DETERMINANTS OF CURRENT ACCOUNT BALANCES

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Abstract

Global current account imbalances tripled during the period of 1994-2008. There is wide consensus that, in addition to other failures, the macroeconomic causes of the 2008 financial crisis were global imbalances. In our panel study the current account balance is explained by a large set of variables that is derived from both the theory and previous studies. To get a clear overall view of the issue we used several estimators (within, GLS, pooled OLS and between) and data at different time frequencies.

The dynamic-optimizing approach has replaced the Keynesian approach as the prevailing conception of current account. It is based on two building blocks: consumption smoothing and global equality in marginal product of capital. However, phenomena such as precautionary saving or liquidity constraints may water down the permanent income consumption behaviour. In addition, capital market imperfections together with heterogeneity in domestic financial markets may prevent the marginal product of capital from equalizing.

By having a sample of 79 countries, 30 of which are advanced economies and 49 of which are developing economies, over a 15-year period from 1993 to 2007 we had the means to a decent panel study. We discovered that there is a sharp distinction between the two groups of countries. As the Ricardian equivalence holds and the GDP per capita growth has a negative effect on the current account balance in the short run the permanent income consumption behaviour is not a bad approximation for the advanced economies. For the developing economies it is just the opposite. Our main suspect for causing this distinction is the existence of liquidity constraints in the developing economies. In both group of countries a higher dependency ratio and a higher private credit ratio have a negative effect on the current account balance. However, these two seem to do better in explaining current account fluctuations within countries than between countries.

Our contribution is as follows: We found out that allowing unobserved heterogeneity to some extent affects the results; that is, studies in which pooled OLS has been used as the only estimator should be read cautiously. In addition, we were able to classify variables based on whether they better explain current account fluctuations within countries or between countries.

Keywords
Global current account imbalances, dynamic-optimizing approach, Ricardian equivalence, heterogeneity in domestic financial markets, panel data methods

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Tiivistelmä

Globaalit vaihtotase-epätasapainot kasvoivat kolminkertaisiksi aikavälillä 1994–2008. On olemassa laaja yhteisymmärrys siitä, että globaalit epätasapainot olivat makrotaloudellinen syy vuoden 2008 finanssikriisin taustalla. Paneelitutkimuksessamme vaihtotaseen tasapainoa selitetään joukolla muuttujia, jotka on johdettu sekä teoriasta että aiemmista tutkimuksista. Selvän kokonaiskuvan saamiseksi käytämme useita eri estimaattoreita (within, GLS, pooled OLS ja between) ja aineistona sekä viiden vuoden keskiarvoja että vuosittaisia havaintoja.

Nykyinen näkemys vaihtotaseesta pohjautuu taloudellisten toimijoiden yli ajan tapahtuvaan optimointiin. Sen mukaan toimijat suosivat yli ajan vakioista kulutuksen tasoa, vaikka heidän tulotasonsa vaihtelisivatkin ja pääomien liikkuessa vapaasti maidenväliset erot pääoman rajatuotossa poistuvat. Todellisuudessa ilmiöt, kuten varovaisuussäästäminen tai luottorajoitteet, voivat vesittää pysyväistulohypoteesin mukaisen kulutuskäyttäytymisen. Lisäksi rahoitusmarkkinoiden epätäydellisyydet ja erot paikallisten rahoitusmarkkinoiden kehittyneisyydessä voivat estää pääoman rajatuoton yhtäläistymisen.

Otoksemme kattaa 79 maata, joista 30 on luokiteltavissa kehittyneiksi ja 49 kehittyviksi talouksiksi, 15 vuoden pituiselta ajanjaksolta vuodesta 1993 vuoteen 2007. Havaitsimme, että maaryhmien välillä on selvä kahtiajako. Pysyväistulohypoteesin mukainen kulutuskäyttäytyminen ei ole huono luonnehdinta kehittyneistä talouksista, sillä ricardolainen ekvivalenssi pätee ja talouskasvulla on lyhyellä aikavälillä negatiivinen vaikutus vaihtotaseen tasapainoon. Kehittyville talouksille asiantila on päinvastainen. Mielestämme kahtiajaon taustalla löytyvät luottorajoitteet. Molemmissa maaryhmissä korkea huoltosuhde ja korkea pankkisektorin kehittyneisyys vaikuttavat vaihtotaseen ylijäämää pienentävästi. Tosin nämä selittävät paremmin maan sisäistä vaihtelua vaihtotaseen tasapainossa kuin eroja maiden välillä.

Tutkimuksemme tuoma lisäarvo on seuraava: Havaitsimme, että tulokset ovat osittain riippuvaisia siitä, sallitaanko ei-havaittua maakohtaista heterogeenisuutta vai ei. Onnistuimme myös hieman luokittelemaan muuttujia sen mukaan, selittävätkö ne paremmin maan sisäistä vaihtelua vaihtotaseen tasapainossa vai eroja maiden välillä.

Asiasanat
Globaalit vaihtotase-epätasapainot, optimointi yli ajan, ricardolainen ekvivalenssi, erot paikallisten rahoitusmarkkinoiden kehittyneisyydessä, paneelimenetelmät

Säilytyspaikka
Jyväskylän yliopiston kauppakorkeakoulu

CONTENTS

1 INTRODUCTION

After the late 1990s world economy drifted into an imbalanced state (see figure 1). What is behind this divergence of domestic saving and investment? Can we make sense of the global current account imbalances? This thesis is an attempt to explain these global imbalances that prevailed before the 2008 financial crisis and which apparently will return after the crisis.

Why should anyone care about current account imbalances? Is it not a bit old-fashioned to make noise about such issues? Yet, if one takes a look at the literature on financial crises, it is clear that a prolonged current account deficit predicts problems to come. The latest example is the global financial crisis which broke out from the U.S. in the fall of 2008. There is some disagreement among economists about the roots of the crisis, but one thing is for sure: global imbalances were essential. The term "global imbalances" refers primarily to a dichotomy between the U.S. and developing economies (especially China) in the current account balances. Even though the euro zone has been in balance with the rest of the world, there have been substantial imbalances and problems within the euro area (see figure 2). However, the issue of sustainability is not the only reason for analysing the determinants of current account balances. The current account dynamics is at the centre of international macroeconomics. If we lack the understanding of it, we lack the understanding of how the world economy functions.

In this thesis the determinants of current account balances are analysed by panel data methods. It is very likely that these determinants depend on time horizon. Factors that matter in the short-run do not necessarily matter in the long-run. Jumping straight to the actual empirical analysis does not make sense. At first, we need to understand the theory and be aware of the previous empirical studies.

The key insights of modern macroeconomic theory on the current account dynamics are introduced in Chapter 2. The prevailing conception of current account is the dynamic-optimizing approach also known as the intertemporal approach. The purpose of Chapter 2 is to find out the variables that are relevant for explaining current account balances and to get a prediction for the signs of the coefficients. In Chapter 3 we consider the role of exchange rates in global imbalances. Two major special cases, the U.S. and the euro area, are recognized. Chapter 3 aims to fill the gap between the theory; that is, the intertemporal approach, and the reality. The linear panel data models and some prior empirical studies are introduced in Chapter 4. The results of the actual empirical analysis are presented in Chapter 5. Conclusions are drawn in Chapter 6.

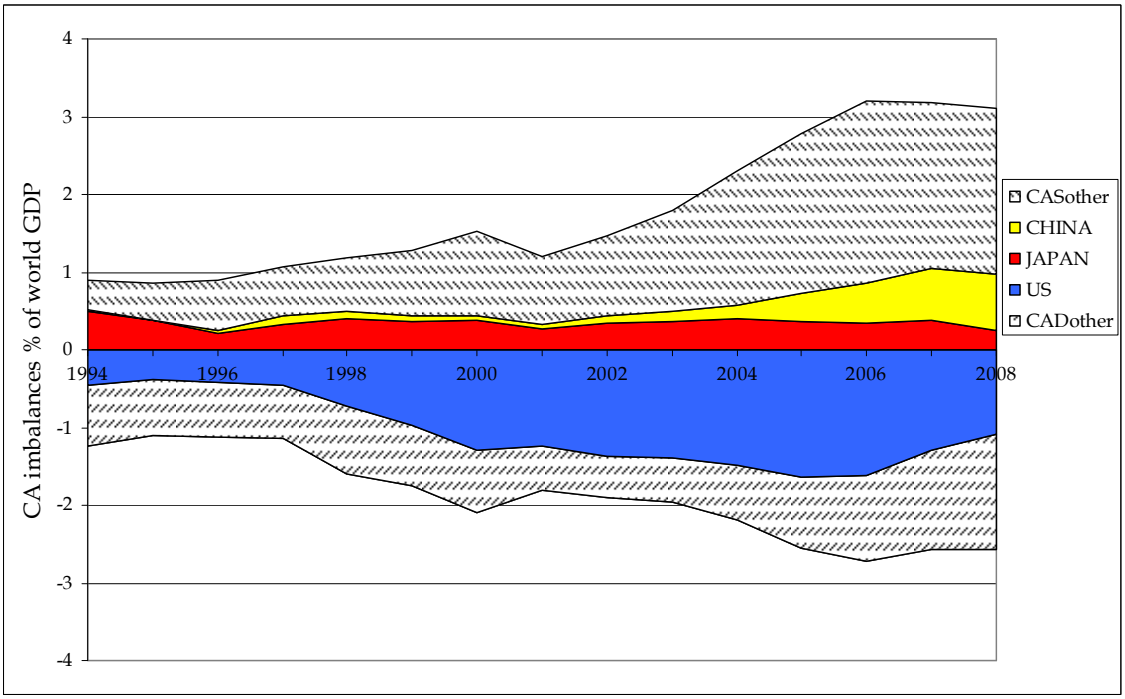

FIGURE 1 Current account imbalances in the world economy
(World Development Indicators)

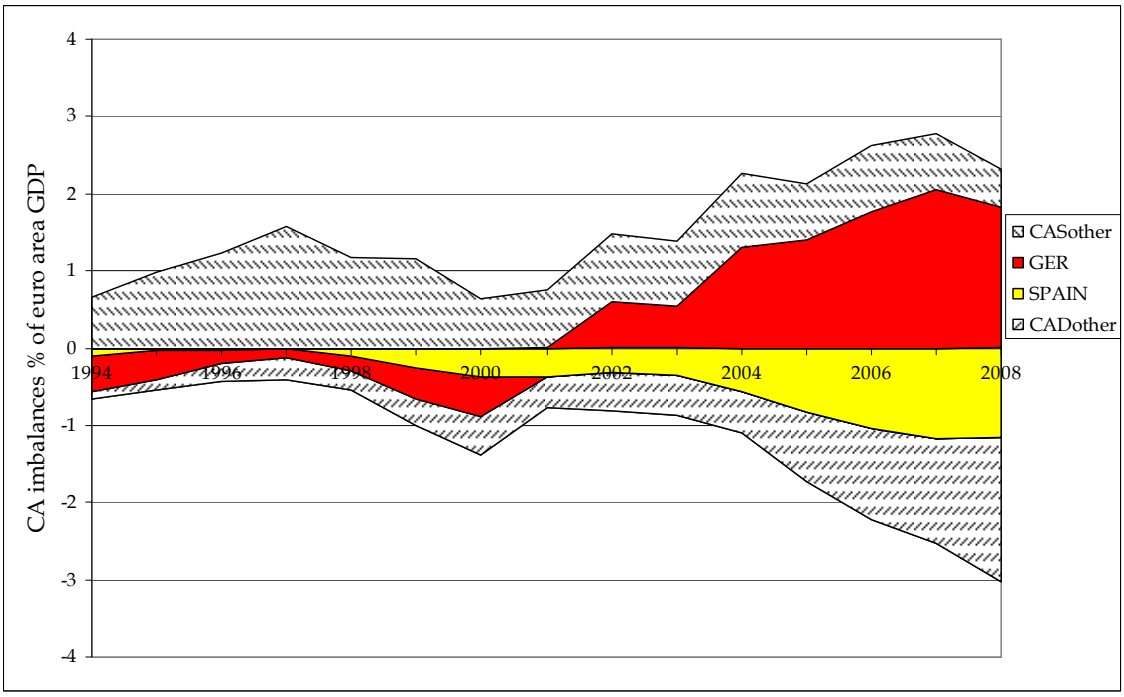

FIGURE 2 Current account imbalances in the euro area
(World Development Indicators)

CASother = current account surpluses of other countries
CADother = current account deficits of other countries

2 THE INTERTEMPORAL APPROACH

Since the 1980s, the prevailing conception of current account has been the intertemporal approach. Before the intertemporal optimizing models emerged, the earlier Keynesian approach to trade balance, and then the monetary approach to the balance of payments prevailed. According to Singh (2007) conventional non-optimizing models, the Keynesian and monetary, can be used for policy considerations, but are incomplete because they lack microeconomic foundations and forward-looking agents. In the Keynesian non-optimization models demand is decisive and the current account balance is determined by the difference of exports and imports that can be written as a function of domestic income, foreign income and real exchange rate. (Singh 2007, 27.) Income elasticity of import demand becomes crucial in this framework.[1] The Mundell-Fleming model, which is familiar to everyone from undergraduate-level books, can be classified as a Keynesian non-optimization model. It models financial account as a flow function of relative interest rate levels (Obstfeld 2001, 10–11).

In the 1970s, the monetary approach to balance of payments was developed. According to this approach the disequilibrium of balance of payments is a monetary phenomenon. (Singh 2007, 28.) Obstfeld (2001) points out that a simultaneous trend, the growth of world financial markets, made the use of balance of payments as an indicator of external balance questionable. The size of gross capital flows is much greater than the size of net capital flows, which is recorded in the balance of payments accounts. In this respect, the view that exchange rate is determined by the equilibrium condition of balance of payments was flawed.[2] (Obstfeld 2001, 9–11.)

Singh (2007) asserts that the 1980s marked "a paradigm shift in open-economy macroeconomics". The intertemporal optimizing models assume perfect capital mobility, just like the Mundell-Fleming model, and a high degree of economic integration. Current account is seen as "a function of domestic saving and investment decisions of the forward-looking optimizing agents". (Singh 2007, 30.) This contrasts with the Keynesian approach which emphasized demand for exports and imports. The intertemporal approach is based on two building blocks: consumption smoothing and global equality in marginal product of capital. The assumption of perfect capital mobility is reflected in the latter. The concept of consumption smoothing will be discussed in Section 2.1. Singh (2007) notes that there has been progress in modelling methodologies. Studies until the late 1980s used the deterministic models, which assume perfect foresight. Since the 1990s, stochastic dynamic general equilibrium (DSGE) models have been used intensively in open-economy macroeconomics.

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[1] Houthakker and Magee (1969) discovered that U.S. income elasticity of import demand exceeds its trading partners' income elasticity of import demand for U.S. exports. Falling in line with the Keynesian approach this Houthakker-Magee effect was considered to have contributed to the U.S. current account deficit.

[2] In text the balance of payments equilibrium refers to a situation, in which reserves are unchanged.

DSGE models have made unnecessary the assumption of perfect foresight. (Singh 2007, 26.)

This chapter relies heavily on Obstfeld and Rogoff's (1996) book which is probably the best presentation of modern macroeconomic theory and international finance. It is important to remember that both the deterministic model and the stochastic model[3] are small-country one-good models with infinitely-lived representative consumers. We abandon the assumption of representative agents in the overlapping-generations model. These three models are from the real side of international macroeconomics. Instead, the Redux model is a two-country general equilibrium model with nominal rigidities and imperfect competition. Between the presentations of the two model families mentioned above, we will briefly deal with the so-called new rule, which offers a jump to portfolio choice models. Also international capital flows are considered before Redux. The predictions rising from the theoretical framework are summarized in Section 2.8. The empirical relevance of the intertemporal approach is discussed shortly in Section 2.9.

There is no reason to present these beautiful models just in the name of art. It is from these models that we get the conception of which variables are relevant in explaining the current account balance. We aim to deduce a prediction of the dynamic response of current account to different shocks from every model or theory. Alternatively, we are interested to obtain a prediction of how several factors, such as demographic structure or state of domestic financial markets, which cannot be characterized as shocks, affect the current account balance. At least as important as getting these predictions, is to realize on which assumptions a particular model is built. By changing assumptions we typically get totally different results. If we change assumptions, we effectively change our model.

2.1 The gains from financial openness and budget constraint

There are in general three kinds of gains from financial globalization: gains from consumption smoothing, efficient investment and diversification of risk (Feenstra and Taylor 2008, 653). In a closed economy incomes and expenditures have to be equal at every point of time. There can be individuals who lend to or borrow from their fellow countrymen, but there are by definition no cross-border capital flows. Open economies have the possibility to borrow or lend resources abroad. This is a great advantage, for example in the case of temporary output shocks. Inequality between incomes and expenditures indicates current account imbalance (see definition (A) and equation (B)). However, it is clear that no economy, despite of financial openness, can run deficits forever. Eventually debts must be paid off.

It is very natural to think that households prefer constant level of consumption to varying level of consumption despite of fluctuations in their current incomes. The concept of consumption smoothing is consistent with the permanent income hy-

[3] Be careful not confuse the stochastic model in Section 2.3 and a fully specified DSGE model.

pothesis[4] proposed by Friedman (1957). If the economy experiences a negative output shock, which is known to be temporary, agents will smooth their consumption against the shock by borrowing from foreigners, and by implication running a current account deficit. Here, output shock is assumed to be exogenous: a temporary fall in the endowment which agents receive every period. When output changes for example as a result of total factor productivity, things get more complicated, because also the optimal level of capital changes. Financial openness allows a smoother consumption path whenever output shocks are temporary and more or less local. If the correlation in output shocks between countries is perfect, there is no-one with whom to practise intertemporal trading.

Along with the difference of incomes and expenditures current account balance is equivalent with the difference of savings and investments (see equation (C)). Without cross-border capital flows domestic investments have to be financed by domestic savings only. This would be very inefficient. Consider for example the discovery of new natural resources. The discovery of new natural resources does not as such have any effect on the GDP. Natural resources translate into higher future income only through investment project. Part of the investment projects can be financed by foreign savings, if there is financial integration. This is an advantage, because it allows domestic agents to maintain constant level of consumption as it is their future and not current incomes that increase. This example illustrates also how closely the second gain from financial openness (efficient investment) is linked to the first one (consumption smoothing). If the economy is very small and the amount of funds needed for the investment project is large, it is even possible that relying on foreigners' savings is the only alternative, whether domestic agents practice consumption smoothing or not.

Another aspect of the efficient investment argument can be observed as follows. Assume: 1) a standard Solovian production function, 2) all countries share the same state of technology, and 3) some countries are capital-abundant (more physical capital per worker), while others are capital-scarce (less physical capital per worker). Under financial autarky marginal product of capital is higher in capital-scarce countries. In this situation worldwide gains from financial globalization are huge, at least if we abstract from potential imperfections in the international capital markets.

It is obvious that a country can run current account deficits only within certain limits. This limit is called intertemporal budget constraint or long-run budget constraint (LRBC). With some simplifying assumptions, to which we return later, current account balance determines the evolution of a country's net foreign assets (see equation (D)). To be more precise, it is the trade balance which is crucial: net interest payments are determined recursively by previous net international investment positions (see equation (E)). According to Feenstra and Taylor (2008), for a country to satisfy the LRBC its present value of net foreign assets from last period must equal to the present value of all present and future trade balances, with opposite signs of course

[4] According to the permanent income hypothesis consumption is determined by expectations of lifetime income, not by current income.

$$(2.1.A) \quad -(1+r)B_{t-1} = NX_t + \frac{NX_{t+1}}{(1+r)} + \frac{NX_{t+2}}{(1+r)^2} + \frac{NX_{t+3}}{(1+r)^3} + \cdots$$

We call equation (2.1.A) as the long-run budget constraint. Equation (2.1.A) represents the condition in which the present value of the country's resources (the present value of net foreign assets from last period plus the present value of present and future GDP) equals the present value of present and future expenditures. (Feenstra and Taylor 2008, 657–659.) The message of this equation (2.1.A) is that, if a country has run trade deficits in the past, it has to pay off debt by running positive net exports at some point in the future. The long-run budget constraint is practically the same as the well-known no-Ponzi-game condition (see equation (F)). The slight difference between the two is that a country cannot end up with unpaid debt to meet the no-Ponzi-game condition. When LRBC holds, economy ends up in neither a negative nor a positive net international investment position.

But reality is not as simple as shown above, especially in equation (D). There are other factors than just the current account balance which affect on a country's NIIP. These other factors are called valuation effects or valuation adjustment. Both Dofa and Foda are exposed to price changes just as any other assets. In addition, exchange rate determines the reciprocal size of Dofa and Foda. The case of the U.S. is a classic example. During the 10-year period 1998–2007 U.S. cumulative current account deficit was 5,207 billion dollars, while NIIP deteriorated only by 1,130 billion dollars (Bureau of Economic Analysis). This gap results from the fact that the price of Dofa appreciated on average more than the price of Foda, and that the dollar's effective exchange rate depreciated during the period. The latter had a positive impact on U.S. NIIP because Foda is denoted in dollars, while Dofa is denoted mainly in foreign currencies. The U.S differs from developing countries, for whom currency depreciation has a negative effect on their NIIP.

These valuation effects have an implication for the LRBC. In theory a country could run sustained current account deficits, if positive valuation adjustment guarantees that the LRBC holds. Gourinchas and Rey (2007a) argue that this financial adjustment channel is important accounting for 31 percentages of the U.S. external adjustment. In their opinion one reason why the empirical predictions of the intertemporal approach has been rejected by the data is its inability to recognize capital gains and losses. (Gourinchas and Rey 2007a.) Clearly it is important not to ignore the valuation channel entirely. However, we would make these two remarks: results from the U.S cannot be generalized, and valuation adjustment probably fades away in the long-run. The dollar is the leading reserve currency and this possibly makes U.S. current account dynamics exceptional. For the U.S., capital gains from Dofa may exceed capital gains in Foda even in the long-run, because foreign central banks' motives to buy assets denoted in dollars differs from private investors' motives. This can be demonstrated also from the fact that even though U.S. NIIP has been negative since 1986 its net interest payments have still always been positive (Bureau of Economic Analysis). In general, it is very unlikely that valuation adjustment has a significant role to play in the long-run, as the LRBC particularly is by definition a con-

straint concerning the long-run. On the other hand, it is important to realize that the potential impact of valuation channel increases as gross holdings increase no matter the value of net holdings. For example 1978-2008 U.S. gross holdings multiplied by more than 40 times (Bureau of Economic Analysis).

We get our first prediction from the long-run budget constraint. If a country's NIIP is initially considerably negative, we should expect that it will run positive trade balances in the future. Of course it is impossible to announce an exact date from which this country begins to catch-up its LRBC. Still, we can confidently make such a claim. The adjustment process can take a form of a severe crisis, or it may happen in a controlled manner. Part of the needed adjustment could, in theory, be carried out by favourable valuation effects. Feenstra and Taylor (2008, 953–954) point out that net debtor cannot convert trade balance from deficit to surplus without experiencing a real depreciation, when we assume differentiated goods and home bias in consumption. If this Keynesian transfer effect holds, it is problematic for those countries who have borrowed in terms of foreign currency.

As long as shocks are not perfectly correlated across countries, it is possible to diversify investment risks internationally. Portfolio diversification allows agents to reduce the volatility of their consumption levels without any net foreign lending or borrowing (Feenstra and Taylor 2008, 692). This brings us to the portfolio choice, which we deal shortly in Sections 2.5 and 2.6.2.2. But before that portfolio allocation is not relevant, because we assume that only riskless bonds are traded.

2.2 A deterministic model

Obstfeld and Rogoff (1996, 74) present a so-called fundamental current account equation (see derivation from Appendix B)

$$(2.2.A) \quad CA_t = \left(Y_t - \tilde{Y}_t\right) - \left(I_t - \tilde{I}_t\right) - \left(G_t - \tilde{G}_t\right),$$

where $\tilde{X}_t$ denotes the permanent level of variable X on date t (see definition (G)). Equation (2.2.A) results from utility maximization behaviour under certain assumptions. These assumptions are infinitely-lived representative agents, time-additive utility function, constant interest rate, the subjective discount factor equals the market discount factor, only riskless bonds can be traded (no state-contingent securities), budget balance and perfect foresight. Because this is a one-good model utility maximization refers here to intertemporal optimization. Whenever the subjective discount factor equals the market discount factor, agents' behaviour is driven by pure consumption smoothing motive. If the two are unequal, agents have other motives along with consumption smoothing: either to tilt consumption upwards ($\beta > 1/(1+r)$), or to tilt it downwards ($\beta < 1/(1+r)$). Assuming perfect foresight is of course unrealistic, but the deterministic model serves as a benchmark for more realistic set-ups (Obstfeld and Rogoff 1994, 8). It is important to recognize that initial shocks are unanticipated. If shocks were anticipated, they would not have an effect on the date

they hit, but on the date they were anticipated. Assuming infinitely-lived agents is also unrealistic, but the behaviour of an economy populated by finite-lived agents, who care about their descendants, is very similar (Obstfeld and Rogoff 1996, 59). The reason why the effect of budget deficit on current account cannot be examined by this model is tautological: government's budget is assumed to be in balance. If government spending rises, taxes rise equally. Even if we would allow budget deficit, it would not have any effect on the current account balance, because with infinitely-lived representative agents Ricardian equivalence[5] always holds as agents fully internalize government's budget constraint (Obstfeld and Rogoff 1996, 133).

It is easy to see the effects of different shocks on current account balance from equation (2.2.A). If for example GDP is temporarily above its permanent level, the current account is in surplus, because agents want to distribute the effect of this one good year on consumption to the entire time span. Current account surplus results in positive net foreign assets (assuming that initially NIIP was zero), which yield interest payments from abroad in future periods. The very same logic applies to the temporary deviations of investments and government spending from their permanent levels. If government spending is temporarily above its permanent level, the current account is in deficit, because the households' net income temporarily decreases. At present, agents borrow from foreigners to avoid a sharp drop in consumption. The changes in government spending are purely exogenous in our model; that is, they are a result of political decision-making and therefore not very interesting.

