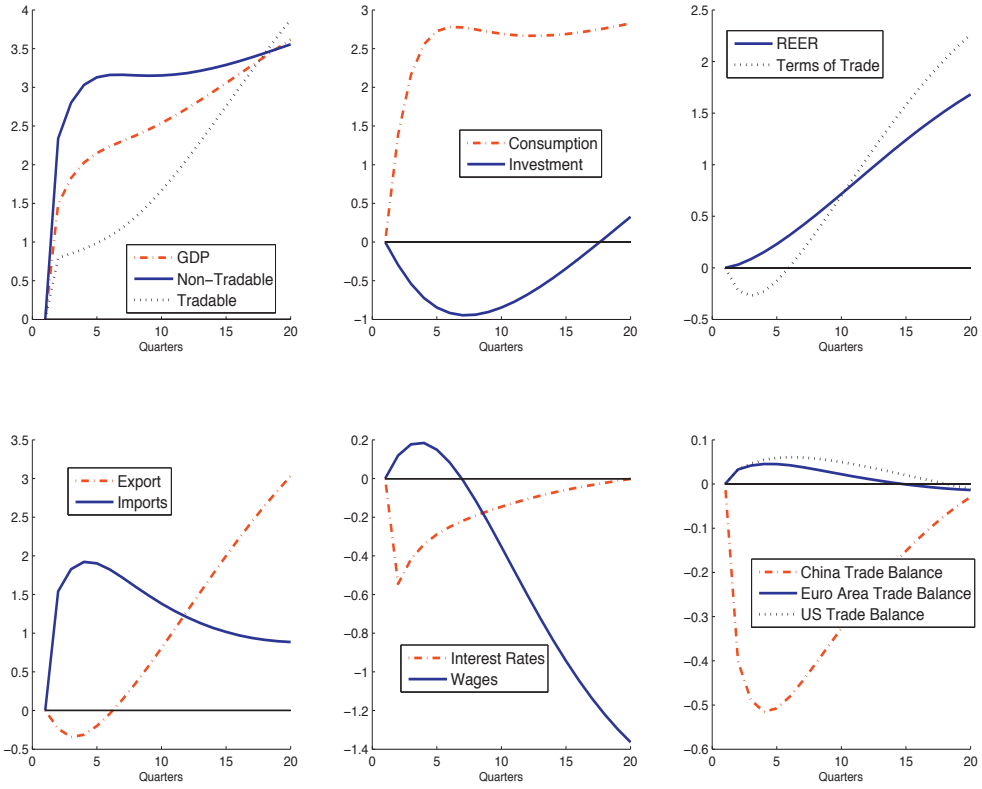

Figure 2: Impulse response functions following a permanent labour supply shock (calibrated to induce a 5 percent increase in GDP in the long run.)

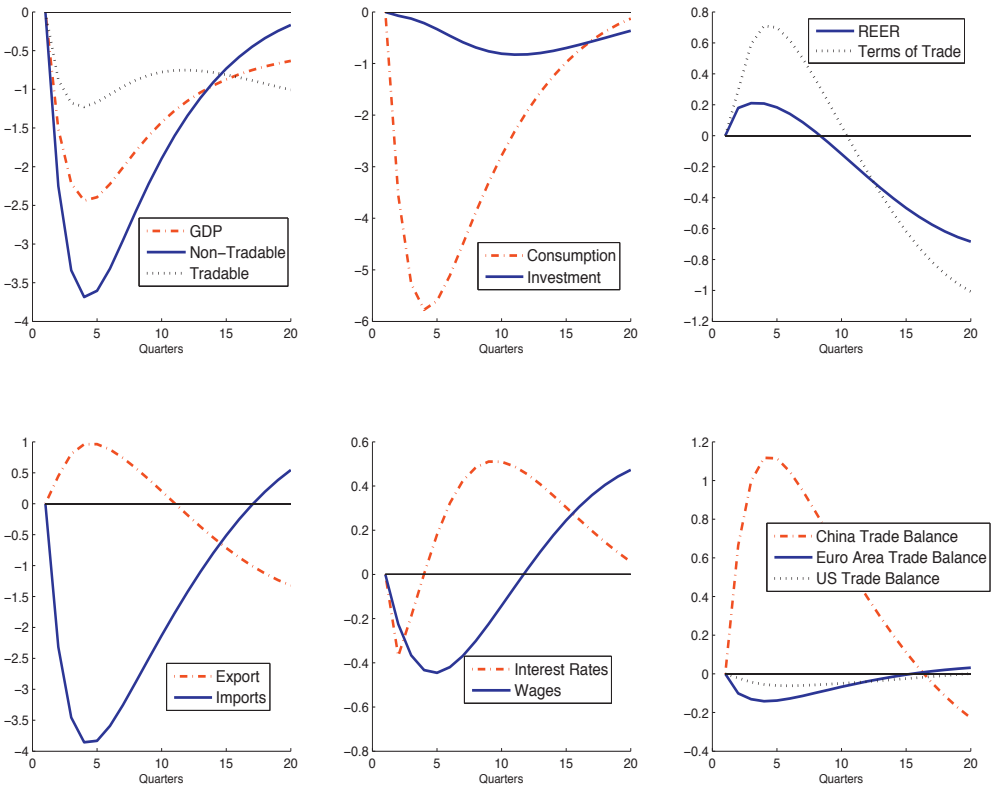

Figure 3: Impulse response functions following a temporary consumption tax shock.

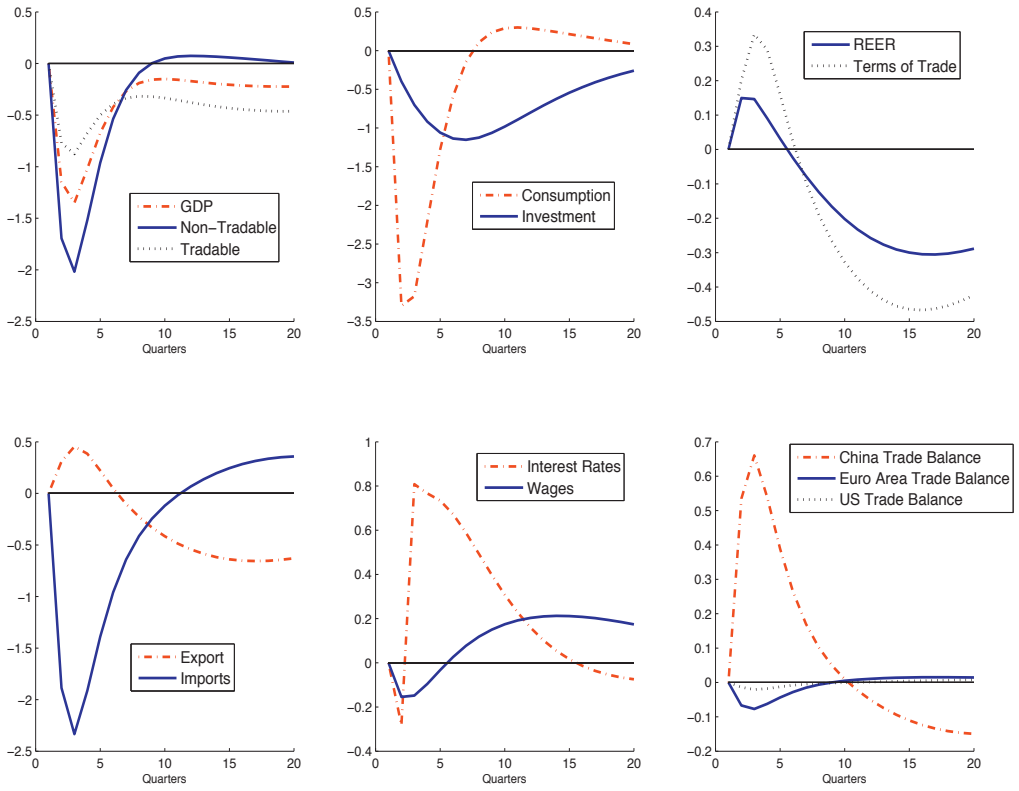

Figure 4: Impulse response functions following a temporary increase in cost of changes in money holdings.

