

INSTITUTE OF ECONOMIC STUDIES

WORKING PAPER SERIES

W05:03

September 2005

Countercyclical Capital and Currency Dependence

Jón Daniélsson
and
Ásgeir Jónsson

Address: Jón Daniélsson
London School of Economics
Houghton Street
London WC2A 2AE
England UK

Email: j.danielsson@lse.ac.uk

Address: Ásgeir Jónsson
Department of Economics
University of Iceland
Oddi, at Sturlugata, 101 Reykjavik
Iceland

Email: ajonsson@hi.is

Countercyclical Capital and Currency Dependence*

Jón Daníelsson Ásgeir Jónsson
London School of Economics University of Iceland

September 2005

Abstract

The introduction of risk sensitive bank capital charges into currency dependent economies exasperates the inherent procyclicality of banking regulations and frustrates the conduct of monetary policy. By requiring capital charges resulting from foreign currency lending to be denominated in the same foreign currency, the capital charge becomes countercyclical.

*Corresponding author: Jón Daníelsson, j.danielsson@lse.ac.uk. Our papers can be downloaded from www.RiskResearch.org. We thank Harald Benink, Charles Goodhart and the participants of the Future of Banking Regulations conference at LSE for valuable comments, and acknowledge the financial support of the EPSRC grant no. GR/S83975/01.

1 Introduction

A consensus has emerged that the sole medium term macroeconomic objective of monetary policy is price stability. However, the interrelationship between monetary policy and financial stability is receiving increased attention. These twin objectives often are subject to the same forces, where policies targeting one may affect or even contradict the other, especially since the transmission mechanism of monetary policy, is not independent of the specific structure of financial markets. Under certain conditions, the interplay between market structure and capital regulation may not only block the transmission of monetary policy but even reverse it.¹

In a wide range of countries, emerging market economies and small open economies alike, a substantial proportion of domestic liabilities are currency linked. In these *currency dependent economies* (CDEs), credit and currency risk is integrated in current capital regulation, and will be even more so when Basel-II is implemented. This is not a problem for diversified large economies with negligible currency risk. However, in CDEs, domestic debtors carry a substantial amount of unhedged currency linked loans. In these economies, currency risk is already a significant part of the systemic risk facing the economy, with exchange rate movements strongly procyclical. Capital regulations are known to be procyclical, (see e.g. Borio et al., 2001), and their introduction into currency dependent economies further exasperates the procyclicality induced by the exchange rate

Our focus is on the interdependence between the transmission of monetary policy and market structure, in particular capital regulations. The problems identified in the nexus debate are particularly relevant for currency dependent economies where the same policy variable, the exchange rate, affects price setting in the goods and financial markets, but on occasions in opposite directions. This implies that capital requirements can cause conventional monetary policy to become procyclical. We suggest that these effects can be mitigated by requiring capital requirements from bank lending in foreign currency to be denominated in the same currency units. The resulting capital charges would be countercyclical while at the same time empowering monetary policy.

Regardless of the clarity of policy goals, outcomes in CDEs may be ambiguous. The central bank may want to react both to inflationary pressures and

¹The question most frequently asked in the so called “Nexus” debate is whether the twin goals of price and financial stability might be in conflict with each other, the “paradox of credibility”, (see Borio and Lowe, 2002; Borio and White, 2004; Goodfriend, 2003).

growing imbalances in the financial sector but the transmission of the policy may be distorted or delayed depending on bank' capital and capital regulations. On one hand, the exchange rate has strong pass-through effect on price determination in the goods market² while also determining the size of banks balance sheets, i.e. the principal of currency denominated loans, and thus their capital charges. An exchange rate appreciation for the purpose of price stability could perversely lead to increased financial instability by reducing the amount of regulatory capital. Thus a key challenge for CDEs is improving the effectiveness of the monetary policy channel, which must take into consideration current capital regulations, and the eventual impact of the Basel-II Accord.