Temporary changes in the level of investment are of more interest. If investment is temporarily above its permanent level, because of the discovery of new natural resources, the current account is in deficit both because of increased need to invest, and because the permanent level of output rises. New (inexhaustible) resources cause incomes to rise permanently in the future, but not in the present time. Reasoning is basically the same in the case of rise in total factor productivity. If agents know that from the next year onwards TFP is on a new higher level, the current account is in deficit both because the optimal level of capital increases (see equation (5) with the assumption that production involves decreasing return to capital), and because the permanent level of output rises. To achieve the higher level of capital investments need to rise only in the current period, because we are abstracting from capital depreciation. It is crucial to understand that the paths of output and investment are not independent (Obstfeld and Rogoff 1996, 75). For example permanent rise in the TFP from the next period onwards changes two components in equation (2.2.A): both I_t and $\tilde{Y}_t$ rise.

If we assume an endowment economy, or alternatively that the level of investment is constant, we get a prediction that current account is procyclical. When output is above its permanent level or growing faster than normal, current account is in surplus. If we assume that there are no fiscal changes made during the different stages of business cycle and budget is in balance only in the long-run instead of being in balance in every period, our prediction is reinforced. Automatic stabilizers guarantee

[5] According to the Ricardian equivalence there is no causality from budget deficit to current account deficit: agents anticipate the offsetting tax increase in the future, and therefore the increase in private saving is equivalent to the decline in public saving.

that when output is above its long-run level, also the government budget is in surplus. Of course our prediction is on a very thin ice, because we abstracted from investment, which fluctuate a lot and is very procyclical. Taking into account fluctuations in investments can easily turn current account from procyclical to countercyclical.

2.2.1 A departure from one-good model

Here we depart from one-good models which we assumed above, and to which we return in Sections 2.3–2.4. Changes in intratemporal relative prices have an effect on current account balance. The easiest way to present this effect is to do it in the deterministic model while ignoring investments and government spending. The terms of trade is defined as the relative price of exports and imports. Obstfeld and Rogoff (1994) demonstrate that, if we make some further assumptions, we get the following consumption function:

$$(2.2.1.A) \quad C_t = rB_t + \frac{r}{1+r}\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(\frac{p_s Y}{P_s}\right),$$

where p is the price of exports in terms of imports, and P is the consumer price index in terms of imports. The assumptions made in this derivation are: economy has an endowment of its export good, but it consumes imports also, an isoelastic period utility function, and ($\beta = 1/(1+r)$). The interpretation of equation (2.2.1.A) is this: fluctuations in terms of trade have the same effect on current account balance than fluctuations in output at constant terms of trade (compare equation (2.2.1.A) to equation (9)) (Obstfeld and Rogoff 1994, 23–24.) If terms of trade temporarily rise, current account is in surplus. On the other hand, permanent changes in terms of trade do not have any effect on current account balance.

Sachs (1981) deduces a similar prediction in a two-period model. For oil importers a temporary rise in oil price indicates larger current account deficits, while permanent price changes do not per se have effect on current account balance. (Sachs 1981, 222.)

2.3 A stochastic model

In the deterministic model it was assumed that agents know the future, the paths of output and government spending along with the payoffs on investment, beforehand. In the real world the future is a result of random events that cannot be known beforehand. Obstfeld and Rogoff (1996) propose a stochastic model, which is more realistic in these respects. The stochastic model recognizes that future levels of output, government spending, and investment are all random variables. It assumes that agents have rational expectations on these. The concept of rational expectations means that the forecasts the agent has are unbiased; that is, the agent's subjective ex-

pectation of the realisation of future events is the same as the variable's mathematical expectation value conditional on all information. (Obstfeld and Rogoff 1996, 79.) Except the formation of expectations, all other assumptions are inherited from the previous model. The assumption of riskless bonds as the only asset is an especially important one. The current account response to various shocks depends on whether or not there are state-contingent securities (Obstfeld and Rogoff 1994, 32). In the other extreme, when there are Arrow-Debreu securities for every state the uncertainty, which is essential in our stochastic model, loses its meaning as agents can get full insurance against future events.

When we assume quadratic utility (see Appendix B), solving the stochastic model is highly comparable to the previous model except that agents maximize the expected value of lifetime utility (Obstfeld and Rogoff 1996, 79–81). In the following two sections we will ignore government spending because, as mentioned earlier, Ricardian equivalence always holds with infinitely-lived representative agents. Throughout the sections we assume that agents do not know when the shocks hit, but after this initial surprise agents do know the persistence of the shocks; that is, they know the parameter value of ρ. Dropping quadratic utility allows us to consider precautionary saving.

2.3.1 Response to output shocks

Here we explore the current account response to unexpected (exogenous) output shocks, while ignoring investment entirely. Obstfeld and Rogoff (1996) distinguish two different cases depending on the stationary of output. In the first case output follows the exogenous stochastic process

$$(2.3.1.A)\quad Y_t - \overline{Y} = \rho\left(Y_{t-1} - \overline{Y}\right) + \varepsilon_t \quad \longrightarrow \quad Y_t = \overline{Y} + \sum_{s=-\infty}^{t} \rho^{t-s}\varepsilon_s ,$$

where $\overline{Y}$ is the permanent level of Y, ε_t is a serially uncorrelated disturbance so that $E_{t-1}\varepsilon_t = 0$, and $0 \leq \rho < 1$. What this stochastic difference equation (2.3.1.A) with implication means is that as long as $\rho < 1$ the shocks' effect on output decay geometrically over time. In the long-run output converges to its pre-shock level. When unexpected output shocks decay geometrically, we get the following equation for the current account balance (see derivation from the Appendix B):

$$(2.3.1.B)\quad CA_t = \rho\left(\frac{1-\rho}{1+r-\rho}\right)\left(Y_{t-1} - \overline{Y}\right) + \left(\frac{1-\rho}{1+r-\rho}\right)\varepsilon_t .$$

Note that there are two components in the equation (2.3.1.B). (Obstfeld and Rogoff 1996, 82–83).

In table 1 some rough approximations of the current account response to an unexpected temporary ($\rho < 1$) positive output shock on period t ($\varepsilon_t > 0$) are calculated. It is crucial to assume that there are no further shocks, and that in the last period output was on its permanent level. An imaginary interest rate (r = 0.05) is assumed. As a result of temporary output shock also the permanent level of output changes a little, but this has been ignored in table 1.

TABLE 1 Approximation of the current account response to an unexpected output shock

ρ	CA_t	CA_{t+1}
ρ = 0	$\left(\frac{1-\rho}{1+r-\rho}\right)\varepsilon_t \approx 0.95\varepsilon_t$	$\rho\left(\frac{1-\rho}{1+r-\rho}\right)\left(Y_t-\bar{Y}\right)=0$
ρ = 0.2	$\left(\frac{1-\rho}{1+r-\rho}\right)\varepsilon_t \approx 0.94\varepsilon_t$	$\rho\left(\frac{1-\rho}{1+r-\rho}\right)\left(Y_t-\bar{Y}\right)\approx 0.19\left(Y_t-\bar{Y}\right)=0.19\,\varepsilon_t$
ρ = 0.8	$\left(\frac{1-\rho}{1+r-\rho}\right)\varepsilon_t = 0.8\varepsilon_t$	$\rho\left(\frac{1-\rho}{1+r-\rho}\right)\left(Y_t-\bar{Y}\right)=0.64\left(Y_t-\bar{Y}\right)=0.64\,\varepsilon_t$

If there is no persistence in the shock at all (ρ = 0), current account is in surplus only in the year that the shock hits. Agents realize that the rise in output is purely temporary, and in the spirit of consumption smoothing they distribute the effect of positive shock to the entire time span by foreign asset accumulation. Current consumption and future consumption are increased by the same amount; an amount which corresponds to the positive interest payment from accumulated foreign assets (see equation (19)). If there is persistence in the shock (ρ = 0.8), current account is in surplus for many years. (Table 1 gives a distorted picture in these respects because also the permanent level of output rises.) Even with some persistence agents realize that the rise in output is only temporary, and that is why they do not increase their consumption according to risen output. The size of the current account surplus decreases along with the fading shock. If the shock is fully persistent (ρ = 1), it has no effect on the current account balance, because the permanent level of output rises to a level which equals the current level of output. There is no reason to smooth consumption, if the new level of output lasts forever.

In the second case, according to Obstfeld and Rogoff (1996), output follows the exogenous stochastic process

$$(2.3.1.C)\quad Y_t - Y_{t-1} = \rho\left(Y_{t-1}-Y_{t-2}\right)+\varepsilon_t \quad \xrightarrow{0<\rho<1} \quad Y_t = Y_{t-1}+\sum_{s=-\infty}^{t}\rho^{t-s}\varepsilon_s\,.$$

Now output is a nonstationary random variable. The difference between the present and the preceding cases is that here as a result of the shock the permanent level of output changes always more than the current output. (Obstfeld and Rogoff 1996, 84.) When there occurs an unexpected output shock on period t, and output is mean reverting in growth rates rather than in levels, Obstfeld et al. (1998, 17) show that we get the following equation for the current account balance (see derivation from the Appendix B):

$$(2.3.1.D)\quad CA_t = \frac{-\rho}{1+r-\rho}\varepsilon_t\,.$$

In the present case the current account response to a positive output shock differs dramatically from the previous case: the current account balance is in deficit on the

year of shock. Consumption smoothing implies current account deficit because the permanent level of output rises more than the current output. This means that during period t consumption is actually more volatile than output.

2.3.2 Response to productivity shock

We can add reality to analysis by recognizing that there is a production function which relates output to capital stock and productivity parameter (see equation (3)). In our stochastic model Obstfeld and Rogoff (1996) treat productivity parameter as a random variable which follows the stochastic process

$$(2.3.2.A) \quad A_t - \overline{A} = \rho\left(A_{t-1} - \overline{A}\right) + \varepsilon,$$

where ε_t is a serially uncorrelated shock so that $E_{t-1}\varepsilon_t = 0$, and $0 \leq \rho \leq 1$. Increased TFP affects output by two channels: both the output given capital stock and the optimal level of capital rise. The effect on current account can also be divided into two parts: increased productivity spurs investment, and risen output has implication for saving.

The current account response to a positive productivity shock depends totally on the persistence of the shock. This can be seen from figure 3, in which economy faces an unexpected 1 percent positive rise in productivity during period t. An imaginary interest rate ($r = 0.05$) and production function ($Y = AK^{0.4}$) are assumed. (Obstfeld and Rogoff 1996, 86–88.)

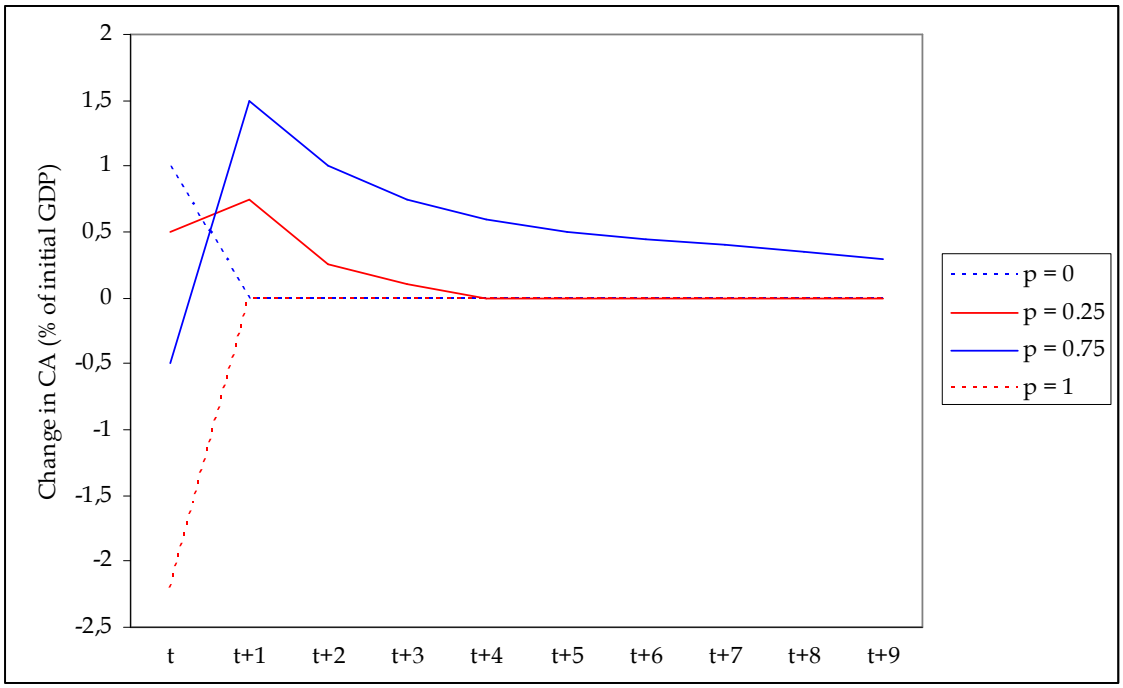

FIGURE 3 Current account responses to a 1 percent productivity increase on period t (Obstfeld and Rogoff 1996, 88, Figure 2.3)

If there is no persistence in the shock at all ($\rho = 0$), current account is in surplus only in the year that the shock hits. Agents realize that the rise in productivity is purely temporary. Therefore, there is no reason to increase investment on current period

(see equation (H)). When the change in TFP is purely temporary, so is the change in output. In the spirit of consumption smoothing agents want to distribute the effect of one good year to the entire time span. This can be done by foreign asset accumulation. If the shock is fully persistent (ρ = 1), the permanent level of output rises more than the current output, even though the level of TFP is constant after the shock. This is because the optimal level of capital rises. From the next period onwards, capital stock is larger, and this is why also the level of output is higher despite no further rise in productivity. Current account deficit on period t results from risen investment and from consumption smoothing. If there is some persistence in the shock (ρ = 0.25 or ρ = 0.75), things get more complicated. With ρ = 0.25 the current output rises by more than the permanent level of output. This means that saving on current period rises (consumption smoothing). Investment on current period rises also, but the rise in saving dominates. With ρ = 0.75 it is the other way round.

It is import to realize the restrictions of the preceding analysis. First, productivity shocks were assumed to be local. In reality, it is typical that productivity changes as a result of global acceleration in TFP growth (for example new general-purpose technology). If this is the case, our small-country model cannot be used to analyse the current account responses. Instead, we would need a general equilibrium model, in which interest rate would not be exogenous. However, it is clear that country-specific productivity shocks have larger effect on current account than global shocks. A second remark is that we assumed economy-wide shocks. In reality, it is typical that productivity shock is concentrated on some sector. There is a great difference whether the productivity rises in the exporting sector or in the service sector. Our one-good model falls short in these respects.

2.3.3 Equation for the current account balance

When consumption is determined according to the certainty equivalence principle (equation (15)), current account balance can be written in stochastic setting comparable with equation (2.2.A) as follows:

$$(2.3.3.A)\quad CA_t = \left(Y_t - E_t\tilde{Y}_t\right) - \left(I_t - E_t\tilde{I}_t\right) - \left(G_t - E_t\tilde{G}_t\right), \text{ or equivalence}$$

$$(2.3.3.A)\quad CA_t = -\sum_{s=t+1}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} E_t\,\Delta Z_s\,,$$

where $\Delta Z_s = Z_s - Z_{s-1}$, and $Z = (Y - I - G)$ (Obstfeld and Rogoff 1996, 90). Briefly, the current account is in deficit, when output net of government spending and investment is expected to rise in the future.

2.3.4 Departures from the permanent income consumption

Above, we assumed that agents have linear-quadratic utility functions. With other simplifying assumptions we concluded (equation (15)) that consumption depends only on the expected values of output net of investment (and government spending).

This so-called certainty equivalence principle means that agents behave as if the future levels of output, government spending, and investment, which are all random variables turned out to their conditional means with certainty (Obstfeld and Rogoff 1996, 81). It is very likely that agents also care about how volatile the output is. Obstfeld and Rogoff (1996) point out that the extent of precautionary saving is related to the third derivative of the utility function. With quadratic utility the third derivative is zero. When agents are inclined to precautionary saving, they respond to increased uncertainty by saving more. An agent with low wealth does not dare to borrow, even when economy is hit by a purely temporary negative output shock. Instead, the agent accumulates assets which can be run down during the bad year. (Obstfeld and Rogoff 1996, 94–95.) Precautionary saving is comparable to tilting consumption upwards ($\beta > 1/(1+r)$). However, the difference between the two is that precautionary saving motive declines as the agent's wealth increases. If there is a full set of Arrow-Debreu securities available, there is no reason for precautionary saving, regardless of the type of utility function.

Precautionary saving is a current issue in the world economy today. Developing countries, especially China, have accumulated huge reserves. There might be other motives for this also, such as exchange rate manipulation, but one motive has been precautionary saving. Fearing a sudden stop in which a country cannot borrow from foreigners, but instead sees foreign capital fleeing the country, has resulted in reserve accumulation. Having huge reserves they are not so vulnerable to the sudden stop.

Along with precautionary saving also the existence of liquidity constraints can cause a departure from the permanent income consumption. If consumers cannot borrow at the same interest rate at which they can save, or if there are individuals who cannot get enough loan to follow the consumption path which is consistent with their intertemporal optimization behaviour, consumption is not determined by permanent income principle (Romer 2006, 374–375).

2.4 The overlapping generations model

If an economy is populated by infinitely-lived representative consumers, as in the deterministic or the stochastic models above, the Ricardian equivalence holds by a self-evident proposition. Eventually the government has to pay back the debt it took while running the budget deficit. The consumers know this. They also know that there will be no-one else to be charged for the repayment than themselves, because the agents live infinitely and new individuals are not born. This awareness makes the agents anticipate the tax increase in the future, which the government will set to repay the debt, and to raise private saving at a time of budget deficit by an amount equivalent to the drop in public saving. Consequently, budget deficit has no effect on the current account balance. To get any current account responses to a budget deficit we have to adopt richer demographic assumptions.

Weil (1989) emphasizes that it is important to draw a distinction between the concepts of infinite horizon model and representative agent model. The length of the

agents' lifetime has no relation to the validity of the Ricardian equivalence. Instead, the birth of new (infinitely-lived) dynasties who do not have any connection to the existing dynasties is a sufficient condition for the failure of Ricardian equivalence. Abandoning the assumption of representative agents, to which the disconnectedness between dynasties implies, is sufficient to violate the Ricardian neutrality. (Weil 1989, 183, 196.)

In general, there are many elements that can water down the Ricardian equivalence, but in the context of our models one in particular is the possible disconnectedness between the generations. If agents live infinitely, arrival of new dynasties is needed to create the disconnectedness. On the other hand, if agents do not live infinitely and there is a full turnover of generation between the periods of budget deficit and tax increase (all the agents living at a time of budget deficit will be dead before the tax increase, and no-one of the generation facing the tax increase was born yet at the time of budget deficit), the existence of intergenerational altruism and the possibility to leave a bequest can remove the obvious disconnectedness. Whenever all agents have descendants and they care about each of their descendants as much as of themselves, all disconnectedness is gone and the Ricardian equivalence holds. As Obstfeld and Rogoff (1996, 177) point out, all we need is that the agents care about their immediate descendants. When the existing generation always cares about the next generation, in fact all the generations will be linked to each other. Some disconnectedness remains, if there are (mortal) agents who do not have descendants, or if there are so-called illegitimate children of whom no-one cares.

Having discussed consumption smoothing, which is just a by-product of the permanent income hypothesis, and factors that cause agents to depart from it (e.g. precautionary saving and liquidity constraints), we observe that the Ricardian equivalence is partly linked with our previous discussion. Romer (2006, 571) builds a bridge between the two by saying: "The issue whether Ricardian equivalence is a good approximation is closely connected with the issue of whether the permanent-income hypothesis provides a good description of consumption behavior." If consumption is determined by current disposable income instead of lifetime income, also the Ricardian equivalence fails; that is, failures of the permanent income hypothesis lead to failures of the Ricardian equivalence. (Romer 2006, 571.)

Considering the above remarks, it is possible to make some predictions on how the Ricardian neutrality holds in a cross-sectional examination. Phenomena such as precautionary saving and liquidity constraint are much more relevant in the poor developing countries than in the rich countries. It is highly probably that a budget deficit has stronger deteriorating impact on the current account balance in the poorer countries.

In the following sections we go back to the perfect foresight framework. The only difference to the earlier model is that now we have infinitely-lived dynasties (families) who come into being on different dates. It is crucial that a new dynasty is not linked to any pre-existing dynasty. This means that individuals are not born with financial wealth. These unlinked new individuals might represent poor immigrants or illegitimate children (Obstfeld and Rogoff 1996, 182). This model of overlapping families of infinitely-lived agents comes directly from Weil (1989). Weil's model is a

descendant of Blanchard's model (1985) and differs from the classical Diamond overlapping generations model by assuming infinitely-lived dynasties. In the Diamond model there is an ongoing turnover in population because agents are mortal (Romer 2006, 76). For simplicity's sake, we stick to the small country case and assume an endowment economy.

2.4.1 Response to temporary output shock

Here we will see how the response to temporary output shock is affected by the recognition of overlapping generations. For our purposes a qualitative analysis is enough. We will ignore the government entirely.

Obstfeld and Rogoff (1996) assert that economy converges to a steady state, in which the per capita aggregate stock of net foreign assets (b_t) is constant, as long as the inequality $(1+r)\beta/(1+n) < 1$ holds.[6] In addition, we make the familiar assumption $\beta = 1/(1+r)$, which in the present context has an implication that b_t converges to zero. If output per capita rises unexpectedly for one period only, agents accumulate foreign assets by running a current account surplus. So far there is nothing new. However, population growth impacts on the speed of convergence. If new individuals are not born, foreign asset holdings are permanently positive, and yield permanently interest income. In this case consumption is permanently on a higher level (consumption smoothing) and b_t never converges to zero. Whenever new individuals are born, per capita consumption returns to the pre-shock level. This is due to the fact that with positive n, b_t converges to zero. The larger the n, the faster is the speed of convergence. Therefore only the long-run implications of temporary output shock differ between the overlapping generations model and the representative-agent model. (Obstfeld and Rogoff 1996, 184, 189–190.) It is essential that net foreign assets are defined as per capita. This is why the birth of new individuals makes b_t converge slowly to zero.

2.4.2 Response to budget deficit

Current account balance is the difference of savings and investments. In an endowment economy there are no investments. Current account is in surplus, if the private sector and the government save in total a positive amount (see equation (3)). According to the Ricardian equivalence, a drop in government saving is fully compensated by private saving. By definition, saving is the remainder of disposable income after consumption. If we are successful in showing that budget deficit has a positive effect on private consumption, we have proved that the Ricardian equivalence fails.

Obstfeld and Rogoff (1996, 190–191) show that in our overlapping generation model the per capita consumption can be written as follows (see derivation from Appendix B):

[6] Note that n is the rate at which population grows.

$$(2.4.2.A)\quad c_t = (1-\beta)\left[(1+r)\left(b_t + \frac{n\bar{d}}{r}\right) + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}(y_s - g_s)\right],$$

where $\bar{d}$ is the per capita budget deficit. (Note that all variables are defined as per capita. For example g_s denotes government spending per capita. Note also that, if n = 0 and $\beta = 1/(1+r)$, equation (2.4.2.A) simplifies to equation (9).) We observe that with a positive n, budget deficit has a positive effect on per capita consumption. In other words, there is causation from budget deficit to current account deficit. The reason is very simple and can be seen from equation (2.4.2.A): part of the burden, which the government's increased debt causes, is carried by individuals who are not yet born at the time of the budget deficit.[7] In the spirit of Weil's (1989) model, these new entrants are not linked to existing individuals. The Ricardian equivalence holds only in the case that new individuals are not born (n = 0).

2.4.3 Demographic structure

Both the permanent income hypothesis and the life-cycle hypothesis, the latter was introduced by Modigliani and Brumberg (1954), recognize that consumption depends on lifetime resources instead of current income. However, the difference between the two is that in the permanent income hypothesis a simplifying assumption of infinitely-lived agents is done (Modigliani 1986, 299). For this reason it makes sense to examine the effect of demographic structure on current account balance in the light of the life-cycle hypothesis. We continue to ignore the role of investments. It is important to realize the logic behind the following reasoning: when we assume that consumption depends on lifetime resources, and consumers prefer stable level of consumption, we effectively agree that national saving determines the current account balance.

Modigliani (2004) repeats a proposition he had expressed even before: the saving rate increases with a steady population growth. To be more precise, it is the demographic structure that is decisive, but there is a predictable relation from population growth to demographic structure, if growth has been stable for long enough. (Modigliani 2004, 150). Why does the demographic structure matter? The answer is obvious. According to Modigliani's (1986) stripped down version of the life-cycle hypothesis, lifetime is divided into two parts: income is constant until retirement and zero thereafter. This means that during the first stage individuals save a positive amount, and during the second they spend what they had accumulated in order to maintain a constant level of consumption. There are no bequests in this simple version. Therefore, we get the following prediction: the faster the population growth, the higher the aggregate saving rate. Hence it is also true that the lower the dependency ratio, the larger the current account surplus. The extent of this demographic effect depends on the length of retirement. If the second phase is relatively long, when

[7] However, see details from Appendix B.

compared to the first phase, demographic structure matters a lot. (Modigliani 1986, 300–301.)

It is important to notice that in the stripped down version of the life-cycle hypothesis the childhood stage was ignored. If the population growth is stable and positive, also the relative size of the child population increases along with the working-age population. This breaks down the relation between population growth and dependency ratio. However, the prediction that low dependency ratio correlates with larger current account surplus prevails.

2.5 The new rule and portfolio choice models

Our view is that current account serves as a buffer against temporary output shocks. This has been essential in our analysis. The ground for this kind of thinking is the fact that agents prefer consumption smoothing. Kraay and Venture (2000) develop a prediction, the new rule, for the current account response to temporary income shocks, which is fundamentally different. According to the new rule, the current account response equals the savings generated by the shock multiplied by the country's share of foreign assets in total asset. This new rule has a fascinating feature: the sign of current account response depends on the sign of NIIP.