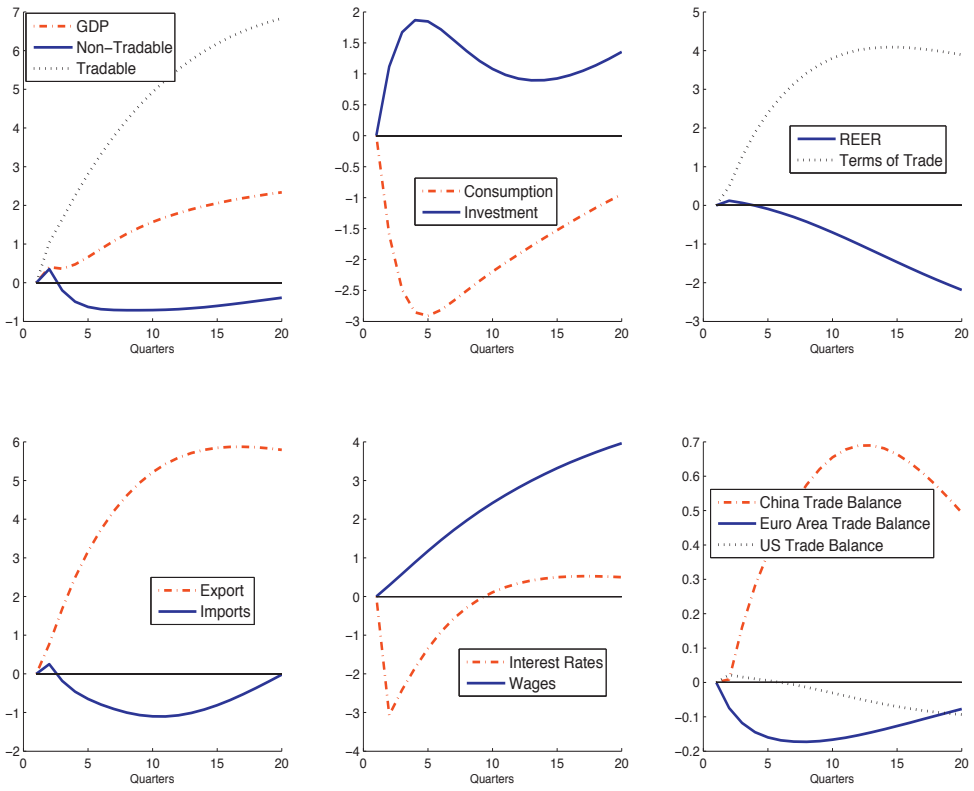

Figure 5: Impulse response functions following a permanent technology under fixed exchange rate regime with financial market distortions (time varying consumption tax).

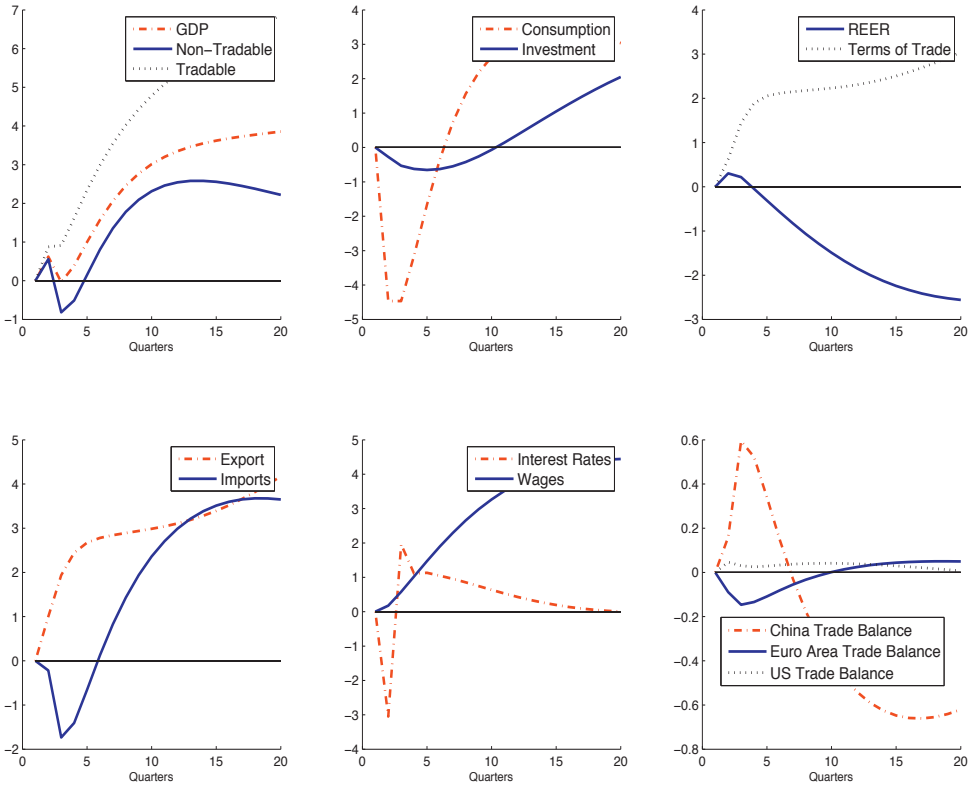

Figure 6: Impulse response functions following a permanent technology under fixed exchange rate regime with financial market distortions (time varying cost of money holdings).

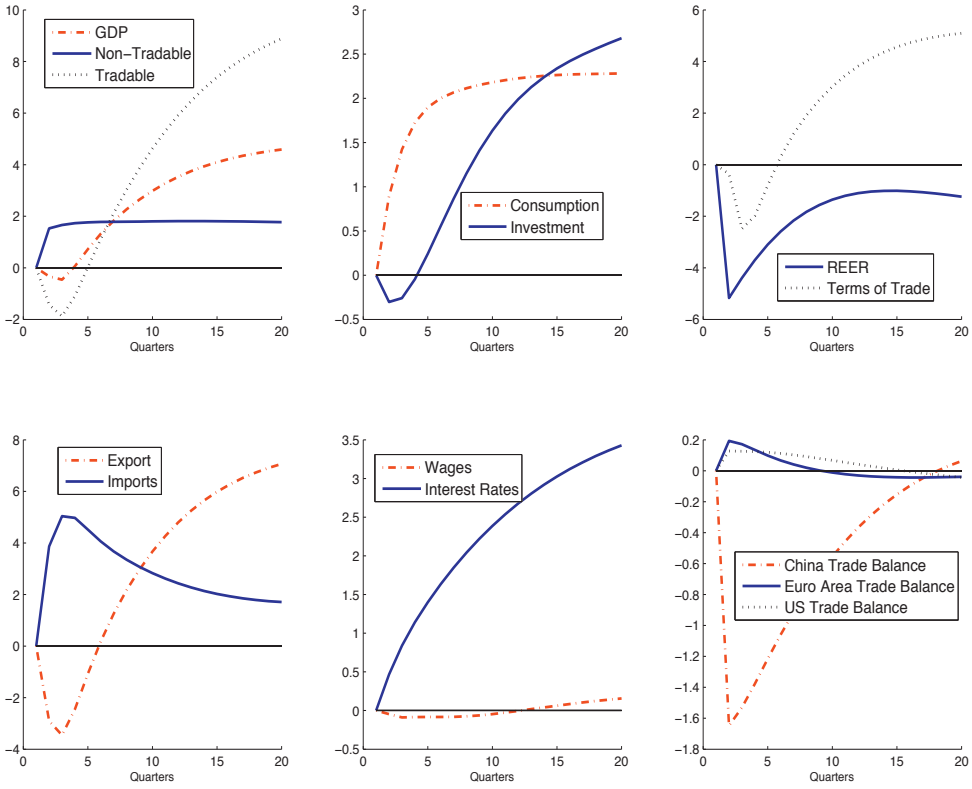

Figure 7: Impulse response functions following a permanent technology shock in the tradable sector under a flexible exchange rate regime.