At the root of the problem is currency risk mispricing. If the level of currency risk mispricing is countercyclical, i.e., currency risk is underestimated in booms and overestimated in busts, and the marginal cost of foreign currency bank lending is directly affected by currency risk, bank lending becomes procyclical. Risk sensitive capital charges will have exactly such an effect, whereby an appreciating currency leads to lower capital charges, and vice versa. Furthermore, foreign currency lending of one bank directly affects the capital charges of other banks, regardless of whether they engage in foreign currency lending and not, because of the expansion of the domestic credit markets, affecting both profitability of lending and the credit quality of the marginal loans. Ultimately, a feedback loop between exchange rate changes, capital charges, bank lending, and private wealth is established. This loop is virtuous in upturns, and vicious in downturns. The presence of these feedback loops frustrates the conduct of monetary policy because standard monetary responses are likely to further amplify the cycle. Interest rate increases in upturns appreciate the exchange rate and further stimulate foreign currency lending, while interest rate drops in downturns depreciate the exchange rate, erode bank capital and magnify the credit crunch. The latter effect is likely to be much more violent, giving rise to an "up by the stairs, down by the elevator" effect.

A sizable literature exists on issues closely related to currency dependence.³

²For an overview of how central have used exchange rate in pursuit of price stability see Amato et al. (2005)

³The concept of currency dependence encapsulates terms such as liability dollarization, (see e.g. Calvo and Reinhart, 2000, 2002; Céspedes et al., 2000), currency mismatch (see e.g. Goldstein and Turner, 2003) and original sin (see e.g. Eichengreen et al., 2003) and refers to economies whose domestic liabilities are currency linked to a large degree but assets are denominated in domestic currency. In contrast to this literature, our focus is not on the causes or the solution to the problem of currency dependence, instead, the only discuss the impact of capital regulations in such economies.

About 97% of all international bond and note issues are denominated in just five currencies, US dollar, yen, euro, sterling, and Swiss franc. This implies that when countries outside of these five currency areas tap international capital markets, they have no choice but to borrow in foreign currency.⁴ The challenges for monetary authorities in these economies in dealing with financial crisis have been well documented, especially potential for procyclical interest rate responses (see e.g. Calvo and Reinhart, 2002; Ganapolsky, 2003; Hausmann et al., 2001). This may lead to a “fear of floating” whereby the monetary authority engages in exchange rate interventions and adjustments of interest rates in order to manage the currencies so as to preserve financial stability.

Banking regulations are inherently procyclical, and the introduction of risk sensitive capital charges, as in the Basel–II Accord, will further exasperate the procyclicality, (see e.g. Daniélsson et al., 2001) because increased risk sensitivity gives banks more freedom in booms and constricts them more in downturns. Several mechanisms for reducing procyclicality have been proposed, such as statistical provisioning, (see e.g. Poveda, 2000; Jaudoin, 2001), where capital buffers are increased in upturns, and reduced in downturns. However, Carmichael and Esho (2003) find little support for using prudential regulation such as portfolio restrictions and adjustments to minimum capital ratios to control the emergence of asset price bubbles. This conclusion is based largely on the practical difficulties of implementing such policies, the potential efficiency costs of overly restrictive regulation and the futile task of supplanting the banks’ own judgement with those of the regulators.

For currency dependent economies, the exchange rate is a key risk factor. Provided the exchange rate risk is measured correctly, risk sensitive capital charges have the potential to become cyclical. However, as a practical matter, measuring currency risk is somewhat challenging because it necessitates identifying the presence and magnitudes of bubbles. Unfortunately, risk sensitive bank capital, in the form of Basel–II, does not address the issue, because given the current directions for measuring currency risk in the Basel–II Accord, currency risk is solely measured by small day–to–day moments and not the occasional big depreciation. Risk models capture the day–to–day risk of the currency as a bubble inflates, but disregard the potential for the bubble bursting. The reason for this is that currencies generally fall into the category of assets which violate the subadditivity of the value–at–risk

⁴Currency dependence is not a modern phenomena. Flandreau and Sussman (2004) show, during the earlier phase of free international capital transaction in 1890–1910 international borrowing was conducted only in a handful of “hard currencies” currencies with a large secondary liquidity.

measure mandated by the Basel-II Accord.