Kraay and Venture deduce that it is reasonable to expect marginal behaviour to obey average behaviour: agents allocate the marginal unit of wealth between foreign and domestic assets in the same proportion as the average unit of wealth. Typically it has been assumed that in the case of temporary positive income shock countries invest the marginal unit of wealth in foreign assets only. The new rule implies that if the share of country's wealth invested in domestic capital is larger than one, a positive income shock results in a greater increase in domestic capital, which by implication means current account deficit. Kraay and Ventura justify their proposition by assuming that investment risk is high compared to how severe the decreasing return to capital is. If investment risk is high, agents are reluctant to invest all additional income in just foreign assets. On the other hand, if decreasing return to capita is not severe, expanding domestic capital stock does not imply decreased returns. The traditional rule can be justified by assuming just the opposite about the relative importance of investment risk and decreasing return to capital. (Kraay and Ventura 2000, 1137–1138.)

There is no reason for to panic. We can solve this apparent contradiction. Kraay and Venture arrive at different predictions, because they emphasize the importance of investment risk. At the beginning of this chapter (Sections 2.1–2.4), we systematically ignored investment risk, when we had an economy in which only riskless bonds were traded. There is no investment risk with riskless bonds. This unrealistic assumption made portfolio choice totally irrelevant. After admitting this we can; however, locate a weak spot also in Kraay and Ventura's reasoning. Investing in foreign assets does not obviously mean investing in any particular asset. The rest of the world consists of many countries. It is possible for an agent to strongly diversify investment risk even when investing in just one destination, namely the rest of the

world. In addition, the obvious necessity to assume constant returns to scale calls the new rule into question.

Tille and van Wincoop (2010) analyse the new rule by the means of two-country DSGE model of portfolio choice. According to the new rule, increased savings are invested domestically because of portfolio home bias. If this was the case, and we had decreasing return to capital, it would have a natural implication: the marginal product of capital falls in the home country. Logically this would lead domestic agents to shift towards foreign assets; that is, there would be a rise in net capital outflow, which is parallel to the current account surplus (see equation (D)). Consequently, the new rule cannot hold whenever we assume decreasing return to capital. However, the assumption of constant returns to scale is a necessary, but not a sufficient condition for the new rule. Domestic agents cannot unilaterally determine the ratio of net foreign assets to wealth. Whenever agents in both countries have cross-border asset holdings, the ratio depends not just on the portfolio allocation of domestic agents, but also on the portfolio allocation of foreign agents, and furthermore on the relative wealth of the two countries. Therefore, the new rule needs one-way capital flows, so that only domestic agents can make cross-border investment in addition to constant returns to scale.

Tille and van Wincoop criticize Kraay and Ventura for another illogical reasoning. The new rule was sold first and foremost as a proposition arising from the data. Still, it is derived entirely from the cross-sectional data.[8] Tille and van Wincoop point out that this cross-sectional evidence reflects behaviour in the steady-state. Here there is a logical contradiction, because the new rule dealt exactly with the dynamic current account response to a temporary income shock, which is by nature purely short-term fluctuation.

Tille and van Wincoop also discuss which one of the portfolio theory and the intertemporal theory describe current account dynamics the best. According to the portfolio theory of current account, capital flows are driven by agents' decisions on portfolio allocation. In this framework investing in foreign assets reflects the need to diversify, when reaching optimal country-shares in the portfolio. Intertemporal approach is built on consumption smoothing, which determines saving and equality between marginal product of capital across countries, which then determines investment. If there are constant returns to scale, marginal product of capital is not related to the size of capital stock. In this case investment and thus also current account is determined by portfolio allocation. Tille and van Wincoop arrive at the conclusion that the truth lies somewhere between the models. However, it is important not to connect the new rule to the portfolio theory of current account. The new rule needed one-way capital flows in addition to constant returns to scale. (Tille and van Wincoop 2010.)

Since making a jump to the portfolio choice models, it is necessary to look at both sides of portfolio allocation. Although, concentrating on the dichotomy between the U.S. and the developing countries, Caballero, Farhi and Gourinchas (2008) pro-

[8] Also Kraay and Ventura (2000, 1159) admit this. Country-specific averages from the entire time span are calculated in a cross-sectional analysis using panel data. It is natural to interpret the result from such an analysis to reflect behaviour in the long-run equilibrium.

duce an important point. In portfolio allocation it is not only demand, but also supply that matters. If in some economies the ability to supply assets differs greatly from the demand, this may have powerful implications on current account balances. (Caballero et al. 2008). The prevailing safe-asset imbalances have been critical for the U.S. current account deficit (Caballero 2010). Caballero's observation is in line with the well-known global saving glut argument proposed by Bernanke (2005).

2.6 International capital flows

Financial globalization makes all countries share a common riskless interest rate.[9] Here we are; however, more interested in marginal product of capital. We will see that, whether or not marginal products of capital equalize, depends on capital market imperfections.

The intertemporal approach, which is the paradigm we follow, is based on two building blocks: consumption smoothing and global equality in marginal product of capital. This far we have mostly concentrated on implications of consumption smoothing in different set-ups using the small-country framework as a workhorse. Now we try to analyse international capital flows in a general equilibrium framework. Especially we will ignore business fluctuations which would, due to consumption smoothing, complicate our analysis and concentrate instead on the long-run dynamics.

2.6.1 Capital markets without imperfections

Although the neoclassical growth model, constructed by Solow (1956) and Swan (1956), has been rightly criticized for many defects, it is still a good starting point for considering cross-border capital flows. Typically, production function is assumed to have the Cobb-Douglas form, which means that the marginal product of capital is positive but strictly decreasing in the stock of capital. In competitive markets, factors of production are being compensated by the sum of money, which corresponds to their contribution in the production process.

At first, we ignore the heterogeneity in the state of technology by dropping technology parameter from the production function (see equations (I)–(J)). If we assume two countries that differ in capital intensity, we get a prediction for net capital flows.[10] Initially marginal product of capital is higher in the (poor) capital-scarce country than in the (rich) capital-abundant country. As a result, capital will flow from the rich country to the poor country. Agents living in the rich country get higher returns when investing in the poor country. This is the state of affairs until the

[9] This is not strictly true. In reality we have to take into consideration exchange rate fluctuations. It is reasonable to assume that the covered interest rate parity holds.

[10] In the Solow growth model, assuming countries already are in their steady states, this might result from a difference in saving rates. The other option is that the poor country has not yet reached its steady state level of capital per capita.

marginal products of capital are equalized; that is, until countries have the same capital intensity.

We can add realism by allowing differences in the state of technology. It is very likely that the rich countries are rich partly because they have technological advantage compared to the poor countries. If this is the case, it is not certain any longer that the marginal product of capital is higher in the capital-scarce country (see equation (K)). When we recognize human capital as a factor of production along with physical capital and labour, our knowledge of the relative magnitudes of the marginal products of capital decreases further (see equation (L)). It is highly likely that the rich countries have larger stocks of human capital than the poor countries. After all, in our two-country world economy we can be sure about two things: there will be one-way capital flows only (no portfolio diversification), and this cross-border capital flow will equalize the marginal products of capital. However, we do not know anymore what the direction of net capital flows is. In addition, it is important to remember that every country has to meet its long-run budget constraint (equation (2.1.A)). If the capital-scarce country will resort to foreign savings while extending its capital stock, it needs to run positive trade balances in the future.

2.6.2 Heterogeneity in domestic financial markets

We can take a giant leap in understanding, when we realize that "financial integration was a global phenomenon, but financial development was not" (Mendoza, Quadrini and Rios-Rull 2009, 373). The distinction between two types of assets is crucial. Until now only riskless bonds have been traded. Now we consider state-contingent securities also.

There are many reasons for capital market imperfections, but two in particular are asymmetric information and enforcement problems. The worlds of the two following sections differ considerable. With asymmetric information all domestic capital market inefficiencies are determined endogenously. In the second model we just assume that enforcement problems are more severe in some countries than in others, and try to find out the implications. In Section 2.6.2.2 we make a jump to portfolio choice.

2.6.2.1 A model with asymmetric information

Gertler and Rogoff (1990) build on informational asymmetries between lenders and borrowers while assuming all enforcing problems away. All domestic capital market imperfections are determined endogenously and depend solely on a country's, or to be more precise, on entrepreneurs' wealth. (See details of this model from Appendix B.)

Consider first a small-country model. Entrepreneurs are unable to finance all the investment projects[11] by themselves, but instead they have to borrow at least part of the money they need. As we all know, investing in new technologies is risky business: there is no guarantee that the investment will pay off. When the entrepreneur

[11] Here investment projects refer primarily to investing in R&D to invent new technologies.

makes an investment in R&D, it is impossible to know beforehand if it will yield a new innovation or not. The only thing that is sure is that it takes lots of money to do research and developing. The asymmetric information means that in a situation, where the entrepreneur's investment project did not succeed, lenders cannot verify was it because the entrepreneur did her best but still failed, or was it because the entrepreneur used the money she borrowed to something else than investing. This is a problem, because, if the entrepreneur does not succeed in investing, there is no money from which to pay her debt other than her prevailing wealth. Entrepreneurs can issue a state-contingent security, which means that the lender receives higher repayment Z^g (where g refers to the *good* outcome) if the project yields good outcome, and lower Z^b (where b refers to the *bad* outcome) if it fails. Lenders require that the security has to offer the market rate of return (see equation (27)).

It can be demonstrated that, as long as Z^g differs from Z^b, the amount of capital invested k will differ from the first-best optimum value k*[12]. This problem cannot be solved by payments that would be fixed across states because, as mentioned earlier, if the investment project fails, the entrepreneur might be unable to repay. The equilibrium under asymmetric information is as follows: entrepreneurs do not secretly use part of the money they borrow for anything else than investing, in the bad state the contract pays lenders a sum of money (Z^b) which is equivalent to the entrepreneur's prevailing wealth, and investment is below its first-best value. The powerful implication of this is that both per-capita investment and per-capita output will depend on per-capita wealth. Why is it so? The less wealthy the entrepreneurs, the more they have to fall back on borrowing. The less wealthy the entrepreneurs, the smaller Z^bs, and furthermore, the less the lenders are willing to lend. The per-capita output will shrink together with the per-capita investment, because new investment projects are needed for higher output.

In case of asymmetric information the marginal product of capital exceeds the world riskless interest rates, and the spread between the two will be larger in the poorer countries (see preceding paragraph and equation (28)). Here we have a powerful result: there can be cross-country differences in marginal products of capital, even if the world capital markets were fully integrated. In a fully integrated global capital market the riskless interest rate will be the same everywhere, but marginal products of capital need not be.

The framework suggests that the correlation between wealth and external borrowing is positive across poor countries, but negative across rich countries. In poor countries the effect of agency problems, resulting from asymmetric information, dominates, and that is why entrepreneurs in those countries are able to borrow more, if they are wealthier. In rich countries the effect of diminishing returns dominates, and that is why the correlation is negative.[13]

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[12] The first-best optimum value k* is the amount of capital invested by entrepreneur with perfect information (see equation (28)). If information is perfect, all informational asymmetries are absent, and lenders can verify how entrepreneurs spend the money they borrow.

[13] In the model there are of course two periods of time, and the present value of the borrower's endowment stream V is defined as in the equation (29). This has been ignored to

Along with the small-country model Gertler and Rogoff also present the two-country general-equilibrium case. The difference between these two models is that in the small-country model the world interest rate was exogenous and here it is endogenous. One country is poor and the other is rich, but in a way that entrepreneurs in neither country can finance first-best investment levels without borrowing. Because there are no enforcement problems, and financial markets are fully integrated, the pattern of investment would be totally independent of the cross-country wealth distribution under conditions of perfect information. But information asymmetries have a dampening effect on investments in the poor country. There entrepreneurs cannot get financing to their projects. This lack of financing, which results from agency costs of lending, is a bigger problem in the poor country than in the rich country. In the equilibrium under asymmetric information marginal products of capital are not equalized between the countries, but instead the marginal product of capital will be higher in the poor country.[14] The pattern of world investment depends on the relative agency costs of lending between the countries. This in turn depends on the relative wealth of entrepreneurs between the countries. In case of perfect information, the direction of net capital flows would be from the rich country to the poor country, because we have assumed all cross-country differences in project technologies away. Information asymmetries cause the fact that less savings flow from the rich country to the poor country. It is even possible that the direction of net capital flows will be reversed. (Gertler and Rogoff 1990.)

Gertler and Rogoff's framework is very useful. For example, it can be applied to consider the effects of wealth shocks or wealth transfers with surprising outcomes. The biggest strength of the framework is its biggest weakness also. Being very simple, it cannot give other than qualitative answers, if even these. It seems to be possible that the direction of net capital flows can be reversed, if there are big enough differences in agency costs of lending. We wonder how theoretical this explanation is. What is the power of this explanation? Gertler and Rogoff did not specify their model to do DSGE simulations, which is fully understandable, because the method was hardly launched at that time. Still, it would be the only way to have even a hunch about how essential the role of informational asymmetries is in explaining the perverse behaviour of capital flows in the real world economy.

2.6.2.2 A model with enforcement problems

Mendoza, Quadrini and Rios-Rull (2009) construct a multi-country DSGE model with incomplete asset markets. (See details of this model from Appendix B.) The capital market incompletenesses are exogenous and do not depend on country's wealth. By presumption, in some countries these incompletenesses are more severe than in others. There are two types of shocks in the economy: endowment and investment

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keep it as simple as possible. So to be precise, the correlation to which the text refers to is the correlation between V and b. If V > k* for some country, it is actually a net lender.

[14] It is crucial to assume that the project technology is the same across entrepreneurs and across countries. The term 'project technology' refers here to the probability of good outcome in investment projects.

shocks. Agents have concave utility functions which mean that they acquire full insurance against shocks through state-contingent assets whenever it is possible.[15] The problem is that no financial intermediary is willing to issue such assets, if the frictions in the financial markets are big enough.

Contracts between individuals and financial intermediaries are not perfectly enforceable, because the realization of shocks cannot be legally verified. Agents can divert, which is practically the same as to hide, part of their incomes they get from endowment or production. After diverting part of the income, an agent can claim to have been hit by the worst realization of shocks, and is therefore entitled to get the biggest payoff. But when diverting income, the agent loses a fraction φ of income. This parameter φ is country-specific. The larger the parameter φ is, the higher the degree of enforcement of contracts. There are no information asymmetries. The intermediary knows, if the agent diverts part of her income. The problem is that there is no such court that could force the repayment of the diverted money, or exclude the agent from capital markets, if she defaults.[16]

Consider an economy that consists of two countries. The countries are identical in all aspects except by assumption the parameter φ is so high in country 1 that even full insurance is feasible, while $\varphi = 0$ in country 2. This means that there are no state-contingent assets in country 2. To get better intuition, we allow first endowment shocks only, and then in return investment shocks only.

Under financial autarky, the equilibrium in country 1 is as follows: interest rate and intertemporal discount rate are the same. This is trivial, because if this was not true, consumption growth would be positive or negative, and this would contradict the full insurance which agents prefer. Under financial autarky the equilibrium in country 2 is as follows: interest rate is lower than intertemporal discount rate. Why is it so? Agents cannot hedge against endowment shocks, because there are no state-contingent assets. In this situation agents have a motive for precautionary saving. In other words, the incompleteness of the financial sector induces saving. This means that the supply of savings is higher in country 2 than in country 1, if there is common interest rate. (Countries had the same intertemporal discount rate by assumption.) When financial markets are integrated, it is obvious that the country which has the lower autarky interest rate, now country 2, becomes a net lender. This result was obtained when we considered endowment shocks only.

Now, let's allow investment shocks, but forget endowment shocks. Under financial autarky the equilibrium in country 1 is as follows: the expected value of gross marginal return from the productive asset and gross interest rate are the same. This is trivial once again. There cannot be any risk premium for the risky asset, because with full insurance there is no risk. Under financial autarky the equilibrium in country 2 is as follows: the expected value of gross marginal return from the productive

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[15] In the case of full assurance there were Arrow-Debreu securities for every case, which means that agents were able to maintain constant net worth and by implication constant consumption. The net worth is defined in equation (30).

[16] The incompleteness of capital markets is here very different from the Gertler and Rogoff's framework. There were information asymmetries, but no enforcement problems. Here it is just the opposite.

asset exceeds gross interest rate. This results directly from the lack of state-contingent assets and the fact that agents are risk-averse. (The option of selling productive assets is not possible under financial autarky.) When financial markets are integrated, country 1 ends up with a negative NIIP but a positive position in the productive asset. Why is it so? From the view point of country 1 there are excess returns available in country 2's productive assets. This is why individuals in country 1 invests there and finance their purchases by foreign debt. Country 1 will end up with a negative NIIP because of the higher autarky interest rate. (The same reasons than was in the case of endowment shocks.) Country 1 will have positive net factor incomes in spite of negative NIIP.

With both endowment and investment shocks, the equilibrium after financial integration is precisely the same as with investment shocks only. Although, it is crucial to assume that the parameter values of φ are just as above.

Along with the simple version Mendoza et al present also a general version of their model. This is the model they calibrate, and use to do the simulations to get quantitative results.[17] The country with the most developed and deepest financial markets accumulate a large negative NIIP. Financial heterogeneity has its effects also on the composition of foreign portfolios. The country with the most developed and deepest financial markets invests in foreign high-return risky assets (= productive assets in the simple version) and borrows heavily from abroad. (Mendoza, Quadrini and Rios-Rull 2009.)

Mendoza et al's model is very promising. It has a great advantage compared to Gertler and Rogoff's model by being able to produce quantitative results. It is common knowledge that the United States has a negative NIIP as a whole, while having a positive position in equity type of assets and positive net factor incomes. Mendoza et al's model seems to be capable of simulating reality in these respects. But one wonders whether these results were got with realistic parameter values in calibration, or were the parameter values chosen so that the model produced realistic results. If the latter is the case, we could question the specification of the model. However, the model predicts that highly developed and deep domestic financial markets may have a deteriorating effect on the current account balance. Often, the perverse flow of net capital flows is seen as evidence against optimization behaviour. Mendoza et al.'s result suggests that capital flow from poor countries to rich countries can be optimal, when we take capital market heterogeneity into consideration.

Funny detail is that in a working paper version of the article (see References) Mendoza et al. conclude: "Our explanation of large and persistent global imbalances implies that these imbalances are consistent with intertemporal solvency conditions, so our analysis predicts that the large negative net foreign asset position of the U.S. is fully 'sustainable' and does not lead to a worldwide financial crisis." I cannot blame them for cutting this sentence off from the final version, which was later published. Actually this is not funny at all. Now economists have one more question to think about. If global imbalances really were an outcome of intertemporal maximization by all agents in a situation with huge financial market heterogeneity, how can it be that

[17] Describing quantitative results in writing is a bit oxymorous, but I repeated the main idea.

we ended up in the biggest financial crisis ever? Debelle and Galati (2007) make an important observation by saying that intertemporal approach is not at its best in assessing current account sustainability, because current account balance is seen as resulting from forward-looking optimization behaviour.

2.7 The Redux model

In Sections 2.2–2.4 our models were from the real side of international macroeconomics. By ignoring money and sticking to one-good models we did not deal with exchange rate fluctuations. In addition, we ignored nominal rigidities and consequently issues such as money supply shocks were irrelevant. Many phenomena in world economy cannot by explained without recognizing nominal price rigidities. However, it has been difficult to combine dynamic-optimization and nominal rigidities.[18]

The Redux model, proposed by Obstfeld and Rogoff (1995, 1996), is a serious attempt to bring nominal rigidities and imperfect competition to the intertemporal optimization paradigm. Redux was apparently the first open-economy dynamic general equilibrium model. According to Obstfeld and Rogoff (1996) the Keynesian view that output is demand-determined in the short-run can be justified by a monopolistic supply sector when prices are fixed. Nominal prices are preset; that is, fixed in the short-run, due to price-adjustment costs (menu costs). (Obstfeld and Rogoff 1996, 659.)

Note that the Redux model is a two-country general equilibrium model. This is why it is proper to analyse for example the current account response to changes in relative productivity. In the following sections we will focus our analysis on short-run dynamics instead of steady states. The difference between the short-run and long-run is that in the short-run prices are preset. Further important assumptions are: perfect-foresight, symmetric steady states where initial net foreign assets are zero, elastic labour supply, identical agents (equal discount rates), and the law of one price (Obstfeld and Rogoff 1996, 660–661, 675).

2.7.1 Response to changes in relative money supply

Here we consider the effect of an unanticipated permanent increase in the relative Home money supply on period t = 1. When we drop investments and government spending, Obstfeld and Rogoff (1996, 661–681) show that we get the following equation for the Home country's current account balance:

$$(2.7.1.A)\quad CA_{t=1} = \bar{b} = \frac{2(1-n)(\theta-1)}{\delta(1+\theta)+2}(m - m^*) > 0\,,$$

[18] For example in the Mundell-Fleming model, which can be found in every undergraduate macroeconomics book, there is no microfoundations.

where $\bar{b}$ is the log change[19] in the steady state value of net foreign asset stock, n is the relative size of Home economy so that $0 < n < 1$, θ is the price elasticity of aggregate demand so that $\theta > 1$, δ is the rate of time preference (subjective discount factor) so that in the steady state $\delta = r$, m is the log change in Home money supply, and variables with asterisk represent the corresponding variables for Foreign economy. There are just two countries involved so the equation (2.7.1.A) gives also the Foreign country's current account deficit. If there will be no further shocks, current account imbalances are gone from period $t = 2$ onwards.

It is not meaningful to go through the derivation of equation (2.7.1.A) in the present context. Can we still make sense of it? Exchange rate fluctuation is the key for the understanding of the equation. Obstfeld and Rogoff (1996) emphasize that even when purchasing power parity holds, this does not mean that the terms of trade were constant over time. Current account dynamics are determined by the intersection of two equations (equations (M) and (N)) which relate log change in nominal exchange rate with log change in relative consumption levels (see figure A from Appendix A). The intercept of equation (M) increases as a result of money supply shock. A one-time permanent change in relative money supply has an implication that the exchange rate jumps immediately to its new steady-state level. Home currency depreciates (see equation (M)), and Home tradables become more competitive in the current period (preset prices). However, the change in exchange rate is not proportional to the increase in money supply, because domestic agents replace work-effort with leisure. Still both Home output and Home consumption rise relatively. Agents practise consumption smoothing and domestic agents share the fruits from one-period competitive advantage to entire time span by running a current account surplus on period $t = 1$. (Obstfeld and Rogoff 1996, 663, 678–681.) One way to get intuition about equation (2.7.1.A) is to observe that current account imbalances rise with θ. If Home tradables and Foreign tradables are very close substitutes, Home country is able to run larger current account surplus.

2.7.2 Response to changes in relative productivity

When we include investment to our model, we are able to analyse current account response to changes in relative productivity. First, consider an unexpected temporary rise in Home productivity. Being a supply-side shock one-period productivity shock does not affect output, because output is demand-determined in the short-run. In the short-run nothing changes. Domestic agents substitute into leisure and produce the same amount with less effort (Obstfeld and Rogoff 1996, 697).

Second, consider an unexpected permanent rise in Home productivity. Changes in productivity result in changes in interest rate. This is why derivation of equation for current account response is difficult, if not impossible. According to Obstfeld and Rogoff (1996), equation (M) does not change from the preceding case, but equation

[19] The model is log-linearized around the steady state. For example $m \equiv dM/M_0 \equiv (M-M_0)/M_0 \approx d \log M$ in the neighborhood of M_0. If the relative Home money supply rises by 10 %, then $m = 0.1$

(N) is replaced by equation (O). The intercept of equation (O) decreases as a result of productivity shock. Home currency appreciates, because in the long-run Home output rises and domestic agents increase consumption immediately (consumption smoothing) which has an implication on money demand: it rises. (Obstfeld and Rogoff 1996, 698.) When relative money demand changes, we are moving on the curve (equation (M)), instead of moving the curve as in Section 2.7.1. In the short-run Home consumption rises, but output is constant. This means that Home country runs a current account deficit. (Familiar result from the previous sections.)

2.7.3 Response to changes in relative fiscal policy

When we include government spending to our model, we are able to analyse current account response to changes in relative government spending. Here government spending does not affect productivity (no public investments) or private utility (no welfare services). In spite of changes in government spending budget is assumed to be always in balance. Obstfeld and Rogoff (1996) show that we get the following equation for the Home country's current account balance:

$$(2.7.3.A) \quad CA_{t=1} = \bar{b} = \frac{(1-n)(\theta-1)}{\delta(1+\theta)+2}\left[g - g^* + \left(\frac{1}{\delta}\right)(\bar{g} - \bar{g}^*)\right] - (1-n)(g - g^*),$$

where g is the log change in government spending, and $\bar{g}$ is the log change in the steady-state level of government spending. Current account dynamics are determined as before: by the intersection of two equations. Except that the two equations are now equations (M) and (P).

First, consider an unexpected temporary rise in Home government spending. The intercept of equation (P) increases as a result of fiscal shock. Home currency depreciates, because tax rise decreases money demand as private consumption falls. Temporary fall in the net output implies current account deficit (consumption smoothing). (Familiar result from the previous sections.) Because of currency depreciation, short-run output is on a higher level than long-run output, but for the private agents this cannot outweigh the effect of risen taxation.

Second, consider an unexpected permanent rise in Home government spending. Again, Home currency depreciates. However, current account is in surplus, because in the short-run domestic producers have competitive advantage, while the tax profile does not change as in the previous case. Output net of government spending is higher in the short-run than in the long-run. (Obstfeld and Rogoff 1996, 700–705.)

2.7.4 Redux under inspection

Even though the Redux model recognizes nominal rigidities it can be criticized for assuming that the law of one price holds always. In reality the speed of convergence to purchasing power parity is relatively slow: a half-life for deviations is three to five years (Rogoff 1996). Yet, the latest econometric research suggests that these results suffer from aggregation bias, and when taking into account sectoral heterogeneity,

the speed of convergence is faster also in aggregate level (Imbs, Mumtaz, Ravn and Rey 2005). If PPP holds only with time lag, because of imperfectly integrated international goods markets, shifts in current account balances are not as sharp as Redux claims. Lane (2001, 242–243, 249) points out that pricing to market can break the LOOP, and he criticizes Redux for allowing riskless real bonds only.