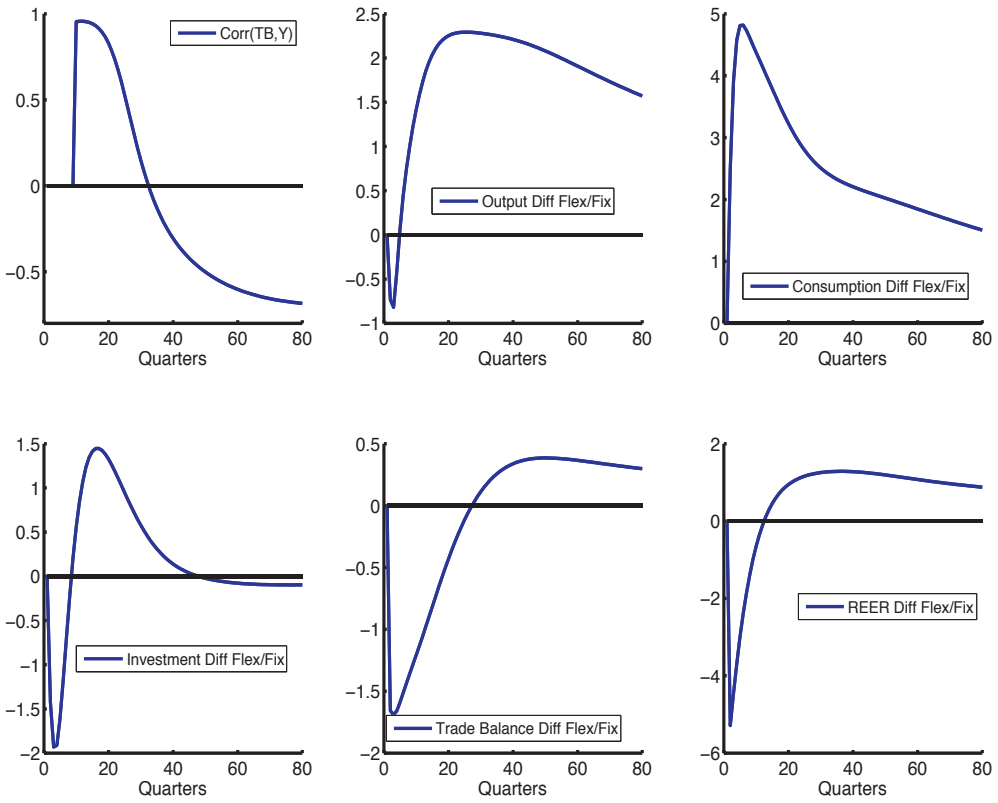

Figure 8: Time varying correlation between trade balance and output under a fixed exchange rate regime with financial market distortions and the percentage differences (measured in units of steady-state values) of the impulse response functions of selected macroeconomic variables under a flexible and fixed exchange rate regime with financial market distortions.

the impact response of trade balance is positive driven by the dampening effect of the consumption tax. Note that the shock is temporary but persistent implying that taxes are higher today than tomorrow. This means that households prefer to postpone consumption towards the future, when distortions are lower, despite the rise in permanent income. The present scenario is able to mimic, at least in the short and medium term, the positive correlation between GDP and trade balance in China.

In Figure 6, we present the scenario with permanent technology shocks and time-varying cost to the transaction technology[8]. The result are very similar as under the time-varying consumption tax, but the current account surplus is less persistent.

In figure 7, when considering the dynamic path of adjustment under flexible exchange rates, we observe a negative correlation between GDP and the trade balance. Expected higher returns on capital, due to higher productivity in the tradable sector in the future, lead to a fall in investment in the short run, while habit persistence avert a fast adjustment of private consumption despite the rise in permanent income. Note also, that in contrast to the effects of a permanent technology shock under a fixed exchange rate regime as presented in Figure 1, i.e. without taking into account the discussed negative spillovers on domestic consumption, the interest rate reaction is more subdued given the calibrated Taylor rule. Overall, under flexible exchange rates, real GDP falls on impact, but recovers after 4 quarters, while the trade balance records a persistent current account deficit.

At this stage, it is also interesting to assess the global implications of the discussed scenarios. In particular, in all scenarios we have also produced a figure depicting the corresponding response of US and euro area current accounts following the discussed stochastic shocks. Interestingly and in contrast to recent developments, the negative response of the US current account is less pronounced in all scenarios that assume a Chinese fixed exchange rate regime (towards the US dollar) and corresponding financial market distortions, than the response of the euro area current account. The results indicate therefore, than the persistent decline of the US current account deficit in the recent years is also related to US specific factors not discussed in this paper.

[8] Of course there are many other factors that might introduce inefficiencies into the intertemporal decision problem of households.

To demonstrate the main differences between the two scenarios, we calculate the difference in the impulse response functions under flexible and fixed exchange rate regime with financial market distortions for the selected macro variable and present the results as percentage of the corresponding steady state values[9]. Furthermore, we present also the dependence of the positive correlation of GDP and trade balance on the evolution of the wedge in the consumption Euler equation created by the consumption tax process. The result are presented in Figure 8.

The correlation between the trade balance and GDP is positive on impact under the fixed exchange rate scenario, but becomes negative after 30 quarters as the effects of the consumption tax is reduced. As shown in figure 7, flexible exchange rates imply lower GDP growth on impact, but induce in the medium term higher growth of above 2 percent of steady-state GDP in our scenario. Also, while the trade balance deficit is higher on impact under flexible exchange rates, this pattern reverses after 30 quarters. Similarly, while in the long-run a fixed exchange rate regime implies a higher real appreciation of the currency, in the short-run flexible exchange rates induce higher volatility, and so stronger adjustment of real exchange rates. While our scenario analysis is certainly suggestive, it provides nevertheless an interesting insight into the adjustment process of macroeconomic variables under the chosen scenarios. The subdued response of domestic absorption in the data to permanent income shocks and the corresponding current account surplus can be replicated by the introduction of temporary shocks to consumption taxes, which on the other hand implies a weaker GDP growth in the medium term.

5.3 Conclusion

This paper argued that in a state-of-the-art DSGE, the accumulation of net foreign asset positions and corresponding persistent current account surpluses cannot be rationalized under general circumstance by the occurrence of permanent technology and labour supply shocks. Permanent technology shocks imply a positive wealth shock to the domestic households, which triggers due to consumption smoothing a rise in private consumption inducing thereby a current account deficit. Even if the latter channel is missing, for example due to

[9]To save space, we only show the results of the scenario with stochastic consumption tax

limited asset market participation or myopia, the rise in the marginal product of capital will imply a current account deficit driven by a rise in domestic investment. Although permanent labour supply shocks, one of the main drivers of potential output growth in China, do have different macro implications, the implications for the current account remain similar.

We argued that for understanding the macroeconomic adjustment process in China, we have to mimic the effects of potential inefficiencies that cause a dampening response of domestic absorption to permanent income shocks that otherwise predicted by an intertemporal DSGE model. In particular, for assessing the macroeconomic implications of the fixed exchange rate regime, it is crucial to go beyond its potential implication for international relative prices, and try to introduce features that are able to approximate its potential implication for the internal macroeconomic adjustment process.

We argued therefore that an important feature of China's exchange rate regime is its potential harmful impact on the intertemporal decision of domestic households due to financial market distortions. We modeled the latter as a temporary, but persistent wedge to the standard intertemporal Euler equation of households. The inefficiencies represented either by a (i) stochastic consumption tax or by (ii) time varying transaction cost technology related to money holdings. We have shown that a scenario with permanent technology shock and financial market distortions is able to mimic the positive correlation between GDP and trade balance in China. We compared the results of the latter scenario to the impulse response functions following a permanent technology shocks under flexible exchange rate regime. Our results indicate that fixed exchange rates might be beneficial for output growth in the short-run, but it might have deleterious effects on GDP growth dynamics in the medium-term compared to a flexible exchange rate regime.