It is however possible to reverse the procyclicality by a relatively simple adjustment in the calculation of bank capital, whereby capital charges arising from foreign currency lending are denominated in the same foreign currency. Suppose a bank in an emerging market lends €100 to domestic clients. At the moment, the capital charge arising from this is €8 denominated in domestic currency, and under Basel-II Accord, will be risk weighted. If however the capital charge arising from lending €100 is €8, i.e. the capital charge was also in euros, it becomes countercyclical, slowing down lending in upswings and encouraging lending in downturns.

The implications of such a calculation of capital would be:

Capital charges are relatively countercyclical because the internalization of currency risk into the capital margin of banks, reduces the capital ratio and increases the capital cost of foreign currency lending in time of booming asset markets, and lessens the severity of loan contraction during crisis

Monetary policy is more effective since interest rate changes have a direct relationship with the level of banking activity, via the impact on bank capital due to exchange rate changes

A lower cost of maintaining foreign reserves since the central bank can keep lower levels of currency reserves, because it does not need to sterilize inflows due to foreign currency lending, nor maintain as high a cushion for times of crisis

2 Banking Regulations

2.1 The Integration of Currency and Credit Risk

A key component in modern banking regulation is the notion of risk weighted minimum bank capital, acting both as a cushion against a possible future default, and as an inducement for banks to model and manage risk. The financial institution uses internal information on its portfolio and risk measure of technology to determine the appropriate level of bank capital.

Under Basel-I, the formula used to calculate bank capital was not very risk sensitive, while the Basel-II Accord will encourage the use of sophisticated risk models to measure credit risk in order for bank capital to reflect the

risk of its loan portfolio. Fundamental to the Basel-II framework is the concept of internal rating based (IRB) methodologies whereby a bank internally estimates some or all of its credit risk.

Credit risk is a function of four parameters: probability of default, loss given default, exposure at default, and maturity. Banks have a choice of level of sophistication of risk measurement methodologies. Banks, under the “advanced” approach, are responsible for providing all four parameters internally, while banks choosing the “foundation” approach only provide the probability of a default parameter, with the other three parameters set externally by the supervisors. Capital charges for loans are derived from the risk characteristics of the loans, and for agents borrowing in foreign currency, currency risk is a part of the credit risk.

The Basel committee determines the Basel Accords, and the committee only represents the largest industrialized countries, none of which suffers much from currency dependence. As a consequence, the possible application of the Basel-II Accord to CDEs, and especially emerging markets, is controversial. Several studies have shown that Basel-II should not lower capital flows to currency dependence countries, but reservations have been made about the appropriateness of a complex regulatory structure designed for the largest banks in the largest industrialized countries to smaller and less developed economies.

Credit and currency risk are bundled together in the current capital regulation and will become further integrated when the Basel-II Accord is finally implemented. This does not create a problem for large economies with financial systems where currency risk is to large degree idiosyncratic and diversifiable, however, domestic agents in CDEs have a significant amount of currency linked debt and are subject to unhedged and undiversifiable currency risk. In this environment currency risk is part of the systemic or macroeconomic risk affecting the economy. Therefore, since exchange rate movements are usually procyclical in open economies, the integration of currency and credit risk is set to exacerbate the problems commonly associated with procyclicality in the financial system.

2.2 Procyclicality

Banking regulations are inherently, and probably inevitably, macro procyclical, as any prudent regulation will allow banks to expand in booms and contract lending in downturns. See Lowe and Stevens (2004) for a survey. The Basel-II proposals are well known to be even more procyclical than

Basel–I, (see e.g. Daniélsson et al., 2001) because increased risk sensitivity gives banks more freedom in booms and constricts them more in downturns. In addition, Basel–II is micro–procyclical, where during financial crises the mandatory risk constraints on financial institutions imply that they may be forced to behave in a manner which perversely amplifies the crisis. Such procyclicality is termed *endogenous risk* by Daniélsson and Shin (2003). Endogenous risk arises because of feedback loops between market participants and market prices. If prices drop, some market participants may hit their risk limits, prompting them to sell into a falling market, further exasperating the crisis, causing other market participants to sell. A vicious feedback loop is formed.