2.8 The summary of predictions

The current account responses introduced in Sections 2.1–2.7 are summarized in table 2. All the shocks in table 2 are country-specific.

TABLE 2 The summary of predictions rising from the theory introduced in Chapter 2

time horizon	shock / factor	expected effect on CA	model / theory
long-run	initial NIIP	negative	intertemporal approach in general
short-run	temporary increase in government spending	negative	deterministic model and Redux model
short-run	permanent increase in government spending	no effect positive	deterministic model Redux model
short-run	discovery of new inexhaustible resources	negative	deterministic model
short-run	temporary improvement in terms of trade	positive	augmented deterministic model
any	permanent improvement in terms of trade	no effect	augmented deterministic model
short-run / medium-run	positive exogenous output shock with some persistence	positive (duration depends on persistence) uncertain (depends on NIIP)	stochastic model with quadratic utility and stationary output new rule (constant returns to scale, high investment risk and one-way capital flows)
short-run / medium-run	positive exogenous output shock with some persistence	negative (duration depends on persistence)	stochastic model with quadratic utility and nonstationary output

short-run	positive productivity shock (temporary)	positive no effect	stochastic model with quadratic utility Redux model
short-run	positive productivity shock (permanent)	negative	stochastic model with quadratic utility and Redux model
any	volatility in net output	positive, but declining with wealth	stochastic model
short-run	budget deficit	no effect negative (stronger effect in developing countries)	any model with representative agents overlapping-generations model with infinitely-lived agents and positive population growth
long-run	dependency ratio	negative	overlapping-generations model with mortal agents (= diamond model) (life-cycle hypothesis)
any	ability to supply assets	negative	portfolio choice models
medium-run	capital intensity	positive	neoclassical growth model with ignorance of all differences in technology and human capital
any	advanced state of domestic financial markets	negative	multi-country DSGE model with incomplete asset markets
short-run	positive monetary shock (permanent)	positive	Redux model

2.9 The empirical relevance of the intertemporal approach

The intertemporal approach is a wide concept and depending on the exact formulation of the model it has several implications. The present value model (PVM) of the current account can be used to produce predicted values of current account (see equation (2.3.3.A)). By comparing these predictions to actual data one can conclude, to some extent, how useful the intertemporal approach is. According to Obstfeld and Rogoff (1994) the evidence is, in this respect, mixed. Usually the biggest difference between the two is that the actual current account is more volatile than the predicted current account. (Obstfeld and Rogoff 1994, 55-59.) Later simple intertemporal models of the current account have been improved by incorporating 1) precautionary saving (the current account is decomposed into a certainty equivalent term and a pre-

cautionary term which depens e.g. on the degree of risk-aversion) (see Ghosh and Ostry (1997)), 2) external shocks (variations in the interest rate and exchange rate are allowed) (see Bergin and Sheffrin (2000)), or 3) consumption habits (the assumption of time separable utility function is abandoned) (see Gruber (2004)).

Nason and Rogers (2002) examine the joint behaviour of investment and the current account using six different identification restrictions one at a time. They used quarterly data of the Canadian economy for the period of 1975-1994. Nason and Rogers find out that the observed relation between investment and the current account depends fundamentally on the identification restriction. But nevertheless, they are able to conclude the following: the current account balance tends to be negative during the investment booms, and country-specific shocks have a persistent effect on the current account. The former result is in line with the intertemporal approach, in which the current account balance is seen in particular as a difference of savings and investments. The latter; however, contradicts the idea that the current account serves as a buffer stock. (Nason and Rogers 2002.)

Imitating the model developed by Bergin and Sheffrin (2000) Campa and Gavilan (2010) build an intertemporal current account model which cannot be rejected for six of the ten original EMU countries (Luxembourg was excluded), as far as the intertemporal elasticity of substitution is 0.5 or below. If the intertemporal elasticity of substitution is 0.75 or more, the model can be rejected. (Campa and Gavilan 2010.) It is difficult to assess the performance of the model as there is no consensus on the actual values of intertemporal elasticity of substitution (see Campa and Gavilan (2010, 210)).

3 EXCHANGE RATE REGIME AND EXTERNAL ADJUSTMENT

In elementary undergraduate-level books we are told that the flexible exchange rate regime is a guarantee for external balance in the medium- and long-run, if not even in the short-run. However, the world outside classrooms is not so simple. Often the current account imbalances are extremely persistent. In this short chapter we make a critical examination of the ability of the flexible exchange rates to assure the external balance. The two major special cases, the U.S. with the leading reserve currency dollar and the euro area with a common currency, are recognized. One important lesson will be that foreign central banks can prevent domestic currency from floating freely by intervening in currency markets whether domestic government desires this is or not. In a currency union the external balance of member countries is probably as necessary as without the common currency, but achieving this balanced state might be much more difficult.

In Chapter 2 we were tracing predictions for the current account responses to several shocks or factors in light of the intertemporal approach. Now we ask: does the speed of adjustment depend on the exchange rate regime? We could not make this question in Chapter 2, because we did not even have money in our models except in Redux. Redux assumed that nominal exchange rates were driven by the PPP which was assumed to hold always. This is not very realistic of course.

3.1 Flexible versus fixed

The view that flexible exchange rates insulate domestic economy from external real shocks was proposed by Friedman (1953). It is commonly believed that the external adjustment is faster in the flexible exchange rate regime than in the fixed exchange rate regime due to the price stickiness. However, very little solid evidence can be found for this argument. Broda (2004) points out that studies in which the adjustment dynamics to real shocks is compared between the regimes are rare. Concentrating on developing countries and on one particular real shock, changes in the terms of trade, he finds strong support for Friedman's hypothesis. (Broda 2004, 32–33.)

Chinn and Wei (2008) dare to doubt the received conventional wisdom that external adjustment is faster in a more flexible exchange rate regime. They use an annual data over the 1971-2005 period from more than 170 countries and by the means of autoregressive analysis try to find out whether the speed of current account adjustment depends on the exchange rate regime. Exchange rate regime is defined on de facto basis using the index classifications from Levy-Yeyati and Sturzenegger (2003) and Reinhart and Rogoff (2004). After controlling many factors they do not find support for the claim that a more flexible exchange rate regime exhibits a faster current account adjustment. Chinn and Wei emphasize that it is the real exchange rate and not the nominal exchange rate that drives external adjustment. They find no

clear relationship between nominal exchange rate flexibility and the speed of convergence in real exchange rates. (Chinn and Wei 2008.)

Chinn and Wei's paper is unconventional and therefore inspiring. Still, their results should be valued with patience. Using AR(1) with an annual data is not very convincing.[20] The results would more convincing, if higher frequency data and higher order autoregressive terms were included. In addition, by measuring just the speed of external adjustment we may throw the baby out with the bath water. Gervais, Suchanek and Schembri (2009, 7) remark that often with a more fixed exchange rate regime the adjustment takes a form of a crisis. When real exchange rates have contributed to the external adjustment, usually the negative impact of deficit reversal on output has been smaller (International Monetary Fund 2007, 106).

3.2 The case of the U.S.

To a great extent research on current account adjustments have concentrated to the global imbalances; that is, to the U.S. current account deficit and the surpluses of developing countries. Recently, the dichotomy between the U.S. and China has been emphasized. Considering the weight of the U.S. in the world economy this is justified. However, it is important not to generalize these results to the rest of the world. The status of the dollar, the leading reserve currency, contributes to the U.S. current account dynamics making it exceptional in some respects. We have had three examples already: the sign of impact of devaluation on NIIP (in Section 2.1), the large role of valuation adjustment (Gourinchas and Rey (2007a) in Section 2.1), and the implications of a highly advanced and deep domestic financial markets (Caballero et al. (2008), Bernanke (2005) in Section 2.5 and Mendoza et al. (2009) in Section 2.6.2.2). In addition to others already mentioned, also Forbes (2010, 19) comes to a conclusion that there is a clear relation between the undeveloped state of domestic financial market and the share of assets invested in the U.S. market.

Bernanke (2005) proposes that the U.S. current account deficit is a result of global saving glut. The series of financial crises in developing countries before and after the millennium turned the direction of net capital flows. At the same time several countries adopted a strategy of promoting exports by fixing their currency to dollar and accumulating large reserves. In these developing countries investment fell while saving increased. This had larger effect on the U.S. than on other developed countries, because dollar is a leading reserve currency and several countries had fixed their currency in particular to dollar and U.S. financial markets were the deepest. Private saving did not decline exogenously in the U.S., but due to the wealth effect that resulted from the huge capital inflow. At first, the wealth effect came from the stock market. After the collapse in 2001 Americans' wealth increased along with the booming housing market. (Bernanke 2005.)

[20] Altough, Chinn and Wei (2008, 4n) checked the higher order autoregressive terms and concluded that the AR(1) was sufficient.

In addition to wide acceptance the global saving glut argument has also received criticism. Laibson and Mollerstom (2010) note that global saving and investment rates did not jump after developing countries had experienced financial crises. Instead, they rationalize observed global imbalances by national asset bubbles. (Laibson and Mollerstrom 2010.) I find it much easier to criticize Laibson and Mollerstrom than Bernanke. Firstly, a rise in the global saving and investment rates is not a necessity for a global saving glut to occur. The global saving glut hypothesis is an argument which relates the supply of savings to the demand of savings recognizing that interest rate makes the two equal. If the interest rate falls, we know that the supply of savings have increased in regard to the demand of saving regardless of changes in the absolute rates. Secondly, Laibson and Mollerstrom's model takes the occurrence of asset bubble as a given (see Laibson and Mollerstrom 2010, 371–372). The global saving glut argument in particular gives an explanation for the asset bubbles in the U.S.

It is reasonable to assume that private investors try to get as high returns as possible for their investments. In this respect it is a paradox why foreign investors have invested in the U.S. with such a willingness. Gourinchas and Rey (2007b) report that returns on Foda have been far below returns on Dofa (see table 3).

TABLE 3 Total real returns (%) on Dofa and Foda during 1973–2004 (see equation (1)) (Gourinchas and Rey 2007b, 26, Table 1.1)

	1973–2004	r	r^{equity}	r^{fdi}	r^{debt}	r^{other}
DOFA	mean	6.82	15.54	9.65	4.05	4.11
	st. dev.	18.84	41.61	26.69	14.77	11.89
FODA	mean	3.50	9.43	9.31	0.32	1.16
	st. dev.	11.07	37.09	25.96	14.50	6.24

In the third column of table 3 total returns are calculated, and in the columns 4–7 returns are grouped by asset type. Part of the Americans' excess return results from the composition effect. Americans have invested abroad in risky assets such as equities and foreign direct investments (FDI) that give higher return, while foreigners hold a large stock of Treasuries which yield less. When explaining the difference in total real returns, the composition effect was responsible for 0.86 percentage points. The rest of the difference (2.45 percentage points) resulted from the fact that Americans have got higher return on Dofa even within a certain type of asset. (Gourinchas and Rey 2007b.)

We cannot get the right picture of the U.S. current account dynamics without recognizing the large role of foreign central banks. Foreign central banks have prevented the dollar from floating freely by their intervention. The U.S. current account dynamics potentially depart from the "normal" due to the fact that the dollar is the leading reserve currency.

3.3 The case of the euro area

The special features of adjustment dynamics within the euro area are discussed in length in the European Commission report (2006).[21] Since in a monetary union all countries share a common nominal interest rate and the nominal exchange rate cannot be elastic, only the following two adjustment channels are left over: the competitiveness channel and the real interest rate channel. The former tries to restore a balanced state, whereas the latter is procyclical and works for the opposite direction. It is plausible to think that the competitiveness channel would be dominant over the medium and long run.

When an economy experiences a positive country-specific shock, in the course of time the price and wage levels begin to increase. A higher-than-average inflation results in a loss of relative (price) competitiveness which once again restores the balanced state. On the other hand, the higher-than-average inflation results also in a lower-than-average real interest rate which aggravates the economic boom even further. If the link between wage setting and productivity is weak, the competitiveness channel lacks the power needed for a smooth adjustment. The same is true, if there are substantial wage rigidities. (European Commission 2006, 6, 94.)

With our current knowledge, it is a bit humorous that the euro experiment was praised as a pure success story in the European Commission report (2008). The report; however, portrays the split that occurred within the euro area by illustrations. In 1997 Germany, Finland and Austria had current account surpluses that corresponded to 5 percent of their GDP. Only the Netherlands entered the third stage of EMU with a larger surplus (tiny Luxembourg is excluded). Yet, these three countries gained competitiveness the most during the period of 1999-2007. Cumulative decrease in relative unit labour cost was 5 percent for Finland, 10 percent for Austria and almost 15 percent for Germany. (Change in unit labour cost is determined by changes in productivity and wages.) The same relation, but in reverse, held for Greece (CA: -10 % of GDP, rel. unit labour cost: +10 %), Ireland (CA: -4 % of GDP, rel. unit labour cost: +14 %), Portugal (CA: -9 % of GDP, rel. unit labour cost: +10 %) and Spain (CA: -9 % of GDP, rel. unit labour cost: +7 %). These four member countries had the largest current account deficits in 1997 and they succeed in decaying the competitiveness even further. (European Commission 2008, 53-61.) Before dropping the competitiveness channel as lacking any empirical relevance, we have to recognize, as did the European Commission report (2006), that the one-time change at the start of the third stage of EMU (1.1.1999) makes analysing the adjustment experience during the first decade of the monetary union difficult. In several member countries the introduction of the common currency meant a dramatic drop in interest rates. In addition, one can speculate on the appropriateness of euro conversion rates. (European Commission 2006, 94, 97.) This is a relevant standpoint. When dealing with the

[21] It should be noted that here the term "adjustment" does not merely refer to the external adjustment, but to output converging to the potential level. Yet, in principle, the two are equal…

current problems, we are, at least to some extent, reaping the harvest of the introduction phase of the euro. If this is true, we can expect a brighter future.

Berger and Nitsch (2010) explore the effect of the common currency on bilateral trade imbalances (in absolute values normalized by the total value of bilateral trade) by taking advance of the natural experiment that occurred when only a few European countries adopted the euro. When controlling for both the time fixed effects and the pair-wise fixed effects, they find out that the EMU dummy is positive and statistically significant. Hence, the adoption of the euro has enlarged the bilateral trade imbalances among EMU member countries (both the buyer and the seller are EMU members). The result is robust even when including country time fixed effects instead of the common time effects. (Berger and Nitsch 2010.)

Adopting a neoclassical view of the net capital flows, according to which it is a natural convergence process that capital flows from the rich countries to the poor countries, Blanchard and Giavazzi (2002) saw the current account imbalances within the euro area as rational. For the poorest EMU member countries (Greece and Portugal) along with the deepening integration in the EU the optimal level of current account deficits have increased. (Blanchard and Giavazzi 2002.) (As a side note, it is good to realize that a different pattern exists within the euro area from the globe: whereas globally the poor countries are capital exporters, within the euro area the poorest countries are capital importers.[22]) Yet, the convergence argumentation mentioned above has turned out to be naive as the productivity growth has been below the average in these least-developed EMU countries (Giavazzi and Spaventa 2010, 4-6).

The intertemporal approach is not at its best in assessing current account sustainability. Camba and Gavilan (2010); however, built an ICA model, which seemed to be working well for most of the EMU countries (Belgium, France, Italy, Netherlands, Portugal and Spain), and tested the issue indirectly by calculating the future per-capita growth rates in net output which the obtained current accounts indicated. With this method and subset sustainability gets called into question especially for Spain. Its current account deficit in 2005 indicated that over the next five years net output growth would be 1.44-fold the historical mean.

By regressing the fitted values of current account balances with and without the end of the sample period (the start of the third stage of EMU) Campa and Gavilon deduce that the introduction of the euro did not cause a structural break to the relation of current account, net output and relative prices. (Camba and Gavilan 2010.) This is not to say that the introduction of the euro was unimportant for the unbalanced state of the euro area. It only means that the ICA model which Camba and Gavilan used performs as well (or poor) with and without the last few years of their sample period.

[22] In principle, a country could have a trade surplus in regard to other EMU member countries even though it had negative net exports in overall, but this situation is fully theoretical.

4 EMPIRICAL LITERATURE

Empirical literature on the determinants of the current account balance is presented compactly in this chapter. Many studies have researched current account dynamics by the means of DSGE models. However, these studies are not empirical, but rather theoretical, even though information from past empirical studies have been used in them (e.g. when calibrating the model). In the present context we are more interested in testing the theory by empirical methods. It seems to be the case that a vast majority of empirical studies have tested the significance of some particular variable in the current account determination (Calderon, Chong and Loayza 2002, 4). In the following sections we are concentrating on previous panel data analyses instead of structural vector autoregressions. When selecting panel analyses, the criterion, in addition to quality, was that they must be comprehensive by nature. Yet, in Section 4.3 we take productivity shocks to a closer examination.

The fundamental difference between the panel data analysis and vector autoregression is that in the former we cannot control the persistence of shocks. In table 2 the expected effect on current account balance was often fully dependent of the persistence of the shock. A single country and its dynamic response to shocks is best analysed by vector autoregressions, while the driving forces of the global imbalances are best analysed by panel data methods.

4.1 Linear panel models

Before rushing into the results, we have to be aware of the special features of the panel data analysis in general. Panel data, or equally, longitudinal data, consists of observations on the same entities at several time periods (Stock and Watson 2007, 350). There are many advantages in using panel data instead of pure cross-section or time-series data. As Stock and Watson (2007) point out, OLS estimator will suffer from omitted variable bias, if the omitted variable is a determinant of the dependent variable and at least one of the regressors correlates with this omitted variable. At the very least lacking data of the omitted variable complicates the analysis, when cross-section data is being used. The problem may be dodged by using instrumental variables regression, but finding a valid instrument is unlikely. (Stock and Watson 2007, 237, 421.) With panel data one can handle omitted variables that are either time-invariant (entity fixed effects) or state-invariant (time fixed effects) (Baltagi 2001, 6). Panel data enables higher precision in estimation, because both the variation between the entities and within the entities is been used (Cameron and Trivedi 2005, 697, and Baltagi 2001, 6). In addition, panel data allows us to examine the dynamics of adjustment and intertemporal relations (Baltagi 2001, 6–7).

Following Cameron and Trivedi (2005) an extremely general linear model for panel is of form

$$(4.1.A) \quad y_{it} = \alpha_{it} + \mathbf{X}'_{it}\boldsymbol{\beta}_{it} + u_{it},$$

where intercept and slope coefficients vary over both the individuals and the time. However, the number of parameters to be estimated exceeds the number of observations. This is why we have to put restrictions on "the extent to which α_{it} and β_{it} vary with i and t, and on the behaviour of the error term". (Cameron and Trivedi 2005, 698–699.)

Panel data models can be classified by several aspects. One is the distinction between the one-way and the two-way error component regression models. In the former composite error consists of unobservable individual specific (= time-invariant) effect and remainder disturbance, while in the latter composite error consists, in addition to previous, of unobservable individual-invariant time effect (see equations (Q) and (R)) (Baltagi 2001, 11, 31). Another important distinction is the one between the "static" panel models and the dynamic panel models, in which a lagged term of the dependent variable is used as a regressor.

The common assumption for simple panel data models is the strong, or equally, the strict exogeneity of regressors. This means that the error term does not correlate with independent variables of any period (past, present or future), or in other words, the error term has mean zero conditional on past, present and current values of regressors (Greene 2008, 182, and Cameron and Trivedi 2005, 700). In principle, there are three such models: pooled model, random effects (RE) model and fixed effects (FE) model. The pooled model is of form:

$$(4.1.B) \quad y_{it} = \alpha + \mathbf{X}'_{it}\boldsymbol{\beta} + u_{it},$$

where all the individuals share a common constant. Hence, for pooled OLS to be consistent there should be no unobserved heterogeneity among individuals. For this reason the pooled OLS is prone to omitted variable bias. If, for example, we had 1000 observations, the pooled OLS in accordance with its name does not make distinctions whether the observations result from 20 entities and 50 periods or vice versa.

The random effects model and the fixed effects model are of form:

$$(4.1.C) \quad y_{it} = \alpha_i + \mathbf{X}'_{it}\boldsymbol{\beta} + u_{it}.$$

The difference between the two models is that in the RE model the following assumption is done: unobserved individual-specific effects (α_i) do not correlate with explanatory variables (X'_{it}). Hence, the choice between the FE model and the RE model narrows down to the question whether or not we can assume the unobserved individual effects to be uncorrelated with the regressors (Greene 2008, 183). If these unobservable individual effects are distributed independently of the regressors, the RE model can be used (Cameron and Trivedi 2005, 700, and Baltagi 2001, 15). If such an assumption cannot be done, which can be tested by the Hausman test, the FE model is the correct model. Because the RE model has tighter assumptions than the FE model, the within estimator (= fixed effects estimator) is also consistent, if the RE

model is the true model, but in which case it will not be efficient (Cameron and Trivedi 2005, 734).
When we abandon the assumption of strong exogeneity, we have to use more advanced methods for obtaining consistent estimation. This assumption is broken, if we use lagged values of the dependent variable as regressors, or alternatively, if some regressors are endogenous; that is, they correlate with the error term. Explanatory variables can also be jointly endogenous, which means that there is simultaneous or reserve causality from dependent variable to regressors.

4.2 Panel data analyses

The previously done comprehensive panel data analyses are the most interesting empirical studies for our purposes. The order of listed variables in tables 4–8 below follows the order used in table 2, in which the predictions from the theoretical framework were summarized.

TABLE 4 Results from cross-sectional regressions
(Debelle & Faruqee 1996, 13, Table 2 and Chinn & Prasad 2003, 55, Table 2)

Dependent variable: current account (% of GDP) The sign and the significance level are shown *, ** and *** denote significance at the 10 %, 5 % and 1 % levels Estimation: OLS	Debelle and Faruqee (1996): 21 industrial countries, 1971–93			Chinn and Prasad (2003): 89 countries in total, 1971–95 constant unreported		
	regression (A)	regression (B)	regression (C)	industrial countries	developing countries	dev. countries without Africa
initial NIIP ()			+ ,***	+ ,***	0	0
average GDP growth				+ ,***	0	0
terms of trade volatility				- ,**	0	+ ,**
budget surplus (% of GDP)	0	0	0	+ ,***	+ ,***	+ ,**
dependency ratio	- ,**	- ,**	- ,***			
rel. (young) dependency ratio (to the sample mean)				0	- ,*	0
rel. (old) dependency ratio ()				0	0	0
relative income (to the U.S.)	0			+ ,*	0	0
rel. income squared ()	0			0	0	0
capital stock (% of GDP)	+ ,***	+ ,***	+ ,***			
capital stock squared	- ,***	- ,***	- ,***			
financial deepening (M2/GDP)				0	+ ,**	+ ,*
trade openness ((X+Z)/GDP)				0	- ,**	0
capital controls (on CA) (binary indicator variable)				+ ,**	0	0
capital controls (on FA) ()				0	0	0
variables not listed	constant - ,***	constant - ,***	constant - ,***		oil export dummy +,*	oil export dummy +,**
adjusted R squared	0.73	0.70	0.84	0.94	0.46	0.57
number of observations	21	21	21	18	71	48

TABLE 5 Results from panel regressions using non-overlapping 5-year averages
(Chinn & Ito 2007, 551, Table 1, 558, Table 3 and Gruber & Kamin 2007, 510, Table 2, 513, Table 3)

Dependent variable: current account (% of GDP) Variables are converted into the deviations from the GDP-weighted full sample mean (with some exceptions)	Chinn and Ito (2007): 89 countries in total, 1971–2004 Time-fixed dummies and constant unreported IDC = industrial countries, LDC = less developing countries and EMG = emerging market country group (EMG is a subset of LDC) Estimation: pooled OLS					Gruber and Kamin (2007): 61 countries in total the last period is 7 years Period fixed effects and constant unreported Estimation: Pooled OLS			
						1982–2003		1991–2003	
	IDC regression (A)	IDC regression (B)	LDC without Africa regression (A)	LDC without Africa regression (B)	EMG regression (B)	regression (C)	regression (D)	regression (E)	regression (F)
initial NIIP ()	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***				
lagged NIIP ()						+ ,*	+ ,**	+ ,***	+ ,**
average GDP growth	0	0	0	0	0				
Δ in growth						0	0	- ,**	0
terms of trade volatility	0	+ ,*	0	0	0				
budget surplus (% of GDP)	+ ,*	+ ,*	+ ,***	+ ,***	+ ,***	+ ,*	+ ,**	+ ,***	+ ,***
rel. (young) dependency ratio	0	0	- ,***	- ,***	- ,*	- ,***	0	0	- ,***
rel. (old) dependency ratio	0	0	- ,**	- ,***	- ,***	- ,**	- ,**	0	0
relative income (to the U.S.)	+ ,**	+ ,**	0	0	+ ,**				
rel. income squared ()	- ,***	0	0	0	0				
rel. income						+ ,***	+ ,***	+ ,***	+ ,***
fin. dept (private	0	0	0	0	- ,**				
political risk index		0		- ,**	- ,*				
fin. dept x political risk		- ,**		- ,**	- ,**				
financial openness		0		0	0				
fin. open. x political risk		+ ,***		0	0				
fin. open. x fin. deep.		0		0	0				
trade openness ((X+Z)/GDP)	+ ,***	+ ,***	0	0	0	0	+ ,***	+ ,*	+ ,***
fin. crisis (indicator							- ,**	- ,**	- ,***
fin. crisis x trade open.							+ ,***	+ ,***	+ ,***
gov. institutions									- ,***
oil balance						+ ,***	+ ,***	+ ,***	+ ,***
variables not listed			oil export dummy	oil export dummy	oil export dummy		us 97-03 dummy -	us 97-03 dummy -	us 97-03 dummy -
adjusted R squared	0.50	0.55	0.53	0.54	0.51	0.286	0.357	0.473	0.494
number of observations	132	126	235	234	203	234	234	117	117