These findings are also important in the context of the international policy debate on China. In this debate, several economists have argued that an exchange rate change will have no impact on the current account surplus, which is essentially driven by high domestic savings. Our paper has argued that the choice of the exchange rate regime is more than the choice of a nominal anchor for monetary policy. In the case of China, to the extent that the exchange rate regime is linked to inefficiencies in the financial sector - stemming from factors

such as interest rate regulations, massive reserve requirements or obligations to banks to purchase large volumes of sterilisation bills - this regime itself is a factor contributing to drive up savings. Therefore, to the extent that a more flexible exchange rate regime would allow to advance in financial liberalisation and development, this might well contribute to lower saving rates and thus a less inflated current account surplus.

References

Aziz, J. and L. Cui (2007), "Explaining China's low consumption: the neglected role of household income", IMF Working Papers no. 07/181, July.

Aziz, J. and S. Dunaway (2007), "China's Rebalancing Act", Finance and Development, vol. 44, pp. 27-31.

Bayoumi, T., D. Laxton and P. Pesenti, 2004, "Benefits and Spillovers of Greater Competition in Europe: A Macroeconomic Assessment", ECB Working Paper No. 341, European Central Bank, April.

Bergsten, F., B. Gill, N. Lardy and D Mitchell (2006), "China: The Balance Sheet", Institute for International Economics and Public Affairs Publishers, New York.

Cappiello, L. and G. Ferrucci (2008), "The Sustainability of China's Exchange Rate Policy and Capital Account Liberalisation", ECB Occasional Paper no. 82, March.

Christiano,L., M. Eichenbaum, and C. Evans, 2005, "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy", *Journal of Political Economy*, University of Chicago Press, vol. 113(1), pages 1-45, February.

Chudik, A., "Assessment of the Equilibrium Exchange Rate of the Chinese Renminbi", ECB, mimeo.

Coenen, G., P. McAdam and R. Straub, 2005, "Tax Reform and Labour-Market Performance in the Euro Area: A Simulation-Based Analysis Using the New Area-Wide Model", forthcoming in the *Journal of Economic Dynamics and Control*.

Coenen, G. and R. Straub, 2005, "Does Government Spending Crowd in Private Consumption? Theory and Empirical Evidence for the Euro Area", *International Finance*, 8, 435-470.

Cui, L. (2007), "China's Growing External Dependence", Finance and Development vol. 44, pp. 42-45.

Devereux, M. and H. Genberg (2007), "Currency appreciation and current account adjustment", Journal of International Money and Finance, vol. 26, pp. 570-586.

De Walque, G., Smets, F., Wouters, R., 2005, "An Estimated Two-country DSGE Model for the Euro Area and the US Economy", European Central Bank, mimeo.

Dooley, M., D. Folkerts-Landau and P. Garber (2004), "The Revised Bretton Woods System", International Journal of Finance and Economics, vol. 9, pp. 307-313.

Erceg, C. J., L. Guerrieri and C. Gust, 2005, "SIGMA: A New Open Economy Model for Policy Analysis", International Finance Discussion Papers No. 835, Board of Governors of the Federal Reserve System, July.

European Central Bank (2007), "Putting China's Economic Expansion in Perspective", ECB Monthly Bulletin Article, January, pp. 77-87.

Frankel, J. and S.-J. Wei (2007), "Assessing China's Exchange Rate Regime", NBER Working Paper no. 13100, May.

Garcia-Herrero, A. and T. Koivu (2007), "Can the Chinese trade surplus be reduced through exchange rate policy?", BOFIT Discussion Paper no. 6/2007.

Goodfriend, M. and E. Prasad (2006), "A Framework for Independent Monetary Policy in China", IMF Working Paper No. 06/111.

Jacquinot, P. and R. Straub, 2007, "The multi-country version of the NAWM", mimeo.

Jacquinot, P. and R. Straub, 2008, "Globalisation and the Euro area", forthcoming ECB Working Paper Series.

Jefferson, G., A. Hu and J. Su (2006), "The sources and sustainability of China's economic growth", *Brookings Papers on Economic Activity, no. 2, pp. 1-60.*

Ji, A. and J. Wang (2006), "Exchange Rate Sensitivity of China's Bilateral Trade Flows", BOFIT Discussion Paper no. 19/2006.

Kamin, S.B., M. Marazzi, and J.W. Schindler, 2006, "The Impact of Chinese Exports on Global Import Prices", *Review of International Economics*, 14(2), 179-201.

Lafrance, R. (2008), "China's Exchange Rate Policy: A Survey of the Literature", Bank of Canada Discussion Paper, no. 2008-05.

Lardy, N. (2007), "China: Rebalancing Economic Growth",Peterson Institute for International Economics.

Lemoine, F. and D. Ünal-Kesenci, 2007, "China and India in international trade: from laggards to leaders?", CEPII Working Papers no. 2007/-19.

Ma, G. and R. McCauley (2007), "Do China's Capital Controls Still Bind? Implications for Monetary Autonomy and Capital Liberalisation", BIS Working Paper No. 233.

McKinnon, R. and G. Schnabl (2006), "China's Exchange Rate and International Adjustment in Wages, Prices and Interest Rates: Japan Dj vu?", CESifo Working Paper no. 1720.

McKinnon, R. (2007), " Why China Should Keep its Dollar Peg", International Finance, vol. 10, pp. 43-70.

People's Bank of China (2008), "China Monetary Policy Report Quarter Four, 2007", released on 22 February 2008.

Prasad, E., R. Rumbaugh and Q. Wang (2005), "Putting the Cart Before the Horse? Capital Account Liberalisation and Exchange Rate Flexibility in China", IMF Policy Discussion Paper no. 05/1.

Roubini, N.(2007), " Why China Should Abandon its Dollar Peg", International Finance, vol. 10, pp. 71-89.

Smets, F. and R. Wouters, 2003, "An Estimated Stochastic Dynamic General Equilibrium Model of the Euro Area", *Journal of the European Economic Association*, 1, 1123-1175.

Shi, J. (2006), "Are Currency Appreciations Contractionary in China?", NBER Working Paper no. 12551.

Su, N. (2004), "China's Economic Development and Current Macroeconomic Policy", delivered at the Conference of Montreal, 9 June 2004, (available at www.pbc.gov.cn).

Sun, H. and Y. Ma (2005), "Balance of Payments Surplus and Renminbi Revaluation Pressure", Hong Kong Institute for Monetary Research Working Paper no. 3/2005, February.

Tan, K.-S. and H.-E. Khor (2006), "China's changing economic structure and implications for regional patterns of trade, production and integration", *China & World Economy vol. 14/6, pp. 1-19.*

Yu, X. (2007), "The Pattern of Exchange Rate Effects on Chinese Prices", Review of International Economics, vol. 15, pp. 683-699.

Zhou, X. (2006), "Remarks on China's Trade Balance and Exchange Rate", delivered at the 'China Development Forum', sponsored by the Development Research Center of the State Council (available at www.pbc.gov.cn).

Appendix A

In this section, we define in detail the behaviour of firms in the model, which clarify the role of openness and channels of international transmissions as discussed in the main text. For more details, see Jacquinot and Straub (2007).

Firms

There are three types of firms, tradable intermediate and nontradable intermediate goods firms and final goods firms. In the nontradable intermediate goods market, there are a continuum of monopolistically competitive firms indexed by $\overline{f} \in S^n$, each of which produces a single nontradable differentiated intermediate good, $\overline{H}_{\overline{f},t}$, while tradable goods firms indexed by $f \in S^n$, produce a single tradable differentiated intermediate good, $H_{f,t}$. In the final goods market, there are three types of firms, which combine domestically-produced tradable intermediate and nontradable intermediate goods with imported intermediate goods into three distinct non-tradable final goods, namely a private consumption good, Q_t^C, a private investment good, Q_t^I, and a public consumption good, Q_t^G.