Several proposals have been made to structure capital charges to reduce procyclicality. Statistical provisioning, as discussed by Poveda (2000) and Jaudoin (2001), suggests that capital buffer should be increased in upturns, and reduced in downturns. This would serve as to reduce cyclical behavior in bank lending. Spain has implemented a statistical provisioning system, where banks make a special capital charge based on average, not current losses, so that banks pay into this charge during upswings, and draw it down during downswings. An advantage of this system is that it does not rely on the measurement of risk or statistical identification of bubbles. However, the system is, for obvious reasons, disliked by both accountants and tax authorities, and most likely would not be allowed under IAS39.

2.3 Measuring Currency Risk

The fundamental issue for the assessment of capital charges in a CDE must, therefore, be the correct estimation and pricing of currency risk, to aid in mitigating the systematic or procyclical bias in estimated credit risk.

In both the Basel–I and Basel–II⁵ Accords, currency risk is measured under the “1996 Amendment to incorporate market , risk”, with historical data and value–at–risk (VaR). The Amendment stipulates that at least one year of daily data should be used for the calculation of VaR, with many national regulators further stipulating that no more than one year of data be used. The most common method for calculating a VaR is conditionally normal volatility models, and the only feasible method when bank portfolios contain derivative products.

While the VaR measure can be quite useful for measuring risk in equity

⁵The recent proposed changes to the Amendment, relating to the “trading book” are primarily concerned with classification not basic risk measurement

portfolios, it does have a structural flaw that can limit its appropriateness for exchange rates and defaultable bonds, i.e. VaR violates subadditivity. Artzner et al. (1999) denote a risk measure, RM , as subadditive if for all assets A and B :

$$RM(A + B) \leq RM(A) + RM(B)$$

i.e., the VaR of a portfolio is always equal to or lower than the VaR of individual assets. While volatility satisfies subadditivity, VaR is only subadditive for assets meeting particular distributional assumptions, (see Daniélsson et al., 2005).

The problem of subadditivity for VaR arises because VaR is only one point on the distribution of profit and loss, and for the purpose of Basel, implies that 99 days out of 100 the asset price movement is less than VaR, and one day out of 100 it exceeds VaR. As a consequence, VaR is incapable of capturing the risk of extreme movements, with a probability of less than 1%. The lack of subadditivity for VaR means that financial institutions using VaR may get the perverse signal that a portfolio is more risky than holding individual assets, and it encourages them to disregard the risk of large infrequent changes in asset prices.

Consider a CDE where the exchange rate is steadily appreciating, while an expectation of a future depreciation is also increasing, in other words, the country is experiencing a bubble. In this case, the exchange rate volatility can be quite low, especially if measured by historical data. If the volatility does not incorporate the potential for the bubble bursting, it underestimates the currency risk. The use of VaR will not solve this problem, because the exchange rate is precisely the type of an asset which leads to subadditivity being violated.

Suppose we apply VaR to an asset with thick tails, where daily returns are relatively small, but occasionally with extreme outcomes, whereby the conditional probability of extreme outcomes is less than 1%. In this case the VaR measure is unaffected by the presence of extreme events, i.e., VaR is the same regardless of whether the probability of extreme events is 0.99% or 0%. For example, a currency that is pegged, will have VaR of zero, even if there is a 0.99% chance that the exchange rate will be hit by a successful speculative attack tomorrow.

Many exchange-rate series exhibit this property. Most of the time the exchange moves along with relatively small changes, perhaps pegged, or free floating. Then a crisis occurs, the currency regime fails with a structural change in the stochastic process of exchange rates. Subsequently the exchange rate returns to a more stable process. Provided the ex-ante proba-

bility of the crisis is less than 1%, regulatory VaR engines are unaffected by the presence of the devaluation risk, and a financial institution with such a VaR engine will not internalize the devaluation risk.