TABLE 6 Results from panel regressions with lagged dependent variable included (Debelle & Faruqee 1996, 19, Table 4 and Chinn & Prasad 2003, 72, Table 5)

Dependent variable: current account (% of GDP) When lagged CA is included, in principle both fixed effect and OLS estimation result in biased estimates. (However, in D&F 1996 with a fixed N and a large T fixed effects should be consistent.)	Debelle and Faruqee (1996): 21 industrial countries, 1971–93 Frequency: non-overlapping 5-year averages Assumptions: CA is stationary (mean-reverting) Hausman test: hypothesis of random effects is reject at the 1 % level In the IV-estimation they first difference the data and use lags of the explanatory variables as instruments.			Chinn and Prasad 2003: 89 countries in total, 1971–1995 Time effects and constant unreported Frequency: annual Estimation: pooled OLS	
	fixed effects	pooled OLS	IV	IDC	LDC without Africa
lagged CA (% of GDP)	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***
initial NIIP (% of GDP)				+ ,**	+ ,*
Δ in terms of trade	+ ,***	+ ,***	+ ,***		
average GDP growth				+ ,**	0
domestic output gap	- ,***	- ,***	- ,***		
terms of trade volatility				0	0
budget surplus ()	+ ,***	0	0	+ ,**	+ ,***
dependency ratio	0	- ,**	0		
rel. (young) dependency ratio				0	0
rel. (old) dependency ratio				0	0
rel. income (to the U.S.)	+ ,**	0	0	0	- ,*
rel. income squared ()				0	+ ,**
fin. deepening (M2/GDP)				0	0
trade openness ((X+Z)/GDP)				0	0
capital controls (on CA) (bin. indicator var.)				0	0
capital controls (on FA) ()				0	0
Δ in real exchange rate	- ,***	- ,*	0		
first lag of Δ in real exchange rate	- ,**	- ,*	- ,*	- ,**	0
variables not listed		constant 0			oil export dummy 0
adjusted R squared	0.82	0.79		0.69	0.51
number of observations				378	703

TABLE 7 Results from panel regressions with lagged dependent variable included (Calderon et al. 2002, 13, Table 3 and 14, Table 4)

Dependent variable: current account (% of GDP) Sample: 44 developing countries, 1966–94 Frequency: annual Sargant test is related to the validity of instruments used (failure to reject the H_0 gives support to the model). With serial correlation the H_0 is that no serial correlation exists.	Limitations: OLS within estimator does not account for the joint endogenous of the explanatory variables. GMM difference estimator allows joint endogenous, but it has low asymptotic precision and large biases in small samples.			Arellano and Bover's system GMM estimator uses additional moment conditions and should be the "best". (However, Sargan test gives strong support for the GMM difference estimator also.)		
	fixed effects / within estimator	GMM difference estimator	GMM system estimator (Arellano-Bover)	GMM system estimator (Arellano-Bover)	GMM system estimator (Arellano-Bover)	GMM system estimator (Arellano-Bover)
lagged CA (% of GDP)	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***
% Δ in terms of trade	+ ,*	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***
GDP growth rate	- ,*	0	- ,***	- ,***	- ,**	- ,***
GDP growth in the industrialized countries	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***	+ ,***
interest rate in the world economy	0	0	+ ,*	0	0	+ ,**
balance of payments controls	0	- ,*	0	- ,*	- ,**	0
% Δ in real effective exchange rate	- ,***	0	- ,***	- ,***	- ,***	- ,***
% Δ in black market premium on foreign exchange	0	0	0	0	0	0
st. dev. of inflation				+ ,***		
external debt (% of GNP)					- ,*	
private saving (% of GNDI)						0
public saving (% of GNDI)						+ ,***
variables not listed			constant +,***	constant +,***	constant +,***	constant +,*
instruments used		levels	levels and differences	levels and differences	levels and differences	levels and differences
Sargan test (p-value)		0.423	0.38	0.187	0.28	0.241
serial correlation: second-order (p-value)	0.664	0.636	0.885	0.767	0.698	0.771
number of observations	709	709	709	709	709	709

TABLE 8 Results from panel regressions with lagged dependent variable included (Bussiere et al. 2004, 19, Table 2 and 21, Table 3)

Dependent variable: current account (% of GDP) Sample: unbalanced panel with 21 OECD countries, 1980–2002 and 12 EU accession countries, 1995–2002 Frequency: annual Variables are transformed into deviations from the OECD mean.	When lagged CA is included, in principle LSDV estimator is inconsistent. Unfortunately, with weak instruments alternative methods are subject to to large finite sample biases. In the IV-estimation they first difference the data. (IV-estimator is the first differenced two stage least squares estimator.) With GMM estimator a balanced panel 1995–2002 is used.				
	LSDV / within estimator	IV	GMM (Arellano-Bond)	LSDV / within estimator	LSDV / within estimator
lagged CA (% of GDP)	+ ,***	+ ,**	+ ,**	+ ,***	+ ,***
public spending (% of GDP)	0	0	0		
investments (% of GDP)	- ,***	0	- ,***	- ,***	- ,***
Δ in output net of investments and government spending	+ ,***	+ ,**	0	+ ,***	+ ,***
budget surplus ()	+ ,**	+ ,***	0	+ ,***	+ ,***
dependency ratio				0	
rel. income	+ ,***	0	0	+ ,***	+ ,***
real exchange rate					0
adjusted R squared	0.753	0.598		0.760	0.762
Sargan test (p-value)			0.587		
number of observations	542	490	198	542	542

The correspondence between table 2 and tables 4–8 is not perfect. Still, it is possible to make some comparisons between the theory and the empirical evidence.

Initial NIIP: obvious contradiction between the two. Usually there is a highly significant positive relation between initial NIIP and current account balance instead of a negative one. This is probably because the time-horizons in all studies are relatively short. The LRBC is related to a very long time-horizon. This same contradiction can be seen also from table 5 (lagged NIIP(+)), tables 6–8 (lagged CA(+)) and table 7 (external debt(–)).

Change in the terms of trade: evidence supports the theory. Temporary improvement in the terms of trade is associated with a larger current account surplus (see tables 6 and 7).

GDP growth: one big mess. This is a very complicated issue. Firstly, theoretical prediction depends entirely on the persistence of the output shock, which we cannot

infer from the empirical studies. Secondly, the theoretical prediction of a small-country model (current account as a buffer) differs from the theoretical prediction of a general equilibrium model (surge in productivity attracts a huge capital inflow). In addition, the empirical evidence is scattered. (This could be a result from the inability to recognize the persistence of the shocks.)

Terms of trade volatility (proxy for economic instability/volatility in output): evidence weakly supports the theory. In Chapter 2 precautionary saving was induced by volatility in net output, but volatility in terms of trade (tables 4–6) and standard deviation of inflation (7) can be used as proxies grabbing this same instability in economic development. Empirical evidence is not very strong, but it subtly suggests that economic instability is associated with a larger current account surplus. This relation seems to be stronger in poor countries just as the theory suggested (see table 4: the signs in C&P 2003 and table 7: the sample).

Budget deficit: evidence strongly supports the theory (= overlapping-generations model). One of the most robust relations is the positive relation between budget surplus and current account balance; that is, these analyses do not support the Ricardian equivalence. There is some evidence that this failure of Ricardian equivalence was stronger in the poorer countries (see table 5: the significance levels in C&I 2007 and tables 4 and 6: the sample in D&F 1996).

Dependency ratio: evidence supports the theory. There is a negative, if any, relation between the dependency ratio and the current account balance. However, in many studies the coefficient is not statistically significant.

Relative income (proxy for the stage of economic development/capital intensity): evidence supports the theory. Relative income measures the stage of development and is related to the capital intensity. There is a positive, if any, relation between the relative income and the current account balance. Ceteris paribus, high-income level countries tend to be capital exporters. This falls in line with the neoclassical growth model ignoring differences in technology and human capital. In regression analysis these factors are not ignored, but to some extent controlled so that the effect of relative income level is shown independent.

Capital stock ratio: evidence supports the theory. This variable, which measures capital intensity directly, is included only in one cross-sectional study (table 4: D&F 1996). However, the positive relation between capital stock ratio and current account balance is highly significant. Countries with high capital intensity tend to be capital exporters (ceteris paribus).

Financial deepening (proxy that measures the state of the domestic financial sector/the depth of domestic financial markets): evidence is mixed. In Chinn and Prasad (2003) there is a significant positive relation between the financial deepening and the current account balance for developing countries in the cross-sectional study (table 4) and in the panel study using non-overlapping 5-year averages (not shown in the tables above). In Chinn and Ito (2007) the relation vanishes, when indicator variables that control for the institutional factors are included (table 5).

Political risk index or *government institutions* (proxy e.g. for the advanced state of domestic financial markets): evidence supports the theory. In Chinn and Ito (2007) legal development is a compound institutional index of corruption, bureaucracy

quality, and law and order. There is a significant negative relation between the legal development and the current account balance for the developing countries and emerging market economies (table 5). Interaction terms complicate the analysis. The interaction term between legal development and financial depth is negative and significant for all country groups. This means that the higher the ratio of private credit is to GDP, the more negative is the relation between legal development and current account. The interaction term between legal development and financial openness is significant only for the industrial countries. In Gruber and Kamin (2007) there is a significant negative relation between the government institutions quality and the current account balance (table 5). Ceteris paribus, countries with higher legal development/better government institutions tend to pull foreign capital and have a larger current account deficit. This same can be seen also from table 5 (fin. crisis(–)).

Real exchange rate: evidence supports the theory. In table 2 the change in exchange rate is not listed. However, Redux assumed that an exchange rate depreciation has a positive effect on the current account. (Note that in Section 2.7 Home currency depreciates, when the exchange rate rises. In tables 6 and 7 it is just the opposite.) Depreciation clearly has a positive effect on current account balance (tables 6 and 7).

4.3 Productivity shocks and the current account

Next, we concentrate on one particular shock, namely, the productivity shock. The reason for this focus does not rise from the economic theory. A few people believe that RBC models are omnipotent. Clearly, the business cycle is not driven by stochastic productivity shocks only. However, it is very hard to control either the budget balance, in the case of an increase in government spending, or the money demand, in the case of an increase in money supply (see table 2).

By building a linear quadratic intertemporal small-country model with adjustment cost to investment[23] Glick and Rogoff (1995) derive estimable equations for investment and the current account (see equations (S) and (T)). After discovering that productivity follows a random walk; that is, ρ equals one in equation (2.3.2.A), they estimate the two equations for G-7 industrialized countries using annual observations from 1960 to 1990. We would expect the following: 1) investment increases with both the country-specific and global productivity shocks, but the former has a larger effect because the interest rate increases in the case of global shock ($0 < a_2 < a_1$), 2) a country-specific productivity shock contributes negatively to the current account balance, while a global shock has no effect ($b_1 < 0$ and $b_2 = 0$), and 3) measuring by the absolute values a country-specific productivity shock has a larger effect on the current account balance than on investment ($|b_1| > |a_1|$).

[23] "With capital installation costs … the permanent rise in A causes a current-account deficit that converges to zero only in the long run" (Obstfeld and Rogoff 1996, 114). See figure 3 for the sake of comparison.

For ΔI, with one exception, the coefficients of country-specific productivity shock were positive at the 0.05 significance level. [24] For ΔI, with two exceptions, the coefficients of global productivity shock were positive at the 0.05 significance level. The reciprocal size of the global and country-specific shocks varied across the countries. For ΔCA, with two exceptions, the coefficients of country-specific productivity shock were negative at the 0.10 significance level. For ΔCA, with one exception, the coefficients of global productivity shock were not significant at the 0.10 significance level. These results are in line with the intertemporal model. However, the inequality $|b_1| > |a_1|$ did not hold for any of the countries. Due to the fact that the consumption response to an income shock drops very dramatically as ρ falls, authors come to a conclusion that the distinction between random walk ($\rho = 1$) and near random walk productivity ($0.95 < \rho < 1$) probably explains the contradiction. (Glick and Rogoff 1995.)

The author of the thesis, just for fun, tested the empirical relevance of Glick and Rogoff's model using the EU KLEMS as a source for the TFP growth. The results are presented in Appendix D.

Bussiere, Fratzscher and Muller (2010) add the country-specific and global primary surpluses (T–G) to equations (S) and (T). The non-Ricardian feature of the model is achieved by assuming that a fraction of agents spend their entire disposable income in each period. Concerning the productivity shocks country by country regressions for the G7 economies for the most part repeats the results from Glick and Rogoff. Given the fact that in the panel studies the budget balance contributes to the current account, it is surprising that Bussiere et al. find country-specific primary surpluses to be insignificant for all G7 economies. (Bussiere, Fratzscher and Muller 2010.) On the other hand it is also apparent from the panel studies reported in Section 4.2 that the Ricardian equivalence breaks down probably only for the developing economies.

[24] In addition to the individual-country time-series regressions Glick and Rogoff did run pooled time-series regressions. However, the latter are not reported here. The same applies to Bussiere et al. (2010).

5 EMPIRICAL ANALYSIS

The results of the actual empirical analysis are presented in this chapter. The determinants of the current account imbalances are analysed at three different frequences. At first, using 5-year averages, then using annual observations, and finally using the averages over the whole time period. But we do not settle in comparing the results in just this one dimension. We will examine, if the determinants differ between the advanced and developing economies. In addition, we will examine, whether the assumption of the true model (FE, RE or pooled) affects our results.

To avoid information overload in Sections 5.2-5.4 results concerning the country group dummies and controlling variables are summarized in Section 5.5. Also the suitability of our chosen variables in explaining the current account determination is discussed briefly there.

5.1 The sample

The sample consists of 79 countries, of which 30 are advanced economies and 49 are developing economies (see details from Appendix C). The sample covers a 15-year period from 1993 to 2007 (balanced panel). The countries included in the sample accounted for more than 95 percent of the world economy during the period. Countries that received foreign aid massively (5 % of GDP or more) were excluded from the sample. Hence the sample consists of countries that behave as normal market economies. The sample begins only from 1993, because many of the former Soviet Union countries became independent at the beginning of 1990s. The year 2007 is the last in the sample, because some data for the year 2008 was still lacking.

Some variables are measured as ratios to the GDP-weighted sample means (see Appendix C). This is done to control the rest of the world effect (Chinn and Ito 2007, 550). Whether, for example, the progress of domestic financial sector should have an effect on the current account balance, depends on the rest of the world. If the progress in home country was equal to the progress in the rest of the world, this should not contribute.

The sample from which all the included variables are calculated is summarized in table A (see Appendix C).

5.2 Panel data analysis using 5-year nonoverlapping averages

Here 5-year nonoverlapping averages are used instead of annual observations, because the latter are dominated by the business cycle and short-run dynamics. In addition, it is plausible that the data for the developing countries suffers from inaccuracies which are not so severe when using multi-year averages (Chinn and Ito 2007, 548). The choice between nonoverlapping averages and overlapping averages is arbi-

trary. Also regressions using the 5-year overlapping averages are run as a robustness check. With the 5-year nonoverlapping averages we have 3 observations (93-97, 98-02 and 03-07) for each country, whereas with the 5-year overlapping averages we would have 11 observations (93-97, 94-98, 95-99 etc.).

It is worth repeating that with the panel data methods we are unable to control the persistence of shocks. (The other dimension of the shocks; that is, the distribution (local/global) can be controlled.) This affects the choice of explanatory variables. With this limitation, the following items from table 2 are left: initial NIIP, volatility in net output, budget deficit, dependency ratio, ability to supply assets, capital intensity, advanced state of domestic financial markets. We have some additional-problems. Initial NIIP is time-invariant and therefore it cannot be used in the FE model. Capital intensity cannot be measured directly. The same is true with the ability to supply assets and the advanced state of domestic financial markets.

The included variables, except the country group dummies, are summarized in table 9. Our set of variables is derived from both the theory (Chapter 2) and previous studies. Variables are more or less the same as in Chinn & Ito (2007) and Gruber & Kamin (2007) (see table 5). However, this panel data analysis can be considered superior to these two because 1) countries that received foreign aid massively are excluded[25], 2) the possible rejection of pooled model is made known and 3) overlapping averages are used as a robustness check. In the following two sections regressions are run using different time frequencies for the sake of comparison. Such a comparison was not performed in either of the studies. Changes in the real exchange rate are not included to our regressions, because our focus is primarily on medium-term fluctuations in current account balances instead of short-term fluctuations. When using multi-year averages, the role of effective exchange rate is not crucial. We will use the same set of variables also with annual observations to preserve the comparability of results. In the case of dynamic panel changes in the real exchange rate are often included.

[25] After noticing that results are sensitive to the inclusion of the African countries, Chinn and Ito excluded them completely (see Chinn and Ito 2007, 551).

TABLE 9 The summary of included variables using the 5-year nonoverlapping averages

name (the role)	within variance (% share)	description
ca (dependent variable)	22%	current account balance (% of GDP)
budget	50%	budget balance (% of GDP)
chinn_rel (control variable)	15%	Chinn-Ito index as a ratio to the GDP-weighted sample mean. Measures country's degree of financial account openness. In the case of cross-border capital flow restrictions the variable tends to be zero. Negative observations in the sample were first recoded to zeros.
dependency	13%	Dependency ratio; that is, the percentage share of the population aged less than 15 or more than 64.[26]
credit_rel (proxy)	10%	Private credit by deposit money banks and other financial institutions (% of GDP) as a ratio to the GDP-weighted sample mean. Measures the state of the domestic financial sector.
gdppercapita_rel (proxy)	less than 1%	GDP per capita as a ratio to the GDP-weighted sample mean. This is a proxy for the capital intensity. If we assume that all countries share the same technology (very unrealistic assumption), differences in the GDP per capita levels result from differences in the capital intensity.
growth	74%	GDP per capita growth. The connection to the theory is weak, because of the inability to control for the persistence.
icrg_rel (proxy)	5%	The average of the six main categories of political risk index as a ratio to the similarly calculated GDP-weighted sample mean. Measures the state of domestic institutions. For the 93-97-period values from the years 1996 and 1998 were used. For the 98-02-period values from the years 2000, 2002 and 2003 were used. For the 03-07-period values from the years 2004-2007 were used.
laggednfa	12%	Lagged net foreign assets (% of GDP). For the 93-97-period the average of the 88-92-period was used etc. There is a small endogeneity problem with the lagged NFA, because this period's current account balance is partly determined by net factor income which on the other hand is determined by the previous NIIP.
stdevgrowth	52%	Standard deviation of the GDP per capita growth during the current 5-year period. By this we try to test the extent of precautionary saving.
trade_rel (control variable)	3%	The sum of exports and imports (% of GDP) as a ratio to the GDP-weighted sample mean. Measures trade openness.

[26] Usually the dependency ratio is calculated as follows:
(number of people aged 0-14 + number of people aged 65 or more) / number of people aged 15-64. However, also the another way of calculating is suitable for our purposes.

The *_rel* ending in a variable's name means that the variable has been calculated as a ratio to the GDP-weighted sample mean. For private credit ratio, GDP per capita and political risk index we have to control the rest of the world effect. Whereas for budget balance, dependency ratio, lagged NFA and standard deviation of GDP per capita growth there is no such need. For the Chinn-Ito index and trade openness, which are control variables, the choice is arbitrary. In general, the choice, whether or not, to control the rest of the world effect seemed to have no effect on the results (see table H in Appendix D).

It can be seen from table 9 that the variable *gdppercapita_rel* is problematic for the FE model, because it has so little variation over time. The coefficient of *gdppercapita_rel* may not be as well identified as others because of this (compare to Baum 2006, 223).

The variable *icrg_rel* is calculated from the political risk index in which there are six main categories: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. For the *icrg_rel* an average of all these six main categories is calculated. Hence it measures the state of institutions and political stability in general. It is very plausible to assume that proper institutions and political stability are necessary for the domestic financial markets to be advanced.

Controlling for the financial openness (*chinn_rel)* and trade openness (*trade_rel)* is not as important here as it is with a dynamic panel. Presumably the speed of external adjustment increases with economic openness. Yet, it is clear that the correlation between the domestic saving and investment rates declines; that is, the current account imbalances increases as the financial openness increases. But this disappearance of the so-called Feldstein-Horioka puzzle, should not per se contribute to the current account balances (see Feldstein and Horioka (1980)).[27] However, controlling for the extent of financial integration makes our results more robust.

5.2.1 The results of the FE, RE and pooled models

Both studies listed in table 5 were done using the pooled OLS. Neither reported how badly the assumptions held. Gruber and Kamin (2007) also ran regressions by including the country fixed effects (not shown in table 5) with a consequence that the results changed dramatically: statistically significant coefficients became insignificant and in some cases even the direction of significance changed. This same phenomenon can also be seen in Chinn and Prasad (2003). However, Chinn and Prased justified the absence of country fixed effects by the fact that most of the current account variation is between and not within countries. By allowing individual heterogeneity, and the correlation between this unobserved individual effect and included variables, the

[27] If our dependent variable were the current account balance in absolute values, the increased financial integration presumably would contribute. But as it does not take a stand to the direction of net capital inflows, it should not contribute to the current account balances.

within estimator waters down the cross-sectional variation. (Chinn and Prasad 2003, 67-68.)

Tables 10 and 11 report the results from panel regressions using the 5-year nonoverlapping averages. Panel robust standard errors are in parentheses under the coefficients.[28] Panel robust standard errors control both the heteroscedasticity and the serial correlation (correlation over periods for a given country) of error terms. Yet, with country-specific constants (FE and RE models) the serial correlation is a lesser problem than in a pooled model (Cameron and Trivedi 2005, 705). Marks *, ** and *** denote significance at the 10 %, 5 %, or 1 % levels. The joint significance of period dummies is tested by an F-test. In the RE and pooled models the following country group dummies are included: oil dummy, us dummy, advanced dummy and euro dummy. The oil dummy equals one, if fuel exports exceeded 50 percentages of merchandised exports in any of the five-year period, or if it exceeded 40 percentages during the whole period. The euro dummy equals one for the original 11 euro zone countries and for Greece. When regressions are ran seperately for the advanced and developing economies, the advanced country dummy is unnecessary. Dummies are time-invariant variables and therefore unidentified, when using the within estimator because of the perfect collinearity with the country-specific constants (Baum 2006, 222, Cameron and Trivedi 2005, 704). On the other hand, the GLS estimator and pooled OLS are less biased, when all statistically significant and reasonable dummies are included.

In the within estimator's column another F-test is reported. In this F-test the null hypothesis is that all unobserved country-specific effects are zeros. If the null hypothesis cannot be rejected, pooled OLS should be consistent. (This is tested always with unrobust standard errors.) In the GLS estimator's column the result of the Hausman test is reported. In the Hausman test the null hypothesis is that along with the FE estimator also the RE estimator is consistent (unobserved country-specific effects are random). If the null hypothesis is rejected, only the FE estimator is consistent. However, there are many problems in this standard Hausman test. It is invalid, if error terms are not iid (Cameron and Trivedi 2005, 718)[29]. In addition, with small samples the test may produce negative values. In this case, following Greene (2008, 209), the consistency of the RE estimator cannot be rejected. Time-invariant variables (country group dummies) were excluded, when doing the Hausman test. Due to the problems in the standard Hausman test, the consistency of the GLS estimator must be evaluated by comparing its coefficients with the within estimator. If a coefficient in the two regressions is significant, but with an opposite sign, the consistency of the GLS estimator can be questioned. If the GLS estimator indicates statistical significance, while the within estimator fails to do so, this is not evidence against the RE model, because the FE estimator is not efficient under the RE model. In the pooled OLS's column results from the Lagrange-multiplier test are reported. In the LM-test

[28] This was done in STATA by *clusted(ID)* command. ID refers to the panelvar.

[29] When using a generalized Hausman test this problem could have been rounded. However, the generalized Hausman test cannot be done as such for the within and GLS estimators. Thus generalized Hausman test was not done.

the null hypothesis is that errors are iid, while the alternative hypothesis is that country-specific random effects exists (Cameron and Trivedi 2005, 737).

To summarize, the F-test (in the within estimator's column) checks the FE model against the pooled model, the LM-test checks the RE model against the pooled model and the Hausman test checks the FE model against the RE model. It is important to remember that the FE estimator is always consistent regardless of the true model, but it will not be efficient, if, for example, the RE model is the true model.

TABLE 10 Results from panel regressions using 5-year nonoverlapping averages (all countries)

dependent variable: ca	FE model / within estimator	RE model / GLS estimator	Pooled OLS
budget	0.335*** (0.118)	0.534*** (0.127)	0.645*** (0.115)
chinn_rel	-0.018* (0.010)	-0.019** (0.009)	-0.022** (0.009)
dependency	-0.967*** (0.161)	-0.284*** (0.093)	-0.025 (0.097)
credit_rel	-0.078*** (0.027)	-0.039** (0.018)	-0.001 (0.014)
gdppercapita_rel	-0.069 (0.066)	0.095*** (0.022)	0.085*** (0.020)
growth	0.087 (0.089)	0.002 (0.098)	-0.076 (0.112)
icrg_rel	0.092** (0.041)	-0.019 (0.031)	-0.049 (0.031)
laggednfa	-0.003 (0.019)	0.015 (0.012)	0.028*** (0.010)
stdevgrowth	0.683*** (0.130)	0.351*** (0.136)	0.067 (0.216)
trade_rel	0.010 (0.009)	-0.005 (0.005)	-0.003 (0.004)
period dummies	excluded, not signicant (p-value 0.25)	excluded, not significant (p-value 0.17)	excluded, not significant (p-value 0.37)
country group dummies	–	oil 0 us –,** adv –,* euro +,*	oil +,* us –,*** adv –,** euro +,**
variables not listed	constant	constant	constant
R-squared	within: 0.48 between: 0.01	within: 0.28 between: 0.56	overall: 0.55
number of obs.	237	237	237
additional information	F-test for unobserved indivisual effects: pooled OLS is rejected at the 0.01 significance level[30] (with unrobust s.e.) Corr(u_i,X_{it})= -0.71 (speaks against RE)	Hausman test (with unrobust s.e. and without country group dummies): negative test statistic (consistency of GLS cannot be rejected)	LM-test for random effects: pooled OLS is rejected at the 0.01 significance level

[30] Note that there are no country group dummies in the FE regressions.