Final-Good Firms

In each country there is a continuum of symmetric firms producing three final goods, Q_t^C (the final consumption good), Q_t^I, (the final investment good) and Q_t^G (public good) under perfect competition. For simplification we will drop the firm indices in what follows.

The representative firm producing the non-tradable final private consumption good, Q_t^C, combines purchases of a bundle of domestically-produced non-tradable goods, $\overline{H}_t^C$, with purchases of a bundle of tradable goods, T_t^C ,

$$Q_t^C = \left((1-\nu_C)^{\frac{1}{\mu_C}} \overline{H}_t^{C\left(1-\frac{1}{\mu_C}\right)} + \nu_C^{\frac{1}{\mu_C}} T_t^{C\left(1-\frac{1}{\mu_C}\right)} \right)^{\frac{\mu_C}{\mu_C-1}}, \tag{5}$$

where the parameter $\mu_C > 1$ denotes the intratemporal elasticity of substitution between the distinct bundles of tradable and non-tradable goods, The weight of the inputs in the consumption basket are defined as $(1-\nu_C)$ and ν_C respectively. The bundle of tradable goods T_t^C is produced by the following constant elasticity of substitution technology:

$$T_t^C = \left(\vartheta_C^{\frac{1}{\mu_T^C}} \left(H_t^C \right)^{\left(1-\frac{1}{\mu_T^C}\right)} + (1-\vartheta_C)^{\frac{1}{\mu_T^C}} \left((1-\Gamma_{IM^C}(IM_t^C/Q_t^C)) IM_t^C \right)^{1-\frac{1}{\mu_T^C}} \right)^{\frac{\mu_T^C}{\mu_T^C-1}} \quad (6)$$

where H_t^C is a bundle of domestic produced tradable and IM_t^C is bundle of imported tradable goods, (which is defined, as we will discuss later, as a bundle of imported goods from all remaining economies), μ_T^C stands for the intratemporal elasticity of substitution between the distinct bundles of tradable domestic and imported goods, and ν_C determines the share of domestic tradable goods compared to imported goods. Notice that the consumption-good firm incurs a cost, $\Gamma_{IM^C}(IM_t^C/Q_t^C)$, when varying the use of the bundle of imported goods in producing the tradable consumption good.

The final good firm takes as given the prices of three inputs and minimizes its costs subject to the technological constraint defined above. The corresponding demand functions for $\overline{H}_t^C, T_t^C, IM_t^C, H_t^C$ are defined as follows:

$$\begin{aligned}
\overline{H}_t^C &= (1-\nu_C) \left(\frac{P_{\overline{H},t}}{P_{C,t}} \right)^{-\mu_C} Q_t^C, \\
T_t^C &= \nu_C \left(\frac{P_{T,t}^C}{P_{C,t}} \right)^{-\mu_C} Q_t^C, \\
H_t^C &= \nu_C \vartheta_C \left(\frac{P_{H,t}}{P_{C,t}} \right)^{-\mu_T^C} \left(\frac{P_{T,t}^C}{P_{C,t}} \right)^{\mu_T^C-\mu_C} Q_t^C, \\
IM_t^C &= \nu_C (1-\vartheta_C) \left(\frac{P_{IM,t}^C}{P_{C,t}\,\Gamma_{IM^C,t}^{\dagger}} \right)^{-\mu_T^C} \left(\frac{P_{T,t}^C}{P_{C,t}} \right)^{\mu_T^C-\mu_T} \frac{Q_t^C}{1-\Gamma_{IM^C}(IM_t^C/Q_t^C)},
\end{aligned}$$

where $P_{\overline{H},t}, P_{H,t}, P_{T,t}^C, P_{IM,t}^C$ are the corresponding prices of inputs, while $\Gamma_{IM^C,t}^{\dagger} = 1 - \Gamma_{IM^C}(IM_t^C/Q_t^C) - \Gamma'_{IM^C}(IM_t^C/Q_t^C)\, IM_t^C$ represents the first order derivative of the import adjustment cost functions with respect to imports and $P_{T,t}^C$ is the price of the composite basket of domestic and foreign tradables (imports) defined as:

$$P_{T,t}^C = \left(\vartheta_C \left(P_{H,t} \right)^{1-\mu_T} + (1-\vartheta_C) \left(P_{IM,t} \right)^{1-\mu_T} \right)^{\frac{1}{1-\mu_T}} \quad (7)$$

The formal characterization of the investment sectors is similar with self-explanatory changes in the notation. As in Coenen, McAdam and Straub (2007), we assume that the government sector is subject to complete home bias. In our model this implies that the final public good Q_t^G is a composite of different varieties of nontradable goods *only*.

Demand for domestic tradable and nontradable intermediate goods

In the next step, we will consider the composition of the baskets of intermediate tradable and non-tradable goods. Intermediate goods come in different varieties (brands) and are produced under monopolistic conditions. Tradable and nontradable intermediate goods are defined over a continuum of mass s, standing for the size of the country. Each nontradable good is produced by a domestic firm indexed by $f \in S^n$, while each tradable good is produced by a firm indexed by $\overline{f} \in S^n$.

In what follows, we will focus first on the production of the final domestically produced non-tradable consumption good $\overline{H}_t^C$, but the formal characterization holds also for the tradable goods sector. Defining as $\overline{H}_{\overline{f},t}^C$ the use of the intermediate goods produced by the domestic firm $\overline{f}$, we have

$$\overline{H}_t^C = \left(\left(\frac{1}{s^n} \right)^{\frac{1}{\theta_{\overline{H}}}} \int_{S^n} \left(\overline{H}_{\overline{f},t}^C \right)^{1-\frac{1}{\theta_{\overline{H}}}} d\overline{f} \right)^{\frac{\theta_{\overline{H}}}{\theta_{\overline{H}}-1}}, \quad , \tag{8}$$

where $\theta_{\overline{H}}$ are the intratemporal elasticities of substitution between the differentiated intermediate nontradable goods.

With nominal prices for differentiated intermediate goods $\overline{f}$ being set in monopolistically competitive markets, the consumption-good firm takes prices $P_{\overline{H},\overline{f},t}$ as given and chooses the optimal use of each differentiated intermediate good $\overline{f}$ and by minimising the expenditure for the bundles of intermediate nontradable goods subject to the aggregation constraints defined above. This yields the following demand functions for the domestic intermediate goods $\overline{f}$:

$$\overline{H}_{f,t}^C = \frac{1}{s^n} \left(\frac{P_{\overline{H},\overline{f},t}}{P_{\overline{H},t}} \right)^{-\theta_{\overline{H}}} \overline{H}_t^C, \tag{9}$$

where $P_{\overline{H},\overline{f},t}$ is the price for nontradable intermediate good $\overline{f}$. Correspondingly, $P_{\overline{H},t}$ is

defined as:

$$P_{\overline{H},t} = \left(\frac{1}{s^n} \int_{S^n} \left(P_{\overline{H},\overline{f},t} \right)^{1-\theta_{\overline{H}}} d\overline{f} \right)^{\frac{1}{1-\theta_{\overline{H}}}} \tag{10}$$

Aggregating across firms and accounting for the public demand of nontradables (assumed to have the same composition as private demand), we get the following total demand function for nontradable goods:

$$\overline{H}^C_{\overline{f},t} + \overline{H}^I_{\overline{f},t} + \overline{H}^G_{\overline{f},t} = \left(\frac{P_{\overline{H},\overline{f},t}}{P_{\overline{H},t,}} \right)^{-\theta_{\overline{H}}} \left(\overline{H}^C_t + \overline{H}^I_t + \overline{H}^G_t \right) \tag{11}$$

Following the same steps we can derive the domestic demand schedule for the tradable intermediate good:

$$H^C_{f,t} + H^I_{f,t} + H^G_{f,t} = \left(\frac{P_{H,f,t}}{P_{H,t}} \right)^{-\theta_H} \left(H^C_t + H^I_t \right) \tag{12}$$