The pooled model is rejected by both the F-test on unobserved country-specific effects and the LM-test, whereas the RE model cannot be rejected on the grounds of the Hausman test. The results of the FE and RE models differ only in *gdppercapita_rel* and *icrg_rel*. Due to the fact that both of these variables had an infinitely small within component of variance, the latter could be considered as more reliable. It should be noted that the within estimator is capable of explaining as little as 1 percent of the cross-country variation in the current accounts. The results (except for the country group dummies and control variables) are listed below.

budget: the Ricardian equivalence is rejected at the 0.01 significance level by all estimators. This means that there is causation from budget deficits to current account deficits.

dependency: the demographic structure is statiscally significant at the 0.01 level. The higher the dependency ratio, the larger the current account deficit tends to be. It could be that the dependecy ratio matter more within a country than between countries.

credit_rel (proxy that measures the state of the domestic financial sector): the heterogeneity in domestic financial markets affects current account balances at the 0.01 significance level. The more advanced the domestic financial sector, the larger the net capital inflow, or equally, the current account deficit, tends to be. However, when using the private credit by deposit banks and other financial institutions as a proxy, we are actually measuring the state of the domestic banking sector rather than the state of domestic stock market. But it is reasonable to assume that there is a strong correlation between the two.

gdppercapita_rel (proxy for the capital intensity): there is a statiscally significant positive relation from a high per capita income to a net capital outflow. Yet, the within estimator fails to indicate any relation. However, we should remember that the within component of variance is small for this variable. This probably explains the contradiction in results. If we ignore the differences in the state of technology, relative per capita income measures relative capital intensity. The more physical capital per capita, the larger the net capital outflow tends to be.

growth: there is no relation between the GDP per capita growth and the current account. (Remember that the result was obtained using the 5-year nonoverlapping averages.)

icrg_rel (proxy that measures the state of domestic institutions and political stability): the evidence is mixed. As the within estimator indicates a positive relation, both the GLS and the pooled OLS fail to do so. (When using the overlapping averages, the within estimator does not find any relation.) Whether a positive or an insignificant coefficient, this contradicts the idea that along with the state of financial sector also the state of institutions would contribute to net capital inflow. This reasoning might fail in several ways and, even if proper instititutions were a necessary condition for well-developed financial markets, it is possible that after controlling the state of the domestic financial sector the coefficient is zero. Chinn and Ito (2007) discovered that the interaction term of private credit ratio (=*credit_rel)* and political risk index *(=icrg_rel)* is negative and statistically significant for all country groups (see table

5). This means that the better the state of institutions, the stronger is the negative contribution of high private credit ratio.

laggednfa: there is not any relation between the lagged net international investment position and the current account. This means that we were unable to see the long-run budget constraint (equation (2.1.A)) in action. Our time horizon is obviously too short for the LRBC. Including initial NFA instead of lagged NFA would probably make a difference, but this would not be possible when using the within estimator.

stdevgrowth: the standard deviation of GDP per capita growth has an effect on current account balances at the 0.01 significance level. Large fluctuations in the growth rate seem to induce precautionary saving.

Comparing these results to previously done studies is challenging. Panel regressions with 5-year nonoverlapping averages (listed in table 5) were done using the pooled OLS. In addition, the included variables differ to some extent. By comparing the pooled OLS regression in table 10 to Gruber and Kamin (2007) (table 5 regressions C–F) we notice the following similarities: budget balance and GDP per capita contribute positively. The former is robust to the model assumed. It remains uncertain whether the same can be said about the latter (*gdppercapita_rel* is not well identified in the FE model).

From table 11 we can see, if there are any differences between the two country groups in the variables that are statistically significant in determining the current account balance.

TABLE 11 Result from panel regressions using 5-year nonoverlapping averages (advanced and developing countries separately)

dependent variable: ca	FE model / within estimator		RE model / GLS estimator		Pooled OLS	
	advanced	developing	advanced	developing	advanced	developing
budget	0.268 (0.223)	0.414*** (0.132)	0.286* (0.158)	0.560*** (0.136)	0.461*** (0.154)	0.680*** (0.128)
chinn_rel	-0.002 (0.020)	-0.011 (0.012)	0.008 (0.019)	-0.037*** (0.011)	0.017 (0.023)	-0.037*** (0.010)
dependency	-0.446 (0.421)	-0.933*** (0.249)	-0.009 (0.281)	-0.013 (0.106)	-0.048 (0.223)	0.130 (0.139)
credit_rel	-0.069** (0.026)	-0.191*** (0.052)	-0.056** (0.024)	-0.015 (0.026)	-0.035 (0.021)	0.030 (0.020)
gdppercapita_rel	-0.085 (0.069)	0.154 (0.193)	0.063*** (0.025)	0.163* (0.090)	0.051** (0.025)	0.135** (0.065)
growth	-0.838 (0.534)	0.074 (0.092)	-0.347 (0.448)	-0.053 (0.100)	-0.190 (0.347)	-0.146 (0.102)
icrg_rel	0.017 (0.088)	0.126*** (0.047)	0.046 (0.074)	-0.009 (0.037)	0.029 (0.076)	-0.045 (0.040)
laggednfa	0.021 (0.019)	-0.029 (0.022)	0.048** (0.020)	0.006 (0.021)	0.062*** (0.017)	0.020 (0.015)
stdevgrowth	0.906*** (0.275)	0.794*** (0.164)	0.997*** (0.332)	0.546*** (0.162)	1.014** (0.430)	0.292 (0.247)
trade_rel	0.034* (0.019)	0.015* (0.009)	0.001 (0.007)	-0.004 (0.008)	-0.002 (0.006)	-0.006 (0.006)
period dummies	yes, p-value 0.08	yes, p-value 0.24	yes, p-value 0.24	yes, p-value 0.01	yes, p-value 0.30	yes, p-value 0.04
country group dummies	–	–	oil +,*** us –,* euro 0	oil 0	oil +,*** us –,*** euro 0	oil 0
variables not listed	constant	constant	constant	constant	constant	constant
R-squared	within: 0.38 between: 0.04	within: 0.61 between: 0.04	within: 0.26 between: 0.70	within: 0.39 between: 0.62	overall: 0.65	overall: 0.61
number of obs.	90	147	90	147	90	147
additional information	F-test for unobserved indivisual effects: p-value < 0.01 Corr(u_i,X_{it}) = -0.82	F-test for unobserved indivisual effects: p-value < 0.01 Corr(u_i,X_{it}) = -0.68	Hausman test: p-value = 0.61 (but panel robust s.e. depart from unrobust s.e.)	Hausman test: p-value < 0.01 (but panel robust s.e. depart from unrobust s.e.)	LM-test: p-value < 0.01	LM-test: p-value < 0.01

Again, the pooled model is rejected. The RE model is rejected by the Hausman test for the developing economies, but for the advanced countries it cannot be re-

jected. The within estimator is still explaning very little of the cross-country variation in current accounts. The results are listed below.

budget: there is a clear difference between the two country groups. For the advanced economies the Ricardian equivalence holds, whereas for the developing economies it does not. This same pattern existed in Chinn and Ito (2007) (compare regressions for IDC and LDC in table 5). The argument that failures of the permanent income hypothesis lead to failures of the Ricardian equivalence, this result was anticipated in Section 2.4. Precautionary saving and liquidity constraints were mentioned as examples negating the permanent income hypothesis. However, now we are able to exclude the former from suspicion as precautionary saving exists in both country groups. Whereas, the fact that private credit ratio is negatively significant directs us to put emphasis on the liquidity constraint argument.

dependency: it could be that the dependency ratio has a stronger negative effect on current account in developing economies. This result gets support at least from Chinn and Ito (2007).

credit_rel: the heterogeneity in domestic financial markets affects current account balances in both country groups. This is more or less a new result as Chinn and Ito (2007) failed to find any effect (except for the emerging economies). Yet, in their regressions the interaction term of private credit ratio and political risk index was negative and statistically significant. This means that the relation between the private credit ratio and the current account is probably nonlinear by nature.

gdppercapita_rel: it could be that the relative income has a stronger positive effect on current account in advanced economies. Again, this result gets support from Chinn and Ito (2007).

growth: no statistical significance in either group.

icrg_rel: the within estimator indicates a positive and statistically significant effect for the developing economies, but neither the other estimators nor the former studies support the results.

laggednfa: there is a difference between the two country groups. One could interpret this as an evidence for the LRBC being less binding for the advanced economies. The previous reasoning assumes that NFA is not positive for all advanced economies.

stdevgrowth: large flunctuations in the growth rate seems to induce precautionary saving in both country groups. One could have expected that the extent of precautionary saving as bigger in developing economies than in advanced economies. Using a standard deviation of terms of trade Chinn and Ito (2007) got this same result.

5.2.2 Robustness check

The choice whether to use nonoverlapping averages or overlapping averages was arbitrary. As a robustness check regressions for the whole sample using the 5-year overlapping averages are run in table 12. For the *icrg_rel* the lacking values (see table 9) were created as follows: for the years 1993–1995 the year 1996 values were used, for year 1997 the year 1998 values were used, for the year 1999 the year 2000 values were used, and for the year 2001 the year 2002 values were used. Lagged NFAs were

calculated as follows: for the year 1995 an average of the 1992–1996 period's net foreign assets was used and so forth.

TABLE 12 Results from panel regressions using 5-year overlapping averages (all countries)

dependent variable: ca	FE model / within estimator	RE model / GLS estimator	Pooled OLS
budget	0.264**	0.363***	0.612***
	(0.111)	(0.105)	(0.109)
chinn_rel	-0.018**	-0.016*	-0.022***
	(0.008)	(0.008)	(0.008)
dependency	-0.742***	-0.455***	0.043
	(0.237)	(0.141)	(0.115)
credit_rel	-0.050**	-0.049***	0.010
	(0.020)	(0.016)	(0.013)
gdppercapita_rel	-0.124**	0.040	0.064***
	(0.057)	(0.027)	(0.018)
growth	0.088	0.086	-0.133
	(0.098)	(0.100)	(0.147)
icrg_rel	0.046	0.005	-0.043
	(0.036)	(0.031)	(0.032)
laggednfa	0.024**	0.032***	0.046***
	(0.012)	(0.011)	(0.011)
stdevgrowth	0.368***	0.368***	0.150
	(0.069)	(0.082)	(0.240)
trade_rel	0.011	-0.003	-0.005
	(0.009)	(0.005)	(0.003)
year dummies	yes, p-value < 0.01	yes, p-value < 0.01	yes, p-value < 0.01
country group dummies	–	oil 0 us 0 adv 0 euro 0	oil 0 us –,*** adv –,** euro +,**
variables not listed	constant	constant	constant
R-squared	within: 0.44 between: 0.01	within: 0.39 between: 0.41	overall: 0.62
number of obs.	869	869	869
additional information	F-test for unobserved indivisual effects: p-value < 0.01 Corr(u_i,X_{it})= -0.76	Hausman test: p-value < 0.01 (but panel robust s.e. depart from unrobust s.e.)	LM-test: p-value < 0.01

By comparing tables 10 and 12 one notices that most of the results are robust to the choice of 5-year averages. (We are not interested in the control variables.) When using the pooled OLS, there is no changes. When using the RE estimator, there is a remarkable change only in the coefficients of lagged NFA and GDP per capita. The reason for the former is that calculating lagged NFA differed between the overlapping and nonoverlapping averages. But the change in the coefficient of GDP per capita remains a mystery. When using the FE estimator, there is a remarkable change in the coefficients of lagged NFA, GDP per capita and political risk index. The same ex-

planation as earlier applies to the lagged NFA. The latter two are not as well identified as other variables, because those are the two with the smallest within variation (see table 9). (Using overlapping averages the within components of variation gets even smaller: 0.4 % for the *gdppercapita_rel* and 4.5 % for the *icrg_rel.)* This probably explains the mess.

5.3 Panel data analysis using annual observations

Another way to run regressions is to use annual observations and not multi-year averages. This is done separately for the advanced and developing economies in table 13. Standard deviations of the GDP per capita growth are calculated as follows: for the year 1993 a standard deviation of the 1992–1994 period is been used and so forth. It is clear that, when using a high-frequency data, business cycle becomes the main driving force. Our explanatory variables, except the *growth,* were not chosen from this perspective. Hence, the regressions in table 13 are less capable of explaining the within variation in the current accounts than regressions that used 5-year averages.

TABLE 13 Results from panel regressions using annual data (advanced and developing countries separately)

dependent variable: ca	FE model / within estimator		RE model / GLS estimator		Pooled OLS	
	advanced	developing	advanced	developing	advanced	developing
budget	0.157 (0.116)	0.360*** (0.083)	0.168 (0.115)	0.424*** (0.074)	0.372*** (0.127)	0.524*** (0.082)
chinn_rel	-0.009 (0.014)	-0.026** (0.012)	0.001 (0.013)	-0.032*** (0.010)	0.013 (0.016)	-0.031*** (0.009)
dependency	-0.256 (0.406)	-1.013*** (0.303)	0.108 (0.301)	-0.176** (0.086)	-0.132 (0.215)	0.124 (0.114)
credit_rel	-0.059** (0.025)	-0.132*** (0.044)	-0.060*** (0.023)	-0.043* (0.025)	-0.034* (0.018)	0.027* (0.016)
gdppercapita_rel	-0.103 (0.063)	0.005 (0.099)	0.056** (0.027)	0.034 (0.065)	0.051** (0.020)	0.050 (0.047)
growth	-0.273** (0.127)	-0.079 (0.087)	-0.307** (0.127)	-0.062 (0.088)	-0.236* (0.126)	-0.068 (0.068)
icrg_rel	-0.021 (0.040)	0.068** (0.034)	-0.002 (0.041)	0.002 (0.030)	0.023 (0.056)	-0.038 (0.033)
laggednfa	0.023 (0.017)	0.020 (0.016)	0.026 (0.019)	0.047*** (0.016)	0.053*** (0.018)	0.055*** (0.012)
stdevgrowth	0.305* (0.159)	0.521*** (0.099)	0.318 (0.198)	0.454*** (0.103)	0.495* (0.275)	0.404*** (0.114)
trade_rel	0.009 (0.011)	0.013** (0.005)	0.003 (0.005)	0.002 (0.006)	0.000 (0.004)	-0.004 (0.006)
year dummies	yes, p-value < 0.01	yes, p-value < 0.01	yes, p-value < 0.01	yes, p-value < 0.01	yes, p-value < 0.01	yes, p-value < 0.01
country group dummies	–	–	oil +,*** us 0 euro 0	oil 0	oil +,*** us –,*** euro 0	oil 0
variables not listed	constant	constant	constant	constant	constant	constant
R-squared	within: 0.25 between: 0.20	within: 0.36 between: 0.11	within: 0.20 between: 0.60	within: 0.31 between: 0.59	overall: 0.59	overall: 0.54
number of obs.	450	735	450	735	450	735
additional information	F-test for unobserved indivisual effects: p-value < 0.01 Corr(u_i,X_{it}) = -0.84	F-test for unobserved indivisual effects: p-value < 0.01 Corr(u_i,X_{it}) = -0.55	Hausman test: p-value < 0.01 (but panel robust s.e. depart from unrobust s.e.)	Hausman test: p-value < 0.01 (but panel robust s.e. depart from unrobust s.e.)	LM-test: p-value < 0.01	LM-test: p-value < 0.01

By comparing tables 11 and 13 one notices that most of the results are robust to the frequency of the data. For example, the sharp distinction in budget balance between the two country groups is present also at the higher frequency. On the other hand, the extent of precautionary saving is now greater in the developing countries. This is in line with the common sense. However, the main finding using annual observations is this: GDP per capita growth contributes negatively and statistically sig-

nificantly to current accounts, but only in the advanced economies. This result seems to be fairly robust, as all the estimators confirm it. When using annual data, prior studies have got mixed results for the GDP per capita (see tables 6-8). Following the intertemporal approach we would expect a negative relation between the GDP per capita growth and the current account, if we assume nonstationary output or permanent productivity shocks. Assuming output to be mean reverting in growth rates rather than levels is plausible.

The sharp distinction in GDP per capita growth between the two country groups is inspiring. The very same factors that water down the Ricardian equivalence can prevent agents from following the consumption path which is consistent with their intertemporal optimization behaviour. Actually, when detecting that the Ricardian equivalence does not hold, we should always also detect that the intertemporal optimization behaviour is not followed in general. We have found some evidence of this.

5.4 Cross-sectional regressions

For the current account balances the cross-section component of variance is larger than the time-series component (see table B in Appendix C). In addition, our time period of 1993-2007 is relatively short. These two facts call for the cross-sectional regressions. Results using the between estimator are reported in table 14. By averaging over the whole time span it uses only the cross-sectional variation (Cameron and Trivedi 2005, 703). The between estimator is inconsistent, if the fixed effects model is the true model (Baum 2006, 226, Cameron and Trivedi 2005, 699, 703). Now we can use the time-invariant initial NFA (year 1993) instead of lagged NFA. Unrobust standard errors are in parenthesis under the coefficients.

Table 14 Results from cross-sectional regressions (all countries)

dependent variable: ca	Between estimator	Between estimator	Between estimator
budget	0.935***	1.028***	0.953***
	(0.169)	(0.190)	(0.169)
chinn_rel	-0.030**	-0.014	-0.030**
	(0.013)	(0.014)	(0.012)
dependency	0.028	0.068	-0.001
	(0.146)	(0.165)	(0.143)
credit_rel	0.020	0.047**	
	(0.019)	(0.021)	
gdppercapita_rel	0.092***		0.099***
	(0.021)		(0.020)
growth	-0.207	-0.498	-0.208
	(0.295)	(0.325)	(0.295)
icrg_rel	-0.076	0.010	-0.075
	(0.053)	(0.056)	(0.053)
initialnfa	0.022**	0.029***	0.022**
	(0.009)	(0.010)	(0.009)
stdevgrowth	-0.361	-0.145	-0.484
	(0.434)	(0.488)	(0.418)
trade_rel	-0.002	-0.001	-0.002
	(0.004)	(0.005)	(0.004)
country group dummies	oil +,* us –,** adv –,* euro +,**	oil +,*** us 0 adv 0 euro +,*	oil +,* us –,** adv –,* euro +,**
variables not listed	constant	constant	constant
R-squared	within: 0.07 between: 0.70	within: 0.05 between: 0.61	within: 0.07 between: 0.69
number of obs.	1185	1185	1185

The cross-sectional regressions partly just repeat our results from table 10. We get additional support for the claim that a high relative income (high capital intensity) has a positive effect on the current account. This is not the same as to say that countries with a high relative income tend to be capital exporters. We know that in reality it is the other way round. In a regression analysis the coefficients indicate the independent effect of a particular variable.

The biggest distinction to the panel regressions with 5-year nonoverlapping averages is that the dependency ratio, private credit ratio and the volatility of GDP per capita growth do not contribute to the current account. It is theoretically plausible that the dependency ratio affects more within a country than between the countries (life-cycle hypothesis). On the other hand, calculating an average of standard deviations of GDP per capita growth does not make sense. But it is more difficult to explain why private credit ratio does not have any effect on the current account. Yet, this could have been anticipated already from table 10 as the pooled OLS is a matrix-weighted average of the within and between estimators (Baum 2006, 226).

Table 15 Results from cross-sectional regressions (advanced and developing countries separately)

dependent variable: ca	Between estimator		Between estimator		Between estimator	
	advanced	developing	advanced	developing	advanced	developing
budget	0.901**	1.064***	1.022**	1.238***	0.911**	1.093***
	(0.346)	(0.223)	(0.391)	(0.223)	(0.336)	(0.225)
chinn_rel	0.046	-0.034**	0.078**	-0.021	0.046	-0.038**
	(0.030)	(0.016)	(0.031)	(0.016)	(0.029)	(0.016)
dependency	-0.004	0.033	0.247	-0.072	0.011	0.005
	(0.372)	(0.177)	(0.409)	(0.182)	(0.361)	(0.178)
credit_rel	-0.011	0.040	0.003	0.059**		
	(0.028)	(0.028)	(0.031)	(0.028)		
gdppercapita_rel	0.060**	0.148**			0.058**	0.174***
	(0.024)	(0.063)			(0.023)	(0.061)
growth	0.145	-0.228	-0.070	-0.612*	0.236	-0.122
	(0.798)	(0.363)	(0.908)	(0.345)	(0.746)	(0.360)
icrg_rel	-0.119	-0.079	-0.064	-0.015	-0.133	-0.090
	(0.114)	(0.065)	(0.128)	(0.062)	(0.106)	(0.065)
initialnfa	0.063**	0.007	0.075***	0.026**	0.061***	0.004
	(0.022)	(0.013)	(0.025)	(0.012)	(0.021)	(0.014)
stdevgrowth	1.203	-0.156	2.644	-0.083	1.025	-0.397
	(1.917)	(0.470)	(2.090)	(0.496)	(1.817)	(0.443)
trade_rel	0.006	-0.010	0.008	-0.008	0.006	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
country group dummies	oil +,** us –,* euro 0	oil 0	oil +,*** us 0 euro 0	oil 0	oil +,** us –,** euro 0	oil 0
variables not listed	constant	constant	constant	constant	constant	constant
R-squared	within: 0.00 between: 0.82	within: 0.11 between: 0.75	within: 0.00 between: 0.74	within: 0.09 between: 0.72	within: 0.00 between: 0.81	within: 0.11 between: 0.74
number of obs.	450	735	450	735	450	735

The main finding in table 15 is that the sharp distinction in budget balance between the two country groups fades away, when we use group means (averages over the entire time period for each country). A persistent budget deficit has a negative effect on the current account also in advanced economies.

5.5 Additional remarks

The inclusion of country group dummies enables us to perceive, if the determination of the current account balance was exceptional in some country groups. Overall, the coefficient of the US dummy is negative and statistically significant. The interpretation is that for the U.S. the current account deficit (surplus) was larger (smaller) than our model, which uses information from the whole panel, predicts. In other word, there is something that the included explanatory variables fail to capture. In these re-

spects our claim of the U.S. as a special case in Chapter 3 gets support. When running the regressions separately for the advanced and developing economies, the coefficient of the euro dummy turns out to be statistically insignificant. Again, this is logical. A common currency means a deeper financial integration that possibly enables larger current account imbalances within the euro area, but it does not affect the direction of net capital flows. Thus the speciality of the euro area is a bit different from the U.S. In the group of developing economies the coefficient of the oil dummy is statistically insignificant. (In the group of advanced economies it is statistically significant, but as there is only one oil-exporting country (Norway), the result is without relevance.) Apparently, several non-oil-exporting countries have adopted an export-led growth strategy as the oil dummy does not contribute to the determination of the current account balances.

Overall, the coefficient of the trade openness is statistically insignificant and thus the trade openness is irrelevant for the current account balances. On the contrary, the coefficient of the financial openness is negative and statistically significant. This significance results from the developing economies. It seems to be that looser restrictions on cross-border capital flows enables a developing country to run a larger current account deficit. Yet, the issue is not that simple. Many developing countries have substantial current account surpluses. Could it be that the countries that promote their exports are the same that restrict the cross-border capital flows? Such a relation would be in line with our results.

Our set of variables does relatively well in explaining the current account dynamics in the world economy. For the pooled OLS the value of R-squared is always above 0.5 and the between estimator is capable of explaining 70 percent of the between variation in the current accounts. Probably the biggest "disappointment" was that we were unable to find robust statistical significance for the *ircg_rel* which measured the state of domestic institutions. (When using the pooled OLS in table 10 and the between estimator in table 14, the p-values for the negative slopes were 0.112 and 0.156.)

In Section 5.2 there is a following circle concerning the question of a suitable linear panel model: The pooled model is rejected and thus the pooled OLS is very likely inconsistent. We cannot verify whether the RE estimator is consistent or not. We know that the FE estimator is consistent. However, some variables are not well-identified when using the FE estimator due to the small time-series components of variances. In addition, the FE estimator is unsuccessful in explaining basically any of the cross-country variation in the current accounts.

The versatile analysis made in this chapter has increased our understanding of the global imbalances. We were able not just to identify whether or not the variables were statistically significant, but also group them according to the dimension of causation in which they matter most. If using only one estimator, this was not possible. Realizing the limitations of the analysis is as important as the analysis itself. We have told these limitations openly. Especially, the usage of the pooled OLS is questionable. Nevertheless, in some influential studies the pooled model has been assumed without confronting the issue of the validity of the model.

6 Conclusions

By having a comprehensive sample of countries that accounted over 95 percent of the world economy, and by using a wide range of estimators with different twists, we were able to perform an exhaustive analysis of the period 1993-2007 during which the global imbalances tripled. In the panel study current account balances (% of GDP) were explained by a large set of theoretically plausible variables. The regressions using 5-year nonoverlapping averages were estimated by the within estimator, the GLS and the pooled OLS, at first for the entire dataset, then separately for the advanced and developing economies. After this, the procedure was replicated, but with the annual observations. Lastly, the regressions were estimated by the between estimator. We performed some formal tests to discover which one of the three models (the FE, RE, or pooled) is the true model.

According to our analysis, assuming the permanent income consumption behaviour is not a bad approximation for the advanced economies: the Ricardian equivalence holds unless the budget deficit, or surplus, is extremely sustained, and the GDP per capita growth contributes negatively to the current account balance in the short run. For the developing economies it is just the opposite: a budget surplus has a positive effect on the current account balance, whereas the coefficient of GDP per capita growth is not statistically significant. Our main suspect for causing this sharp distinction between the groups of countries is the existence of liquidity constraints in the developing economies. We arrive at this conclusion, because 1) the private credit ratio, which gauges the severity of liquidity constraints, is (negatively) statistically significant, and 2) the private credit ratio is much lower in the developing economies (see table A in Appendix C). Due to the fact that the precautionary saving seems to exist within both country groups, we cannot consider it as responsible for the distinction. Yet, when using the higher frequency data, the precautionary saving seems to have been limited to the developing countries. The dependency ratio contributes negatively to the current account balance equally in both country groups. However, this holds more within a country than between the countries. The same is true with the private credit ratio. These differences in the dimension of causation cannot result merely from the possible inconsistency of the pooled OLS, because 1) the between estimator is consistent, if the RE model is the true model, and 2) the GLS estimator stands by the within estimator indicating the relations mentioned above. The relative income, which we used as a proxy for the capital intensity, contributes positively to the current account balance. We did not find robust statistical significance for the state of domestic institutions. Yet, the between estimator indicates the theoretically plausible negative relation at the 0.20 significance level.