Imported Goods Sector

The representative domestic firm producing the final imported consumption good, IM^C_t combines purchases of a bundle of imported goods $IM^{C,n}_t$using a CES technology:

$$IM^C_t = \left(\sum_n \left(\nu^{C,n}_{IM} \right)^{\frac{1}{\mu^C_{IM}}} \left(IM^{C,n}_t \right)^{1-\frac{1}{\mu^C_{IM}}} \right)^{\frac{\mu^C_{IM}}{\mu^C_{IM}-1}}, \tag{13}$$

where $0 \leq \nu^{C,n}_{IM} \leq 1$, $\sum_N \nu^{C,n} = 1$ and μ^C_{IM} is the elasticity of import substitution across countries. The higher μ^C_{IM}, the easier it is to substitute imports from one country with imports from the other. The parameter $\nu^{C,n}_{IM}$ determines the composition of import baskets across countries. Note that the share of consumption goods imports of total consumption imports from a generic country does not need to be the same as the share of investment goods imports of total investment imports. Looking at the individual components of the final-imported consumption good aggregator, $IM^{C,n}_t$ is in analogy to the domestically produced sector, a CES index of all varieties of all tradable intermediate goods produced by firms f^n in country n. In particular:

$$IM^{C,n}_t = \left(\left(\frac{1}{s^n} \right)^{\frac{1}{\theta^n_{IM}}} \int_{S^n} \left(IM^{C,n}_{f^n,t} \right)^{1-\frac{1}{\theta^n_{IM}}} df^n \right)^{\frac{\theta^n_{IM}}{\theta^n_{IM}-1}}, \tag{14}$$

note that s^n is the share of a generic country. Furthermore, θ^n_{IM} is the elasticity of substitution between intermediate tradable goods in the generic country n.

Taking the prices of imported goods as given, the final imported-good firm chooses a combination of imported goods that minimizes $\sum_N P^n_t \, IM^n_t$ subject to aggregation constraint (13). This yields the following demand functions for $IM^{C,n}_{f^n,t}$:

$$IM^{C,n}_{f^n,t} = \frac{1}{s^n}\left(\frac{P^{C,n}_{IM,f^n,t}}{P^{C,n}_{IM,t}}\right)^{-\theta^n_{IM}} IM^{C,n}_t, \tag{15}$$

Correspondingly $P^{C,n}_{IM,t}$ can be defined as:

$$P^{C,n}_{IM,t} = \left(\frac{1}{s^n}\int_{S^n}\left(P^{C,n}_{IM,f^n,t}\right)^{1-\theta^n_{IM}} df^n\right)^{\frac{1}{1-\theta^n_{IM}}} \tag{16}$$

The aggregate imported good price index can be defined as follows:

$$P^C_{IM,t} = \left(\sum_N \nu^{C,n}_{IM}\left(P^{C,n}_{IM,t}\right)^{1-\mu^H_C}\right)^{\frac{1}{1-\mu^H_C}} \tag{17}$$

Similar conditions hold for the investment imported-good sector.

Intermediate Non-tradable Good Firms

Each intermediate-good firm $\overline{f}$ produces its differentiated output using an increasing-returns-to-scale Cobb-Douglas technology,

$$\overline{H}_{\overline{f},t} = \max\left[z_{\overline{H},t}\, K^{\overline{\alpha}}_{\overline{f},t}\, N^{1-\overline{\alpha}}_{\overline{f},t} - \psi_{\overline{H}},\, 0\right], \tag{18}$$

utilising as inputs homogenous capital services, $K_{\overline{f},t}$, that are rented from the members of household I in fully competitive markets, and an index of differentiated labour services, $N_{\overline{f},t}$, which combines household-specific varieties of labour supplied in monopolistically competitive markets. The variable z_t represents (total-factor) productivity which is assumed to be identical across firms and which evolves over time according to an exogenous serially correlated process, $\ln(z_{\overline{H},t}) = (1-\rho_{z,\overline{H}})\, z_{\overline{H}} + \rho_{z,\overline{H}} \ln(z_{\overline{H},t-1}) + \varepsilon_{\overline{H},z,t}$, where $z_{\overline{H}}$ determines the steady-state level of productivity. The parameter $\psi_{\overline{H}}$ represents the fixed cost of production.[10]

[10]The fixed cost of production will be chosen to ensure zero profits in steady state in the tradable and non-tradable sectors respectively. This in turn guarantees that there is no incentive for other firms to enter the market in the long run.

Capital and Labour Inputs

Taking the rental cost of capital $R_{K,t}$ and the aggregate wage index W_t (to be derived below) as given, the firm's optimal demand for capital and labour services must solve the problem of minimising total input cost $R_{K,t}\, K_{\overline{f},t} + (1+\tau_t^{W_f})\, W_t\, N_{\overline{f},t}$ subject to the technology constraint defined above. Here, $\tau_t^{W_f}$ denotes the payroll tax rate levied on wage payments (representing the firm's contribution to social security).

Defining as $MC_{\overline{f},t}$ the Lagrange multiplier associated with the technology constraint, the first-order conditions of the firm's cost minimisation problem with respect to capital and labour inputs are given, respectively, by $\overline{\alpha}\,(\overline{H}_{\overline{f},t} + \psi_{\overline{H}})/K_{\overline{f},t}\, MC_{\overline{f},t} = R_{K,t}$ and $(1-\overline{\alpha})\,(\overline{H}_{\overline{f},t} + \psi_{\overline{H}})/N_{\overline{f},t}\, MC_{\overline{f},t} = (1+\tau_t^{W_f})\, W_t$, with the payroll tax rate $\tau_t^{W_f}$ introducing a wedge between the firm's effective labour cost and the marginal revenue of labour.

The Lagrange multiplier $MC_{\overline{f},t}$ measures the shadow price of varying the use of capital and labour services; that is, nominal marginal cost. We note that, since all firms $\overline{f}$ face the same input prices and since they all have access to the same production technology, nominal marginal cost $MC_{\overline{f},t}$ are identical across firms; that is, $MC_{\overline{f},t} = MC_{\overline{H},t}$ with

$$MC_{\overline{H},t} = \frac{1}{z_{\overline{H},t}\,\overline{\alpha}^{\overline{\alpha}}(1-\overline{\alpha})^{1-\overline{\alpha}}}\,(R_{K,t})^{\overline{\alpha}}((1+\tau_t^{W_f})\, W_t)^{1-\overline{\alpha}}. \tag{19}$$

Intermediate Tradable Good Firms

Each intermediate-good firm f produces its differentiated output using an increasing-returns-to-scale Cobb-Douglas technology,

$$Y_{f,t} = \max\left[\, z_t\, K_{f,t}^{\alpha}\, N_{f,t}^{1-\alpha} - \psi_H,\, 0\,\right], \tag{20}$$

utilising as inputs homogenous capital services, $K_{f,t}$, that are rented from the members of household I in fully competitive markets, and an index of differentiated labour services, $N_{f,t}$, which combines household-specific varieties of labour supplied in monopolistically competitive markets. The variable z_t represents (total-factor) productivity which is assumed to be identical across firms and which evolves over time according to an exogenous serially correlated process, $\ln(z_{H,t}) = (1-\rho_{H,z})\, z + \rho_{H,z}\, \ln(z_{H,t-1}) + \varepsilon_{H,z,t}$, where z_H determines

the steady-state level of productivity. The parameter ψ_H represents the fixed cost of production.[11]

Capital and Labour Inputs

Taking the rental cost of capital $R_{K,t}$ and the aggregate wage index W_t (to be derived below) as given, the firm's optimal demand for capital and labour services must solve the problem of minimising total input cost $R_{K,t}\,K_{f,t}+(1+\tau_t^{W_f})\,W_t\,N_{f,t}$ subject to the technology constraint. Here, $\tau_t^{W_f}$ denotes the payroll tax rate levied on wage payments (representing the firm's contribution to social security).

Defining as $MC_{f,t}$ the Lagrange multiplier associated with the technology constraint, the first-order conditions of the firm's cost minimisation problem with respect to capital and labour inputs are given, respectively, by $\alpha\,(Y_{f,t}+\psi_H)/K_{f,t}\,MC_{f,t} = R_{K,t}$ and $(1-\alpha)\,(Y_{f,t}+\psi_H)/N_{f,t}\,MC_{f,t} = (1+\tau_t^{W_f})\,W_t$, with the payroll tax rate $\tau_t^{W_f}$ introducing a wedge between the firm's effective labour cost and the marginal revenue of labour.

The Lagrange multiplier $MC_{f,t}$ measures the shadow price of varying the use of capital and labour services; that is, nominal marginal cost. We note that, since all firms f face the same input prices and since they all have access to the same production technology, nominal marginal cost $MC_{f,t}$ are identical across firms; that is, $MC_{f,t} = MC_{H,t}$ with

$$MC_{H,t} = \frac{1}{z_{H,t}\,\alpha^{\alpha}(1-\alpha)^{1-\alpha}}\,(R_{K,t})^{\alpha}((1+\tau_t^{W_f})\,W_t)^{1-\alpha}. \tag{21}$$

[11] The fixed cost of production will be chosen to ensure zero profits in steady state. This in turn guarantees that there is no incentive for other firms to enter the market in the long run.

Appendix A

A- Macroeconomic Aggregates

		E A	U S	China	R W
Output Share in World Output		0.23	0.30	0.09	0.37
Consumption to GDP	C/Y	0.59	0.63	0.36	0.62
Investment to GDP	I/Y	0.22	0.20	0.50	0.23
Government Spending to GDP	G/Y	0.18	0.16	0.16	0.16
Trade Balance to GDP	TB/Y	0.01	0.03	-0.02	-0.02
Net foreign Assets to GDP	Bf/Y	-0.52	-1.12	1.00	0.97

B- Household

		E A	U S	China	R W
Population size	s	0.200	0.200	0.300	0.300
Subjective discount factor	β	0.993	0.993	0.993	0.993
Inverse of the intertemporal elasticity of substitution	σ	2.000	2.000	4.000	2.000
Habit persistence	κ	0.600	0.600	0.600	0.600
Inverse of the Frish elasticity of labour supply	ζ	2.000	2.000	2.000	2.000
Depreciation rate	δ	0.025	0.025	0.025	0.025
Size of household J	ω	0.250	0.250	0.500	0.250
Households Calvo parameter	ξ_I, ξ_J	0.750	0.750	0.750	0.750
Wage indexation	χ_I, χ_J	0.750	0.750	0.750	0.750

C- Intermediate-good firms

		E A	U S	China	R W
Share of capital income	α_H, α_O	0.300	0.300	0.300	0.300
Share of fixed cost in production	ψ_H	0.200	0.154	0.143	0.200
	ψ_O				
TFP parameter	z	1.000	1.000	1.000	1.000
Price elasticity of labour demand	η	4.300	7.300	7.300	6.000
Price elasticity of specific labour demand	η_I, η_J	4.300	7.300	7.300	6.000
Firms Calvo parameter	ξ_H	0.900	0.900	0.900	0.900
	ξ_O	0.900	0.900	0.900	0.900
	ξ_X	0.300	0.300	0.300	0.300
Price indexation	χ_H, χ_O	0.500	0.500	0.500	0.500
	χ_X	0.500	0.500	0.500	0.500

Note: The subscript I stands for unconstrained and J for liquidity constrained households in our model. Correspondingly, H stands for tradable, X for the exports sector and O for nontradable sector in the model.

D- Final-goods firms

		E A	U S	China	R W
Quasi-share of domestic nontradable goods	ν_C	0.650	0.700	0.650	0.700
	ν_I	0.300	0.350	0.300	0.350
Quasi-share of tradable goods	ν_{TC}	0.301	0.617	0.324	0.417
	ν_{TI}	0.873	0.689	0.220	0.467
Price elasticity of goods demand	μ_C, μ_I	0.500	0.500	0.500	0.500
	μ^C_{IM}, μ^I_{IM}	1.500	1.500	1.500	1.500
	μ_{TC}, μ_{TI}	2.500	2.500	2.500	2.500
Price elasticity of intermediate goods demand	θ	6.000	6.000	6.000	6.000

Note: The subscript C stands for consumption goods sector, and I for investment goods sector. Correspondingly, the subscripts TC and TI stand for tradable consumption and investment goods sector, while IM denotes imported goods sector. The parameter μ^C_{IM} denote therefore the elasticity between different type of imported goods in the imported consumption good sector. The parameter μ_{TC} stand for the elasticity of substitution between domestic and imported tradable goods.

E- Fiscal and monetary authorities

		E A	U S	China	R W
Government debt-to-output ratio	B^*_Y	2.400	2.400	2.400	2.400
Sensitivity of lump-sum taxes to BY	Φ_{TB}	0.100	0.100	0.100	0.100
Inflation target	π^*	1.020	1.020	n.a.	1.020
Interest rate inertia	Φ_{RR}	0.950	0.950	0	0.950
Inflation gap	$\Phi_{R,\Pi}$	2.000	2.000	0	2.000
Output gap	$\Phi_{R,GY}$	0.100	0.100	0	0.100
Response to US dollar FX	$\Phi_{R,S}$	0	0	+ inf	0.100

F- Adjustment and transaction costs

		E A	U S	China	R W
Transaction cost	γ_{v1}	0.029	0.029	0.029	0.029
	γ_{v2}	0.150	0.150	0.150	0.150
Capital utilisation cost	γ_{u2}	0.007	0.007	0.007	0.007
Investment adjustment cost	γ_I	3.000	3.000	3.000	3.000
Import adjustment cost	γ_{IMC}, γ_{IMI}	5.000	5.000	5.000	5.000
Intermediation cost	γ_B	0.050	-	0.050	0.050

G- Trade matrix (imports as a share of nominal GDP)

to/from	E A	U S	China	R W
Consumption goods				
E A	-	0.006	0.023	0.120
U S	0.011	-	0.014	0.049
China	0.027	0.027	-	0.063
R W	0.051	0.044	0.011	-
Investment goods				
E A	-	0.006	0.004	0.014
U S	0.006	-	0.012	0.023
China	0.017	0.037	-	0.098
R W	0.032	0.031	0.017	-

H- Import Market Shares (as a percentage of total imports): Benchmark Calibration

	Euro Area	United States	China	Rest of the World
Consumption				
Euro Area	-	4.47	15.54	79.98
United States	14.92	-	19.77	65.30
China	23.10	22.90	-	54.00
Rest of the World	47.46	42.10	10.43	-
Investment				
Euro Area	-	25.74	15.62	58.64
United States	14.46	-	29.24	56.30
China	11.09	24.52	-	64.39
Rest of the World	40.26	39.01	20.73	-

Note: The columns indicate the country of origin, while the rows indicate the consumption and investment sector in a particular market.

European Central Bank Working Paper Series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.europa.eu).

973 "Do China and oil exporters influence major currency configurations?" by M. Fratzscher and A. Mehl, December 2008.

974 "Institutional features of wage bargaining in 23 European countries, the US and Japan" by P. Du Caju, E. Gautier, D. Momferatou and M. Ward-Warmedinger, December 2008.

975 "Early estimates of euro area real GDP growth: a bottom up approach from the production side" by E. Hahn and F. Skudelny, December 2008.

976 "The term structure of interest rates across frequencies" by K. Assenmacher-Wesche and S. Gerlach, December 2008.

977 "Predictions of short-term rates and the expectations hypothesis of the term structure of interest rates" by M. Guidolin and D. L. Thornton, December 2008.

978 "Measuring monetary policy expectations from financial market instruments" by M. Joyce, J. Relleen and S. Sorensen, December 2008.