It is important to recognize the difference between our empirical study and the global imbalances portrait in figure 1. In 2007 the three biggest economies (the U.S., Japan and China) accounted together approximately for a half of the world economy. Consequently, global phenomena, such as the global current account imbalances, are a game between a few giants. In the estimation process all countries have an equal importance. When considering the sustainability of current account imbalances we

face another problem. Looking from figure 1 the situation in 2007 could have been fully sustainable as well as unsustainable. Our analysis sheds only little, if any, light on the issue. A country can borrow resources from abroad to finance its irresponsible consumerism, or equally to finance its investments in the tertiary education. From the sustainability point of view these two cases differ significantly. In other words, even though the global imbalances that prevailed in 2007 turned out to be unsustainable, we cannot make such a claim that imbalances of the magnitude of 6 percent (in absolute value) were per se unsustainable. We dismissed the question of sustainability and concentrated on finding the determinants of current account balances.

To reduce the global imbalances our analysis suggests the following policy recommendation[31]: In the developing countries one should promote the institutional development of domestic financial sectors. Along with the deepening financial integration also the state of financial markets should begin to catch up the world frontier. Developing economies with substantial current account surpluses should loosen the restrictions on cross-border capital flows. In addition to the usual gains from financial openness, we argue that this would have a balancing effect on the current accounts; that is, foreign borrowing would be greater than foreign lending. Net capital exporters (importers) among the developing economies ought to avoid large budget surpluses (deficits). After adding the word "prolonged" to the previous, the same advice is valid also for the advanced economies. Outside our panel study, we suggest that the Fed and the ECB should adopt an inflation target that would not only take into consideration changes in the consumer prices, but also changes in the property prices. This would control the wealth effect on consumption. There is disagreement on how much renminbi's dollar peg contributes to the global imbalances. If the PBC allowed renminbi to float more freely, probably everyone would gain. The issue of current account imbalances within the euro area is a complex one. An often repeated remedy seems to be the strengthening of the competition channel. By remembering how the Stability and Growth Pact was disobeyed, one cannot be very optimistic about the effects of new pacts.

[31] A well-know pattern of the global imbalances is that the aggregated current account balance of advanced economies is negative, while the aggregated current account balance of developing economies is positive (see for example figure B in Appendix C). Our policy recommendation assumes this pattern to prevail.

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APPENDIX A – Equations and definitions

Net foreign assets or net international investment position (NIIP) is defined as

$$(A) \quad B := Dofa - Foda ,$$

where Dofa is the domestically owned foreign assets, and Foda is the foreign owned domestic assets.

Current account balance (the difference of incomes and expenditures) in year t is

$$(B) \quad CA_t = (Y_t + r_t \times B_{t-1}) - (C_t + G_t + I_t),$$

where Y_t is the gross domestic product (GDP), r_t is the interest rate, $(r_t \times B_{t-1})$ is the net factor income from abroad, C_t is consumption, G_t is government spending, and I_t is investment. Note that $(Y_t + r_t \times B_{t-1})$ is the gross national product (GNP).

Current account balance (the difference of savings and investments) in year t is

$$(C) \quad CA_t = S_t - I_t = (Sp_t - I_t) + (T_t - G_t),$$

where S_t is national saving, Sp_t is private saving, and T_t is government tax. Note that $(T_t - G_t)$ is the budget surplus.

Current account balance (the change in net foreign assets) in year t is

$$(D) \quad CA_t = B_t - B_{t-1} = -FA_t ,$$

where B_t is the value of net foreign assets at the end of year t, and FA_t is the financial account balance on year t. Note that here all valuation adjustments have been ignored. The current account balance is the opposite of the financial account balance. Valuation effects do not change this equality. Note also that a slight modification on how to interpret time indexes in current account identity (the combination of equations (B) and (D)) will be done in the Appendix B.

Current account balance (the sum of trade balance and net factor income from abroad) in year t is

$$(E) \quad CA_t = (X_t - Z_t) + r_t \times B_{t-1} = NX_t + r_t \times B_{t-1} ,$$

where X_t is export, Z_t is import, and NX_t is net export which is the same as trade balance.

No-Ponzi-game condition is

$$(F) \quad \lim_{T \to \infty} \left(\frac{1}{1+r} \right)^T B_{t+T+1} \geq 0 .$$

Equation (F) is a modified version of condition (13) from Obstfeld and Rogoff (1996, 64) with a notice from page 65.

The permanent level of variable on date t is defined as

$$(G) \quad \tilde{X}_t := \frac{r}{1+r} \sum_{s=t}^{\infty} \left(\frac{1}{1+r} \right)^{s-t} X_s .$$

Definition (G) is the identity (17) from the Obstfeld and Rogoff (1996, 74).

In stochastic model the first-order condition with respect to K_{t+1} is

$$(H) \quad E_t\{A_{t+1}F'(K_{t+1})\} = r,$$

where the covariance between the marginal product of capital and domestic consumption has been ignored.
Equation (H) is a modified version of equation (40) from Obstfeld and Rogoff (1996, 86).

Cobb-Douglas production function with Hicks-neutral technology:

$$(I) \quad Y = K^{\alpha}L^{1-\alpha} \xrightarrow{\text{per capita notation}} y = k^{\alpha},$$

where K is the capital stock, L is the labour force, and $0 < \alpha < 1$. Note that $y = Y/L$ and $k = K/L$.

Marginal product of capital:

$$(J) \quad MPK := \frac{\partial y}{\partial k} = \alpha k^{\alpha-1} > 0 \Rightarrow \frac{\partial^2 y}{\partial k^2} = \alpha(\alpha-1)k^{\alpha-2} < 0.$$

Marginal product of capital with Hicks-neutral technological progress is

$$(K) \quad MPK = A(\alpha k^{\alpha-1}),$$

where A is a parameter which describes the state of technology.

The effect of human capital on marginal product of (physical) capital:

$$Y = AK^{\alpha}H^{\beta}L^{1-\alpha-\beta} \Rightarrow MPK = \alpha AK^{1-\alpha}H^{\beta}L^{1-\alpha-\beta}$$

$$(L) \quad \frac{\partial MPK}{\partial H} = \alpha\beta AK^{1-\alpha}H^{1-\beta}L^{1-\alpha-\beta} > 0,$$

where H is the stock of human capital.

$$(M) \quad \mathrm{e} = (\mathrm{m} - \mathrm{m}^*) - (\mathrm{c} - \mathrm{c}^*),$$

where variables are in log-change form. If $\mathrm{e} > 0$, it means that Home currency depreciates.
Interpretation: relative increase in Home consumption → Home money demand increases → Home price level falls (equilibrium between (real) money supply and demand) → Home currency appreciates (purchasing power parity).
Equation (M) is the equation (60) from the Obstfeld and Rogoff (1996, 678), and it is deduced from money demand and Euler equations.

$$(N) \quad \mathrm{e} = \frac{\delta(1+\theta)+2\theta}{\delta(\theta^2-1)}(\mathrm{c} - \mathrm{c}^*),$$

where variables are in log-change form, but θ and δ are parameters: θ is the price elasticity of aggregate demand so that $\theta > 1$, δ is the rate of time preference (subjective discount factor) so that in the steady state $\delta = r$.
Interpretation: exchange rate depreciation is needed for relative increase in Home consumption (depreciation gives a momentary competitive advantage to domestic producers).

Equation (N) is the equation (64) from the Obstfeld and Rogoff (1996, 679), and it is deduced from short-run equilibrium conditions other the money demand equations.

See an illustration of equations (M) and (N) from the figure below:

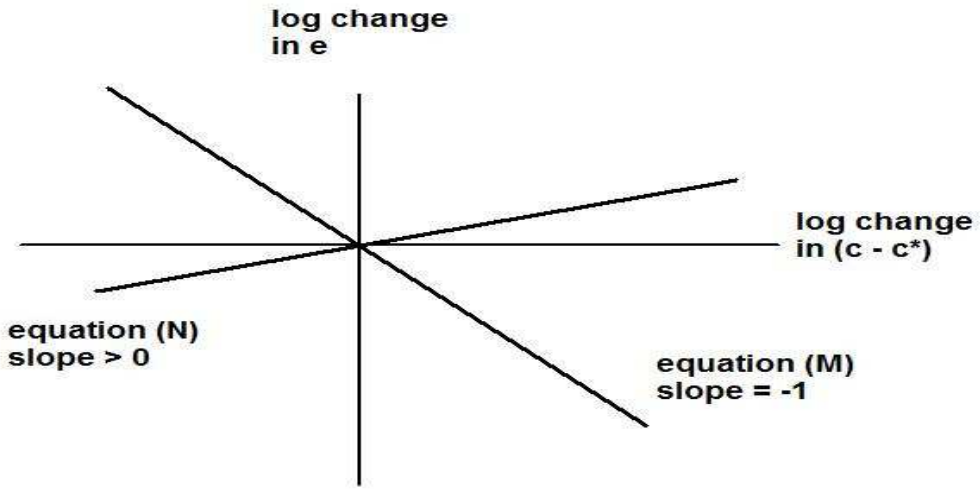

FIGURE A Equilibrium in the Redux model
(Obstfeld and Rogoff 1996, 679, Figure 10.1 with a slight modification)

$$(O) \quad \mathrm{e} = -\frac{\bar{\mathrm{a}} - \bar{\mathrm{a}}^*}{\delta(1+\theta)} + \frac{\delta(1+\theta)+2\theta}{\delta(\theta^2-1)}(\mathrm{c}-\mathrm{c}^*),$$

where $\bar{\mathrm{a}}$ is the log change in steady-state level of productivity.
Equation (O) is the equation (105) from the Obstfeld and Rogoff (1996, 698).

$$(P) \quad \mathrm{e} = \frac{1}{\theta-1}\left[\mathrm{g} - \mathrm{g}^* + \left(\frac{1}{\delta}\right)(\bar{\mathrm{g}} - \bar{\mathrm{g}}^*)\right] + \frac{\delta(1+\theta)+2\theta}{\delta(\theta^2-1)}(\mathrm{c}-\mathrm{c}^*),$$

where g is the log change in government spending, and $\bar{\mathrm{g}}$ is the log change in the steady-state level of government spending.
Equation (P) is the equation (137) from the Obstfeld and Rogoff (1996, 704).

The one-way error component regression model:

$$(Q) \quad y_{it} = \alpha_i + \mathbf{X}'_{it}\boldsymbol{\beta} + u_{it} = \alpha + \mathbf{X}'_{it}\boldsymbol{\beta} + \mu_i + \nu_{it}, \text{ where } \nu_{it} \sim IID\left(0, \sigma_\nu^2\right)$$

The two-way error component regression model:

$$(R) \quad y_{it} = \alpha_i + \mathbf{X}'_{it}\boldsymbol{\beta} + u_{it} = \alpha + \mathbf{X}'_{it}\boldsymbol{\beta} + \mu_i + \lambda_t + \nu_{it}, \text{ where } \nu_{it} \sim IID\left(0, \sigma_\nu^2\right)$$

Equations for ΔI and ΔCA in a linear quadratic interemporal small-country model:

$$(S)\quad \Delta I_t = a_0 + a_1 \Delta A_t^C + a_2 \Delta A_t^G + a_3 I_{t-1} + a_4 T$$

$$(T)\quad \Delta CA_t - (r-1) CA_{t-1} = b_0 + b_1 \Delta A_t^C + b_2 \Delta A_t^G + b_3 I_{t-1}$$

where C refers to country-specific and G to global. Country-specific components of TFP growth were formed as the deviations from the global average. See details from Glick and Rogoff (1995).

APPENDIX B – Derivation of the models

Note that in Sections 2.2 and 2.3 population size is normalized to 1. This simplification allows us to treat individual quantity choices as economy-wide aggregates. In Section 2.4 when we allow population to grow, this simplification is of course abandoned.

Section 2.2 - A deterministic model

A proof of the fundamental current account equation (equation (2.2.A)) is presented below:

First, rewrite the current account identity (the combination of equations (B) and (D)) with a slight modification

$$(1)\quad CA_t = B_{t+1} - B_t = (Y_t + r \times B_t) - (C_t + G_t + I_t).$$

The reason for this modification is purely technical. Now B_{t+1} is the value of net asset value at the beginning of year t+1.

Assume a time-additive utility function

$$(2)\quad U_t = \sum_{s=t}^{\infty} \beta^{s-t} u(C_s).$$

The current account identity (equation (1)) gives

$$(3)\quad C_s = (1+r) B_s - B_{s+1} + A_s F(K_s) - (K_{s+1} - K_s) - G_s,$$

where we have used notations $Y_s = A_s F(K_s)$, and $I_s = (K_{s+1} - K_s)$. A_s is the total factor productivity (TFP) and $F(\cdot)$ is the production function.

When we substitute equation (3) in equation (2), and maximize U_t in respect to B_{s+1} and K_{s+1}, we get the necessary first-order conditions:
for every year $s \geq t$ both

$$(4)\quad u'(C_s) = (1+r)\beta u'(C_{s+1})$$

and

$$(5)\quad A_{s+1} F'(K_{s+1}) = r$$

must hold.

Equation (4) is called an intertemporal Euler equation or a consumption Euler equation. What it means is that as a result of intertemporal optimization agents cannot achieve higher utility level by distributing consumption expenditures some other

way between the time periods. If the subjective discount factor equals the market discount factor ($\beta = 1/(1+r)$), agents have constant level of consumption. Equation (5) makes it sure that the marginal product of capital is equal to the interest rate. If the marginal product of capital would exceed the interest rate, there was profitable investment projects left. In the optimum all profitable investment opportunities have to be exploited.

By iterating the current account identity (equation (1)) forward, we get a budget constraint

$$(6)\quad \sum_{s=t}^{t+T}\left(\frac{1}{1+r}\right)^{s-t}(C_s+G_s+I_s)+\left(\frac{1}{1+r}\right)^{T}B_{t+T+1}=(1+r)B_t+\sum_{s=t}^{t+T}\left(\frac{1}{1+r}\right)^{s-t}Y_s\,.$$

When $T \to \infty$, the LRBC takes form

$$(7)\quad \lim_{T\to\infty}\left(\frac{1}{1+r}\right)^{T}B_{t+T+1}=0\,,$$

which is equation (F) with strict equality.

When we substitute equation (7) in equation (6) with $T \to \infty$, we get

$$(8)\quad \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}(C_s+G_s+I_s)=(1+r)B_t+\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}Y_s\,.$$

If we assume that ($\beta = 1/(1+r)$), we get a consumption function

$$(9)\quad C_t=\frac{r}{1+r}\left[(1+r)B_t+\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}(Y_s-G_s-I_s)\right].$$

This consumption path satisfies the intertemporal Euler equation (equation (4)) and the budget constraint. Both first-order conditions are met whenever investment and output levels are determined by equation (5). This is the level of consumption in which wealth net of government spending and investment remains constant over time. Note that the wealth is a different concept from the net foreign assets which measures external wealth.

When we substitute equation (9) in the current account identity (equation (1)), we get

$$(10)\quad CA_t=B_{t+1}-B_t=Y_t-\frac{r}{1+r}\left[\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}(Y_s-G_s-I_s)\right]-(G_t+I_t).$$

If we apply definition (G) on equation (10), we get equation (2.2.A) as a result. □

The proof above relied on Obstfeld and Rogoff (1996, 60–65, 74).

Section 2.3.1 – Stochastic model: response to output shocks

A proof of equation (2.3.1.B) is presented below:

Agents maximize the expected value of lifetime utility

$$(11)\quad U_t = E_t\left\{\sum_{s=t}^{\infty}\beta^{s-t}u(C_s)\right\},$$

where $E_t\{\cdot\}$ is a mathematical conditional expectation.

When we use the current account identity (equation (1)) to equation (11), and maximize U_t in respect to B_{s+1}, we get the necessary first-order condition:
for every year t

$$(12)\quad u'(C_t) = (1+r)\beta E_t\{u'(C_{t+1})\}$$

must hold.

Assume a quadratic period utility function

$$(13)\quad u(C) = C - \frac{a_0}{2}C^2,$$

where $a_0 > 0$.

Remember that we are still assuming that the subjective discount factor equals the market discount factor ($\beta = 1/(1+r)$)!

When we substitute marginal utility (of equation (13)) in the necessary first-order condition (equation (L)), we obtain

$$(14)\quad E_t C_{t+1} = C_t.$$

This means that consumption follows a random walk.

A budget constraint is the same (equation 8) as in the deterministic model; that is, it holds with probability one.

Combining the consumption random walk (equation (14)) with the budget constraint (equation (8)), gives us

$$(15)\quad C_t = \frac{r}{1+r}\left[(1+r)B_t + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}E_t\{Y_s - G_s - I_s\}\right],$$

which is equation (9) with operator $E_t\{\cdot\}$. This consumption path means that the agents act under uncertainty as if future levels of output, government spending, and investment, which are all random variables, turned out to their conditional means with certainty.

In the present model we abstract from government spending and investment.

We can simplify our notation by observing that

$$\frac{r}{1+r}\left[\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}E_t\{Y_s\}\right]$$
$$=\frac{r}{1+r}\left[E_t\{Y_t\}+\left(\frac{1}{1+r}\right)E_t\{Y_{t+1}\}+\left(\frac{1}{1+r}\right)^2E_t\{Y_{t+2}\}+\ldots\right]$$
$$=\frac{r}{1+r}\left[\bar{Y}+\left(\frac{1}{1+r}\right)\left[E_t\{Y_{t+1}-\bar{Y}\}+\bar{Y}\right]+\left(\frac{1}{1+r}\right)^2\left[E_t\{Y_{t+2}-\bar{Y}\}+\bar{Y}\right]+\ldots\right]$$
$$=\bar{Y}+\frac{r}{1+r}\left[\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}E_t\{Y_s-\bar{Y}\}\right]$$

This means that we can rewrite equation (15) as follows:

$$(16)\quad C_t=r\times B_t+\bar{Y}+\frac{r}{1+r}\left[\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}E_t\{Y_s-\bar{Y}\}\right].$$

When output follows the stochastic process (2.3.1.A), we can write for all s > t

$$(17)\quad E_t\{Y_s-\bar{Y}\}=\rho^{s-t}(Y_t-\bar{Y}).$$

Using equation (17) to equation (16), we observe (assuming $0 \le \rho < 1$) that

$$\frac{r}{1+r}\left[\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}E_t\{Y_s-\bar{Y}\}\right]$$
$$=\frac{r}{1+r}\left[E_t\{Y_t-\bar{Y}\}+\left(\frac{1}{1+r}\right)E_t\{Y_{t+1}-\bar{Y}\}+\left(\frac{1}{1+r}\right)^2E_t\{Y_{t+2}-\bar{Y}\}+\ldots\right]$$
$$=\frac{r}{1+r}\left[(Y_t-\bar{Y})+\left(\frac{1}{1+r}\right)\rho(Y_t-\bar{Y})+\left(\frac{1}{1+r}\right)^2\rho^2(Y_t-\bar{Y})+\ldots\right]$$
$$=\frac{r(Y_t-\bar{Y})}{1+r}\left(1+\left(\frac{\rho}{1+r}\right)+\left(\frac{\rho}{1+r}\right)^2+\ldots\right)$$
$$=\frac{r(Y_t-\bar{Y})}{1+r}\times\frac{1-\left(\frac{\rho}{1+r}\right)^{\infty}}{1-\left(\frac{\rho}{1+r}\right)}$$
$$=\frac{r(Y_t-\bar{Y})}{1+r}\times\frac{1}{1-\left(\frac{\rho}{1+r}\right)}$$

$$= \frac{r\left(Y_t - \bar{Y}\right)}{1 + r - \left(\frac{\rho}{1+r}\right) - r\left(\frac{\rho}{1+r}\right)}$$
$$= \frac{r\left(Y_t - \bar{Y}\right)}{1 + r - \rho}$$

This means that we can rewite equation (16) as follows:

$$(18) \quad C_t = r \times B_t + \bar{Y} + \frac{r\left(Y_t - \bar{Y}\right)}{1 + r - \rho}.$$

If there is an unpexped temporary positive output shock on period t, current consumption increaces by less than current output. This is because shock is known to temporary which means that it has only a small effect on permanent output.

By using the stochastic difference equation (2.3.1.A) in equation (18), we get

$$(19) \quad C_t = r \times B_t + \bar{Y} + \frac{r\rho}{1 + r - \rho}\left(Y_{t-1} - \bar{Y}\right) + \frac{r}{1 + r - \rho}\varepsilon_t.$$

If we substite equation (19) into the current account identity (equation (1)), while ignoring government spending and investment, and use the stochastic difference equation (2.3.1.A) once again, we get equation (2.3.1.B) as a result. □

The proof above relied on Obstfeld and Rogoff (1996, 79–83).

A proof of equation (2.3.1.D) is presented below:

One can show that when output follows the stochastic process (2.3.1.C) and there is an unexpected output, the following equality holds:

$$(20) \quad C_t - C_{t-1} = \frac{1 + r}{1 + r - \rho}\varepsilon_t.$$

Taking equation (20) as granted, we can write

$$\begin{aligned} CA_t &= Y_t - C_t + r \times B_{t-1} \\ &= \left(Y_t - C_t\right) - \left(E_{t-1}\{Y_t\} - E_{t-1}\{C_t\}\right) \\ &= \left(Y_t - E_{t-1}\{Y_t\}\right) - \left(C_t - E_{t-1}\{C_t\}\right) \\ &= \left(Y_t - E_{t-1}\{Y_t\}\right) - \left(C_t - C_{t-1}\right) \\ &= \varepsilon_t - \frac{1 + r}{1 + r - \rho}\varepsilon_t, \end{aligned}$$

from which we get equation (2.3.1.D) by a simplification. □

The proof above relied on Obstfeld, Rogoff and Gopinath (1998, 17).

Section 2.4.2 – Overlapping generations model: response to budget deficit

A proof of equation (2.4.2.A) is presented below:

Note that here we abandon the simplification which normalized population size to 1, and instead begin to use per capita variables.

An agent (dynasty) born on date υ lives forever and maximizes lifetime utility

$$(21)\quad U_t^{\upsilon} = \sum_{s=t}^{\infty} \beta^{s-t} \log\left(c_s^{\upsilon}\right).$$

Equation (21) has an implication that we are assuming an isoelastic period utility function with σ = 1.

The budget constraint for the agent who was born on date υ at time t ≥ υ is

$$(22)\quad \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} c_s^{\upsilon} = (1+r)b_t^{p,\upsilon} + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(y_s - \tau_s\right),$$

where $b_t^{P,\upsilon}$ is individual bond holdings and τ_s is per capita tax.

We assume that individuals born with zero bond holding. (In Weil's model newly born individuals are not linked to pre-existing dynasties.)

When assuming β = 1/(1+r), maximization of equation (21) subject to equation (22) gives us an individual consumption function

$$(23)\quad c_t^{\upsilon} = (1-\beta)\left[(1+r)b_t^{p,\upsilon} + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(y_s - \tau_s\right)\right].$$

We assume that number of individuals in the economy (N_t) grows at rate n < r; that is, $N_t = (1+n)N_{t-1}$. In addition, we assume that $N_0 = 1$. Therefore $N_t = (1+n)^t$. This follows from the formula of geometric series. With these assumptions, we can write aggregate per capita consumption on date t as follows:

$$c_t = \frac{c_t^0 + nc_t^1 + n(1+n)c_t^2 + \cdots + n(1+n)^{t-1}c_t^t}{(1+n)^t}.$$

When we assume that all individuals are identical, and use the formula of geometric series once again, we obtain that aggregate consumption per capita on date t is

$$(24)\quad c_t = (1-\beta)\left[(1+r)b_t^{p} + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(y_s - \tau_s\right)\right].$$

It is important to understand what the exact set-up in Section 2.4.2 was. Government runs a budget deficit which is financed by foreign borrowing. Using these resources government gives a claim as a gift to every domestic individual currently alive. Government never pays back the principle, but maintains the per capita debt to foreigners stable by a combination of new borrowing and uniform taxes on all of those alive. Claims which government gave yield interest income to their holders.

To maintain the per capita public debt constant, per capita taxes in each period s ≥ t must be set at

$$(25)\quad \tau_s = (r-n)\bar{d} + g_s.$$

The reason why Ricardian equivalence breaks down can be deduced from equation

(25). For those individuals who get a claim the present value of additional future taxes is smaller than the present value of additional future interest income. This is because part of the burden which increased public debt causes will be carried by those who were not yet born at a time of budget deficit. These future generations will be left without government's generosity, but instead will be involved in additional taxes.

If initially government had no debt to foreigners, we know that $b^p = b + \bar{d}$. When we substitute this together with equation (25) in equation (24), and apply the formula of geometric series, we get

$$(26) \quad c_t = (1-\beta)\left[(1+r)(b_t + \bar{d}) + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}(y_s - g_s) - \frac{(1+r)(r-n)}{r}\bar{d}\right].$$

Equation (2.4.2.A) results straightforwardly from equation (26). □

The proof above relied on Obstfeld and Rogoff (1996, 182–183, 190–191).

Section 2.6.2.1 – Heterogeneity in domestic financial markets: a model with asymmetric information

Some details:

There are two periods and individuals try to maximize their second-period consumption. They can make W_1, an endowment they receive in period 1, to yield either by lending abroad at the riskless interest rate or by investing in a new technology. The latter contains a risk, because it is not sure will the investments pay off. (Gertler and Rogoff 1990.)