979 "Futures contract rates as monetary policy forecasts" by G. Ferrero and A. Nobili, December 2008.

980 "Extracting market expectations from yield curves augmented by money market interest rates: the case of Japan" by T. Nagano and N. Baba, December 2008.

981 "Why the effective price for money exceeds the policy rate in the ECB tenders?" by T. Välimäki, December 2008.

982 "Modelling short-term interest rate spreads in the euro money market" by N. Cassola and C. Morana, December 2008.

983 "What explains the spread between the euro overnight rate and the ECB's policy rate?" by T. Linzert and S. Schmidt, December 2008.

984 "The daily and policy-relevant liquidity effects" by D. L. Thornton, December 2008.

985 "Portuguese banks in the euro area market for daily funds" by L. Farinha and V. Gaspar, December 2008.

986 "The topology of the federal funds market" by M. L. Bech and E. Atalay, December 2008.

987 "Probability of informed trading on the euro overnight market rate: an update" by J. Idier and S. Nardelli, December 2008.

988 "The interday and intraday patterns of the overnight market: evidence from an electronic platform" by R. Beaupain and A. Durré, December 2008.

989 "Modelling loans to non-financial corporations in the euro area" by C. Kok Sørensen, D. Marqués Ibáñez and C. Rossi, January 2009.

990 "Fiscal policy, housing and stock prices" by A. Afonso and R. M. Sousa, January 2009.

991 "The macroeconomic effects of fiscal policy" by A. Afonso and R. M. Sousa, January 2009.

992 "FDI and productivity convergence in central and eastern Europe: an industry-level investigation" by M. Bijsterbosch and M. Kolasa, January 2009.

993 "Has emerging Asia decoupled? An analysis of production and trade linkages using the Asian international input-output table" by G. Pula and T. A. Peltonen, January 2009.

994 "Fiscal sustainability and policy implications for the euro area" by F. Balassone, J. Cunha, G. Langenus, B. Manzke, J. Pavot, D. Prammer and P. Tommasino, January 2009.

995 "Current account benchmarks for central and eastern Europe: a desperate search?" by M. Ca' Zorzi, A. Chudik and A. Dieppe, January 2009.

996 "What drives euro area break-even inflation rates?" by M. Ciccarelli and J. A. García, January 2009.

997 "Financing obstacles and growth: an analysis for euro area non-financial corporations" by C. Coluzzi, A. Ferrando and C. Martinez-Carrascal, January 2009.

998 "Infinite-dimensional VARs and factor models" by A. Chudik and M. H. Pesaran, January 2009.

999 "Risk-adjusted forecasts of oil prices" by P. Pagano and M. Pisani, January 2009.

1000 "Wealth effects in emerging market economies" by T. A. Peltonen, R. M. Sousa and I. S. Vansteenkiste, January 2009.

1001 "Identifying the elasticity of substitution with biased technical change" by M. A. León-Ledesma, P. McAdam and A. Willman, January 2009.

1002 "Assessing portfolio credit risk changes in a sample of EU large and complex banking groups in reaction to macroeconomic shocks" by O. Castrén, T. Fitzpatrick and M. Sydow, February 2009.

1003 "Real wages over the business cycle: OECD evidence from the time and frequency domains" by J. Messina, C. Strozzi and J. Turunen, February 2009.

1004 "Characterising the inflation targeting regime in South Korea" by M. Sánchez, February 2009.

1005 "Labor market institutions and macroeconomic volatility in a panel of OECD countries" by F. Rumler and J. Scharler, February 2009.

1006 "Understanding sectoral differences in downward real wage rigidity: workforce composition, institutions, technology and competition" by P. Du Caju, C. Fuss and L. Wintr, February 2009.

1007 "Sequential bargaining in a new-Keynesian model with frictional unemployment and staggered wage negotiation" by G. de Walque, O. Pierrard, H. Sneessens and R. Wouters, February 2009.

1008 "Liquidity (risk) concepts: definitions and interactions" by K. Nikolaou, February 2009.

1009 "Optimal sticky prices under rational inattention" by B. Maćkowiak and M. Wiederholt, February 2009.

1010 "Business cycles in the euro area" by D. Giannone, M. Lenza and L. Reichlin, February 2009.

1011 "The global dimension of inflation – evidence from factor-augmented Phillips curves" by S. Eickmeier and K. Moll, February 2009.

1012 "Petrodollars and imports of oil exporting countries" by R. Beck and A. Kamps, February 2009.

1013 "Structural breaks, cointegration and the Fisher effect" by A. Beyer, A. A. Haug and B. Dewald, February 2009.

1014 "Asset prices and current account fluctuations in G7 economies" by M. Fratzscher and R. Straub, February 2009.

1015 "Inflation forecasting in the new EU Member States" by O. Arratibel, C. Kamps and N. Leiner-Killinger, February 2009.

1016 "When does lumpy factor adjustment matter for aggregate dynamics?" by S. Fahr and F. Yao, March 2009.

1017 "Optimal prediction pools" by J. Geweke and G. Amisano, March 2009.

1018 "Cross-border mergers and acquisitions: financial and institutional forces" by N. Coeurdacier, R. A. De Santis and A. Aviat, March 2009.

1019 "What drives returns to euro area housing? Evidence from a dynamic dividend-discount model" by P. Hiebert and M. Sydow, March 2009.

1020 "Opting out of the Great Inflation: German monetary policy after the break down of Bretton Woods" by A. Beyer, V. Gaspar, C. Gerberding and O. Issing, March 2009.

1021 "Rigid labour compensation and flexible employment? Firm-level evidence with regard to productivity for Belgium" by C. Fuss and L. Wintr, March 2009.

1022 "Understanding inter-industry wage structures in the euro area" by V. Genre, K. Kohn and D. Momferatou, March 2009.

1023 "Bank loan announcements and borrower stock returns: does bank origin matter?" by S. Ongena and V. Roscovan, March 2009.

1024 "Funding liquidity risk: definition and measurement" by M. Drehmann and K. Nikolaou, March 2009.

1025 "Liquidity risk premia in unsecured interbank money markets" by J. Eisenschmidt and J. Tapking, March 2009.

1026 "Do house price developments spill over across euro area countries? Evidence from a global VAR" by I. Vansteenkiste and P. Hiebert, March 2009.

1027 "Long run evidence on money growth and inflation" by L. Benati, March 2009.

1028 "Large debt financing: syndicated loans versus corporate bonds" by Y. Altunbaş, A. Kara and D. Marqués Ibáñez, March 2009.

1029 "The role of fiscal transfers for regional economic convergence in Europe" by C. Checherita, C. Nickel and P. Rother, March 2009.

1030 "Forecast evaluation of small nested model sets" by K. Hubrich and K. D. West, March 2009.

1031 "Global roles of currencies" by C. Thimann, March 2009.

1032 "Assessing long-term fiscal developments: a new approach" by A. Afonso, L. Agnello, D. Furceri and R. Sousa, March 2009.

1033 "Fiscal competition over taxes and public inputs: theory and evidence" by S. Hauptmeier, F. Mittermaier and J. Rincke, March 2009.

1034 "The role of the United States in the global economy and its evolution over time" by S. Dées and A. Saint-Guilhem, March 2009.

1035 "The role of labor markets for euro area monetary policy" by K. Christoffel, K. Kuester and T. Linzert, March 2009.

1036 "Search in the product market and the real business cycle" by T. Y. Mathä and O. Pierrard, March 2009.

1037 "What do asset prices have to say about risk appetite and uncertainty?" by G. Bekaert, M. Hoerova and M. Scheicher, March 2009.

1038 "Are 'intrinsic inflation persistence' models structural in the sense of Lucas (1976)?" by L. Benati, March 2009.

1039 "Real time' early warning indicators for costly asset price boom/bust cycles: a role for global liquidity" by L. Alessi and C. Detken, March 2009.

1040 "The external and domestic side of macroeconomic: adjustment in China" by R. Straub and C. Thimann.