Equations:

$$(27) \quad \pi(k)Z^g + [1-\pi(k)]Z^b = rb,$$

where π(k) is the probability of the good outcome (the good outcome is that the investment succeeded), k is the amount of capital invested, Z^g is the sum of money that the state-contingent security pays in the case of good outcome, Z^b is the sum of money that the state-contingent security pays in the case of bad outcome, r is the market rate of return, and b is the amount entrepreneur borrows. The probability function π() is increasing in k, and it is strictly concave. This means that the probability of good outcome increases as the amount of capital invested rises but at a decreasing rate. In other words, the first derivate of probability function is positive, while the second derivate is negative.
Equation (27) is the equation (4) from Gertler and Rogoff (1990, 247).

$$(28) \quad \pi'(k^*)\theta = r,$$

where θ is the number of units of output which the investment project yields if it suc-

ceeds. Note that the left side of equation is the marginal product of capital under first-best value k*.
Equation (28) is the equation (6) from Gertler and Rogoff (1990, 248).

$$(29) \quad V = W_1 + \frac{W_2}{r},$$

where W_1 is an endowment individual receives in period 1 and by analogy W_2 is an endowment individual receives in period 2. Note that the interest rate is actually the gross interest rate which is typically larger than one.
Equation (29) is from Gertler and Rogoff (1990, 248).

Section 2.6.2.2 – Heterogeneity in domestic financial markets: a model with enforcement problems

Some deteils:

Simple version:
Production is individually run and all the shocks are idiosyncratic (= characteristic, though random of course, for the particular individual at the given point of time). There are no aggregate shocks at all. Agents can hedge against shocks by buying Arrow-Debreu type of securities. The payoffs of these securities depend on the state of nature (= the realization of shock). In the case of the worst realization of shocks the state-contingent security pays the most, and in the case of the best realization of shocks the least, to its owner. To be more precise, an agent can avoid investment risk completely by choosing not to hold any productive assets (see equation (30)). (Mendoza, Quadrini and Rios-Rull 2009.)

General version:
There are three extensions to the simple model: cross-country diversification of investment risk, a second source of financial heterogeneity, and differences in the economic size of countries. The first extension results from individual's possibility to divide his managerial capital across countries. This was not possible in the simple model. (Managerial capital is needed in production along with productive asset.) As long as idiosyncratic investment shocks are not perfectly correlated across countries, it is possible to diverse investment risks internationally. This has an implication that prices of productive assets will not necessary be equalized because the composition of portfolio matters. Adding a second source of financial heterogeneity allows countries to be divided in three groups according to that how developed their financial sectors are. The third extension is needed to get realistic results from qualitative analysis. (Mendoza, Quadrini and Rios-Rull 2009.)

Equations:

$$(30) \quad a_t - c_t = k_t P_t^i + \sum_{s_{t+1}} b(s_{t+1}) q_t^i(s_t, s_{t+1}),$$

where a_t is the end-of-period net worth before consumption. The first term in the right side of equation is the value of risky assets (= productive assets) and the second

term is the total value of riskless assets (= state-contingent assets).
Equation (30) is a modified version of equation (1) from Mendoza, Quadrini and Rios-Rull (2009, 380).

APPENDIX C – Describing the sample

The list of countries:

Advanced economies (30 in total): Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea[32], Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States.

Developing economies (49 in total): Algeria, Argentina, Azerbaijan, Bahrain, Belarus, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Guatemala, Hungary, India, Indonesia, Iran, Kazakhstan, Kuwait, Latvia, Lithuania, Mexico, Moldova, Morocco, Oman, Pakistan, Panama, Paraguay, Peru, Poland, Russia Federation, Saudi Arabia, Singapore, South Africa, Sri Lanka, Syrian Arab Republic, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, Uruguay and Venezuela.

Country is classified as an advanced economy, if it is either an OECD member country or an EU-25 country *and* classified as an advanced economy by IMF in the WEO database. Some countries are absent because the lack of data. Some countries, especially African, were excluded because they had received foreign aid heavily. If according to the WDI & GDF database (net bilateral aid flow from DAC donors, total) a country had received foreign aid corresponding 5 percent of its GDP or more during any of the five-year periods (93-97, 98-02, 03-07), it was excluded from the sample.

Controlling the rest of the world effect:

There are two ways to handle the rest of the world effect. One is to calculate a deviation from the GDP-weighted sample mean the other is to calculate a ratio to the GDP-weighted sample mean. The latter cannot be used with negative GDP-weighted sample means (e.g. with budget balance negative sample means are very likely). Ratios instead of deviations are used whenever possible, and the rest of the world effect is controlled only if it is theoretically reasonable to do so. Yet, proper robustness checks are done (see e.g. table B from Appendix D). For example in Chinn and Ito (2007) all variables, except the initial NIIP, were converted into the deviations from the GDP-weighted full sample means. It is hard to find justification for this.

When calculating GDP-weighted sample means, each country got a number which corresponded its share of the whole sample aggregate GDP (measured in constant 2000 US$). (Remember that the countries in the sample covered more than 95 % of

[32] Korea refers to South Korea (officially Republic of Korea).

the world economy.) For example the United States got a number 0.314, which was its share on average during the 1993-2007. For simplicity each country got just one number. In reality, for example China's share rose from 0.026 (1993) to 0.061 (2007), but on average it was 0.042.

Table A The summary of the sample

	advanced economies			developing economies			
name	median	max	min	median	max	min	number of created observations
current account balance (% of GDP)	0.004	0.173 (NOR, 06)	-0.240 (ISL, 06)	-0.015	0.446 (KUW, 06)	-0.307 (AZE, 98)	3 (of 1185)
budget balance (% of GDP)	-0.021	0.060 (ISL, 06)	-0.208 (GRE, 94)	-0.015	0.435 (KUW, 06)	-0.289 (KUW, 93)	28 (of 1185)
Chinn-Ito index (negative values to zero)	2.500	2.500 (many)	0.000 (many)	0.000	2.500 (many)	0.000 (many)	58 (of 1185)
dependency ratio	0.328	0.396 (ISR, 93)	0.278 (SVK, 07)	0.361	0.493 (SYR, 93)	0.202 (UAE, 07)	0 (of 1185)
fuel exports (% of merchandise exports)	-	0.678 (NOR, 06)	0.000 (many)	-	0.980 (ALG, 05)	0.000 (many)	-
GDP per capita (constant 2000 US$)	21 193	56 625 (LUX, 07)	3 967 (SVK, 93)	2 518	31 118 (SIN, 07)	336 (IND, 93)	1 (of 1185)
GDP per capita growth (annual %)	0.026	0.105 (SVK, 07)	-0.075 (KOR, 98)	0.034	0.330 (AZE, 06)	-0.308 (MDA, 94)	0 (of 1185)
net foreign assets (% of GDP) (years 88-06)	-0.122	1.686 (LUX, 90)	-1.650 (FIN, 99)	-0.263	5.505 (KUW, 91)	-3.045 (BUL, 91)	75 (of 1501)
political risk index (96-02 biannual, 03-07 annual)	0.864	0.991 (NED, 00)	0.643 (ISR, 98)	0.602	0.913 (HUN, 00)	0.280 (INA, 00)	10 (of 711)
private credit (% of GDP)	0.960	2.698 (ISL, 06)	0.194 (SLO, 93)	0.271	1.660 (THA, 98)	0.041 (ALG, 98)	28 (of 1185)
trade openness ((X+Z)/GDP)	0.727	3.198 (LUX, 07)	0.160 (JPN, 93)	0.723	3.495 (SIN, 06)	0.149 (BRA, 96)	0 (of 1185)

In addition, GDP per capita growth for the years 1992 and 2008 are needed in the regressions that use annual data (table 13). Sources for these numbers are the same as for the 1993-2007 period.

The evolution of the aggregated current account surpluses:

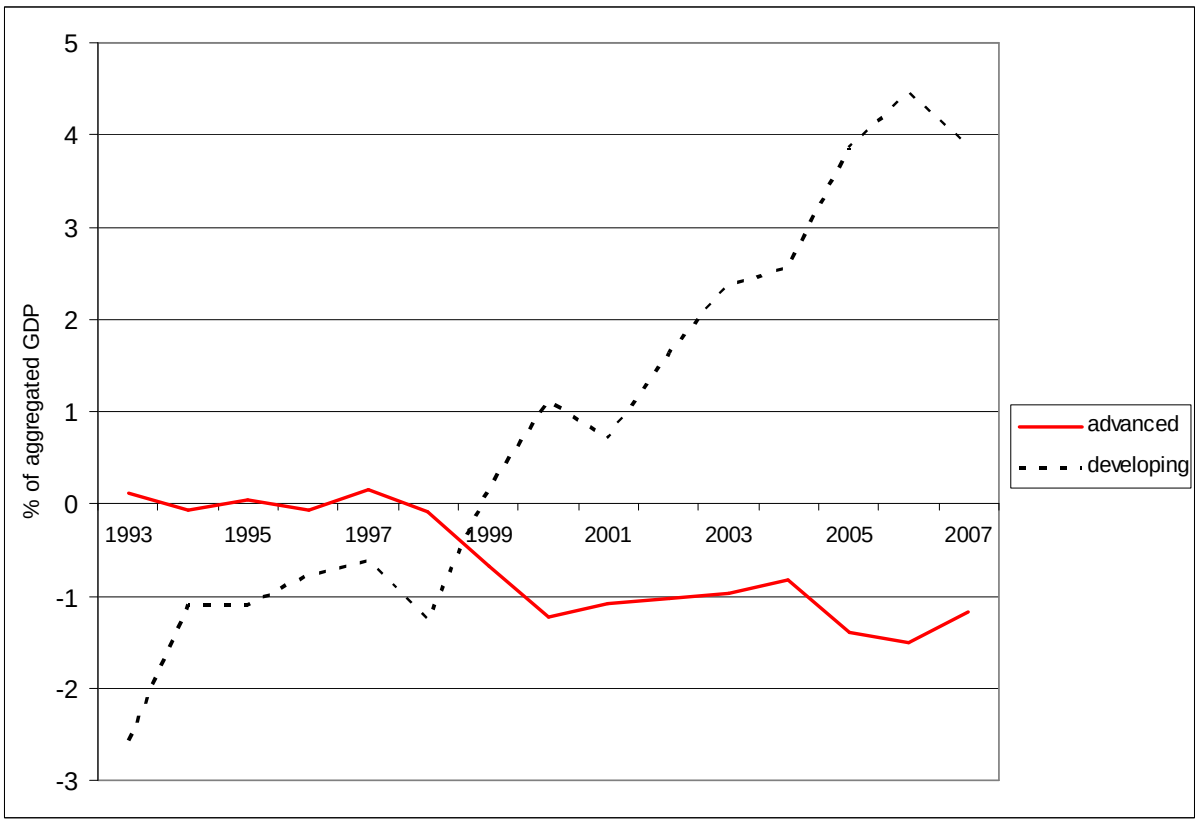

Figure B The evolution of the aggregated current account surpluses (calculated using the WDI & GDF database as the only source)

Be careful not to misinterpret the figure B as it deviates substantially from figures 1 and 2. First, in figure B the aggregation is based on the country groups. Second, the aggregated current account surpluses are divided by the likewise aggregated GDPs. Thus, the aggregated current account deficit of advanced economies is of the same magnitude as the aggregated current account surplus of developing economies.

The methodology used in creating the lacking observations:

If the lacking observations were at the beginning or at the end of a time series, the hole was filled by replicating the nearest value. If the lacking observations were at the middle of a time series, the hole was filled by taking the average of the previous and the next value. If there were more than four annual observations lacking in succession for a country, it was excluded from the sample. There were two exceptions for this rule: the Chinn-Ito index for Luxembourgh and the net foreign assets for several countries. For the entire period Luxembourgh got the highest possible value of the Chinn-Ito index. The coverage of NFA begins from the year 1988. Several countries became independent not until the beginning of the 1990s. This explains the large number of created observations.

Sources for the sample:

Current account balance:
current account balance (% of GDP) from the World Development Indicators (WDI) & Global Development Finance (GDF) database and
current account balance (percent of GDP) from the October 2010 World Economic Outlook (WEO) database.

Budget balance:
cash surplus/deficit (% of GDP) from the WDI & GDF database,
general government structural balance[33] *(percent of potential GDP)* from the WEO,
cash surplus/deficit (national currency) together with *gross domestic products (national currency)* both from the International Financial Statistics (IFS) May 2010,
cash surplus/deficit as percent of GDP from the Government Finance Statistics (GFS),
general government financial balances (as a per cent of nominal GDP) from the OECD Economic Outlook 88 database,
government deficit/surplus (percentage of GDP) from the Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/government_finance_statistics/data/database),
budget surplus/deficit (national currency) together with *GDP (national currency)* both from the International Financial Statistics Yearbook 1998,
central government, fiscal balance (% of GDP) from the African Development Bank Group (internet address for upper directory http://dataportal.afdb.org/Default.aspx),
overall surplus/deficit (in millions of U.S. dollars) together with *gross domestic product at purchaser's values (in million of U.S. dollars, at current prices)* both from the Arab Monetary Fund (internet address for upper directory http://www.amf.org.ae/econ_ind), and
general government balance (in per cent of GDP) from the European Bank for Reconstruction and Development (EBRD) (http://www.ebrd.com/downloads/research/economics/macrodata/sei.xls).

Chinn-Ito index:
By Menzie Chinn and Hiro Ito
<http://www.ssc.wisc.edu/~mchinn/kaopen_2008.xls>. 23.4.2011.

Dependency ratio:
population ages 15-64 (% of total) from the WDI & GDF database (dependency ratio is easily calculated from this).

Fuel exports:
fuel exports (% of merchandise exports) from the WDI & GDF database.

[33] General structural budget balance was used under compulsion (difficulties in gathering the data). General structural budget balance is "adjusted for nonstructural elements beyond the economic cycle" (WEO database, October 2010).

GDP per capita:
GDP per capita (constant 2000 US$) from the WDI & GDF database.
For couple of countries *gross domestic product per capita (current prices)* and *gross domestic product, deflator* both from the WEO were used with *official rate (US dollars per national currency)* from the IFS to get comparable numbers.

GDP per capita growth:
GDP per capita growth (annual %) from the WDI & GDF database and
gross domestic product per capita (constant prices) from the WEO (by taking natural logarithm).

Net foreign assets:
By Philip Lane and Gian Maria Milesi-Ferretti
<http://www.imf.org/external/pubs/ft/wp/2006/data/update/wp0669.zip>. 23.4.2011.

Political risk index:
By the PRS Group (the free-of-charge version)
<http://info.worldbank.org/governance/wgi/pdf/PRS.xls>. 23.4.2011.

Private credit ratio:
By Thortsen Beck and Asli Demirguc-Kunt
<http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/FinStructure_2009.xls>. 23.4.2011.

Trade openness:
trade (% of GDP) from the WDI & GDF database.
For Singapore *goods exports* and *goods imports* both from the IFS with *GDP (current US$)* from the WDI & GDF database.

The decomposition of variance:

Table B Variation over time (% of total variance)

name (the role)	5-year nonoverlapping averages		annual observations	
	advanced	developing	advanced	developing
ca (dependent variable)	18%	24%	27%	43%
budget	33%	56%	48%	69%
chinn_rel (control variable)	21%	18%	26%	24%
dependency	16%	15%	17%	16%
credit_rel (proxy)	28%	7%	34%	11%
gdppercapita_rel (proxy)	1%	2%	2%	2%
growth	39%	77%	75%	88%
icrg_rel (proxy)	7%	17%	21%	26%
laggednfa	13%	11%	27%	9%
stdevgrowth	60%	58%	80%	75%
trade_rel (control variable)	3%	1%	3%	3%

Trivially, the time-series component of variance is larger at the higher frequence.

APPENDIX D – Additional regressions

Productivity shocks and the current account (testing the empirical relevance of Glick and Rogoff's model):

For this exercise the sample consisted of nine countries: Austria, Denmark, Finland, France, Germany, Italy, Japan, United Kingdom and United States and covered a 27-year period from 1981 to 2007. The data on productivity growth is the total factor productivity (TFP) growth for "total industries" from the EU KLEMS database. Global TFP growth is calculated as a GDP-weighted average of France, Germany, Italy, Japan, United Kingdom and United States. These economies were the six largest during the period and accounted for 64 percent of the world economy. The division of TFP growth components is a bit artificial for the U.S. as its share was 0.46 of the sample. Data on the current account, exchange rates, GDP deflator, investment (gross fixed capital formation), and GDP are from the International Financial Statistics. An-

nual observations are used in all regressions. For the individual country time-series regressions nominal variables were converted into real term and both components of TFP growth were multiplied by the mean of local real GDP over the period. As a result the coefficients of TFP growth have a meaningful interpretation: $0.379\Delta A^C$ for Austria means that, when country-specific TFP growth increases by 1 percent, investment increases by 0.379 percent (see table D). For the panel regressions variables were measured as ratios to real GDP.

According to Barro and Sala-i-Martin (1990) world real interest rate averaged 0.017 during the period 1959-1988. An approximation (r-1) = 0.01 is used in all regressions below. It is obvious that due to the valuation effects the current account balance is a poor approximation for the change in net foreign assets in the short run. This is why as a robustness check $0.01\Delta NFA_t$ are used instead of $0.01CA_{t-1}$ on the LHS of equation (T). The data on net foreign assets is from the updated and extended version of the External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2007).

Testing the time-series properties of productivity:

Equations (S) and (T) assumed permanent productivity shocks. Table C reports the Dickey-Fuller test for the TFP.

Table C

	test statistic	p-value
Austria	0.395	0.9813
Denmark	-2.301	0.1717
Finland	1.709	0.9982
France	-2.470	0.1229
Germany	-0.656	0.8577
Italy	-1.157	0.6919
Japan	-1.855	0.3534
United Kingdom	-1.827	0.3673
United States	0.146	0.9691
Global	-0.703	0.8460

For any of the time series we cannot reject the nonstationarity hypothesis (a unit root).

Individual country time-series regressions:

Tables D and E report the individual country time-series regressions. The Newey-West standard errors with one lag are in parentheses. Constants are not reported. The values for R-squared are of regressions with unrobust standard errors.

Table D

Dependent variable: ΔI	ΔA^C	ΔA^G	I_{t-1}	R-squared
Austria	0.379** (0.167)	0.640** (0.272)	0.029 (0.038)	0.259
Denmark	-0.040 (0.295)	0.122 (0.370)	0.037 (0.093)	0.020
Finland	0.639 (0.383)	1.058 (0.621)	0.009 (0.099)	0.230
France	0.259* (0.135)	0.642* (0.308)	0.145** (0.059)	0.276
Germany	0.981*** (0.270)	0.392 (0.308)	-0.002 (0.050)	0.462
Italy	0.137 (0.192)	0.465 (0.311)	0.078 (0.053)	0.160
Japan	0.843*** (0.142)	0.924*** (0.179)	0.021 (0.031)	0.714
United Kingdom	-0.210 (0.202)	0.034 (0.433)	-0.007 (0.071)	0.080
United States	0.332 (0.235)	0.272 (0.295)	0.013 (0.038)	0.161

Table E

Dependent variable: $\Delta CA\text{-}0.01CA_{t-1}$	ΔA^C	ΔA^G	I_{t-1}	R-squared
Austria	0.056 (0.199)	-0.391 (0.494)	0.035 (0.050)	0.094
Denmark	-0.124 (0.289)	0.459 (0.413)	-0.002 (0.094)	0.059
Finland	0.257 (0.205)	-0.276 (0.394)	-0.151*** (0.049)	0.255
France	-0.390*** (0.134)	-0.405* (0.215)	-0.134*** (0.045)	0.383
Germany	-0.719* (0.402)	0.123 (0.326)	0.036 (0.054)	0.235
Italy	0.165 (0.203)	-0.360 (0.387)	-0.063 (0.067)	0.134
Japan	-0.314*** (0.086)	-0.069 (0.134)	-0.050* (0.028)	0.272
United Kingdom	-0.052 (0.160)	-0.534* (0.297)	0.013 (0.048)	0.113
United States	-0.474** (0.196)	-0.007 (0.218)	0.0117 (0.031)	0.227

For the ΔI equations the coefficient of country-specific TFP growth is positive and statistically significant for 4 of 9 countries. For the ΔCA equations the coefficient of country-specific TFP growth is negative and statistically significant for 4 of 9 countries, 3 of which are the same as in table D. The first prediction ($0 < a_2 < a_1$) holds only for Germany (yet, the first inequality is uncertain). The second prediction ($b_1 < 0$ and $b_2 = 0$) holds for Germany, Japan and the U.S. The third prediction (($|b_1| > |a_1|$) with $b_1 < 0$ and $a_1 > 0$ holds only for France.

Results in table E are robust to using ΔNFA_t instead of CA_{t-1}.

Panel regressions:

Tables F and G report the panel regressions for the six major economies. Panel robust standard errors that account for both the autocorrelation and heteroscedasticity are in parentheses. When using the pooled OLS, country-specific dummies were in-

cluded. Following the previous studies (Glick & Rogoff (1995) and Bussiere et al. (2010)) dummies for Germany and the U.S. in 1991 were included, when using the GLS or within estimators. Neither dummies nor constants are reported.

Table F

Dependent variable: ΔI	ΔA^C	ΔA^G	I_{t-1}	R-squared
Pooled OLS	0.093 (0.114)	0.253** (0.092)	-0.157** (0.057)	0.242
GLS estimator (the RE model)	0.082 (0.121)	0.296*** (0.093)	-0.057** (0.024)	Within: 0.235 Between: 0.886
Within estimator (the FE model)	0.069 (0.139)	0.247** (0.096)	-0.154** (0.056)	Within: 0.277 Between: 0.942

Table G

Dependent variable: $\Delta CA-0.01CA_{t-1}$	ΔA^C	ΔA^G	I_{t-1}	R-squared
Pooled OLS	-0.170 (0.122)	-0.157 (0.086)	0.047 (0.030)	0.092
GLS estimator (the RE model)	-0.085 (0.086)	-0.143* (0.083)	0.029 (0.018)	Within: 0.218 Between: 0.013
Within estimator (the FE model)	-0.115 (0.096)	-0.151 (0.077)	0.035 (0.035)	Within: 0.219 Between: 0.009

From tables F and G it is apparent that, when unobserved country-specific effects are allowed, country-specific TFP growth is not statistically significant for either ΔI or ΔCA. On the other hand, all estimators declare that the coefficient of global TFP growth is positive and statistically significant for the ΔI equation. For the ΔCA equation the statistical significance of global TFP growth is uncertain. There is a striking distinction on how well our model is capable of explaining the cross-country variations of dependent variables. The model explains the cross-country differences in the current account balances poorly.

Results in table G are robust to using ΔNFA_t instead of CA_{t-1}.

REFEENCES:

Barro, R. and Sala-i-Martin, X. 1990. World real interest rates. In the O. Blanchard and S. Fischer (Eds.), *NBER Macroeconomic Annual: 1990*. MIT Press, Cambridge, MA.

DATA:

TFP (value added based) growth: EU KLEMS Growth and Productivity Accounts.

Net foreign assets: Updated and extended version of the External Wealth of Nations Mark II database developed by Lane, R. and Milesi-Ferretti, G. 2007. The External Wealth of Nations Mark II. Journal of international economics, vol. 73(November), 223-250.

All others: International Financial Statistics, May 2010.

Testing the sensitivity of the results in Section 5.2.1 to the rest of the world effect:

TABLE H Results from panel regressions using 5-year nonoverlapping averages (all countries)

dependent variable: ca	FE model / within estimator	RE model / GLS estimator	dependent variable: ca	FE model / within estimator	RE model / GLS estimator
budget	0.307*** (0.115)	0.511*** (0.125)	budget_dev	0.297** (0.120)	0.507*** (0.123)
chinn	-0.011** (0.005)	-0.012** (0.005)	chinn_rel	-0.023** (0.009)	-0.024** (0.009)
dependency	-0.864*** (0.148)	-0.200** (0.098)	dependency_rel	-0.265*** (0.066)	-0.065** (0.033)
credit_rel	-0.074*** (0.025)	-0.042** (0.018)	credit_rel	-0.080*** (0.026)	-0.041** (0.019)
gdppercapita_rel	-0.130* (0.068)	0.096*** (0.022)	gdppercapita_rel	-0.095 (0.065)	0.094*** (0.022)
growth	0.069 (0.091)	-0.021 (0.102)	growth_dev	0.007 (0.093)	-0.051 (0.101)
icrg_rel	0.098** (0.042)	-0.008 (0.031)	icrg_rel	0.089** (0.042)	-0.008 (0.031)
laggednfa	-0.002 (0.020)	0.016 (0.013)	laggednfa	0.000 (0.019)	0.017 (0.012)
stdevgrowth	0.692*** (0.139)	0.400*** (0.145)	stdevgrowth_rel	0.009*** (0.002)	0.005*** (0.002)
trade	0.058** (0.022)	-0.007 (0.012)	trade_rel	0.014 (0.009)	-0.003 (0.005)
period dummies	excluded, not signicant (p-value 0.67)	yes, p-value 0.11	period dummies	yes, p-value 0.02	yes, p-value 0.04
country group dummies	–	oil 0 us –,** adv 0 euro +,**	country group dummies	–	oil 0 us –,** adv 0 euro +,**
variables not listed	constant	constant	variables not listed	constant	constant
R-squared	within: 0.49 between: 0.03	within: 0.30 between: 0.56	R-squared	within: 0.49 between: 0.02	within: 0.30 between: 0.56
number of obs.	237	237	number of obs.	237	237

After comparing tables 10 and H it is clear that results are robust to the extent of how the rest of the world effect has taken into account. There are no differences in the significance levels of explanatory variables between the RE regressions. (Advanced country dummy and euro dummy are the only exceptions.) Between the FE regressions there are differences in control variables (Chinn-Ito index and trade openness),

but the only differences in the significance levels of actual explanatory variables are in budget balance and GDP per capita. It is not surprising that the significance level of budget balance is lower, when taking a deviation from the GDP-weighted sample mean, because budget balances are in deficit on average. However, there is not any good reason to use budget balances as deviations from the sample mean. The coefficient of GDP per capita is not as well identified as the others, because the within component of the variance is so small (see table 9).