Consider the daily Mexican Peso/US Dollar exchange rate around the Mexican crisis of 1994 (see Figure 1) and the Venezuelan Bolivar/US Dollar exchange rate from 1995, (see Figure 2). In both cases it is clear that VaR does not internalize the probability of the extreme exchange rate movements. In the case of Mexico this is a one-off event, where the cluster of extreme movements starts suddenly, and dies out slowly. Not only is the onset of the crisis unpredictable if modelled solely with historical data, the exchange rate risk during and after the crisis is also impossible to predict with historical data. In the case of Venezuela the pattern of exchange of movements is much different, with several large one-off movements in the exchange rate, but the impact of accuracy of VaR is much the same as in the case of Mexico. Similar patterns in data exist in many other emerging markets and small open economies.

It is doubtful whether risk models can be modified to accurately measure exchange rate risk in the presence of a potential future depreciation. Not only is it impossible to distinguish in real time between bubbles and a strong economy, but also the precise timing of the bubble bursting is impossible to identify. The 1996 Amendment requires banks to use stress testing to gauge the sensitivity of the bank to factors such as extreme exchange rate movements. Stress testing is, however, not a solution to this problem, since the problem of estimating depreciation probabilities remains.

This means that for banks using the IRB approach, most direct foreign exchange risk exposures will not enter into their risk management systems. Because currency risk is underestimated, it is not correctly reflected in banks' capital ratios. Hence, banks have incentives to act as if they are hedged against currency risk, because that is the message from the supervisors.

2.4 Monetary Policy in the Presence of Capital Requirements

The presence of minimum capital regulations has a direct impact on the monetary transmission mechanism. For example, suppose in a downturn the monetary authorities desire to expand the money supply. However, a bank may not be able to expand lending, without raising equity, in order to comply with capital adequacy requirements. It may be difficult or impossible to raise capital during downturns, and as a consequence the capital adequacy

constraints may become increasingly binding, see. e.g. work on the “credit crunch” by Bernanke and Lown (1991).

Monetary policies are further constrained during crises for economies using a Basel-II style regulatory system. When bank capital falls, the capital ratio gets closer and closer to the minimum 8%. During a crisis, this might cause banks to contract lending to a greater extent than they would do in the absence of Basel-II regulations and the social optimum. In this case, expansionary monetary policy is ineffective, leading to a *virtual liquidity trap*. The credit channel of monetary policy is blocked and attempts by the Central Bank to stimulate bank lending by lowering the short rate and inject cash into the economy are fruitless. Authorities are forced to respond to negative shocks with a monetary contraction and higher interest rates to shore up the exchange rate against a massive outflow of foreign currency. They even have to inject new bank capital into the system or take over failed banks in order to prevent a collapse of the financial system.

Even if banks are not close to breaching the 8% minimum capital constraint, there is always a small chance that the constraint could be breached. Van den Heuvel (2001), in a model calibrated with U.S. data, argues that a low capital bank may optimally forgo profitable lending opportunities in order to lower the risk of future capital inadequacy. Aikman and Vlieghe (2004) show that shocks to the economy are amplified and also more persistent in the presence of capital market frictions; especially when the shock is directly to banks’ net worth. Moreover, since no interbank market exists for bank capital, it is not only the aggregate level but the distribution of equity among banks that matter for the operation of monetary policy on the wider economy, (see Basle Committee on Banking Supervision, 1999).

It is, therefore, clear that the conduct of capital regulation can have a substantial effect on the stability of the transmission of monetary policy, and that the level of risk sensitive regulatory capital determines the response of individual banks to policy innovations. Capital regulations are a part of the monetary policy transmission mechanism. This in turn creates a direct connection between the procyclicality of the Basel-II Accord, and the conduct of monetary policy.

3 The Procyclical effects of Currency Dependency

3.1 The Static impact on Banks and Borrowers

In most CDEs domestic financial institutions assume the role of channeling funds from international capital markets and domestic foreign currency savers to domestic borrowers. The inflow of foreign credit expands the total amount of funds available for lending, relaxing constraints on the supply of credit, and leading to higher credit risk on marginal loans. To the extent that foreign capital is used to buy domestic assets, it leads to asset price increases. Such forces are especially prevalent when foreign capital is used to finance real estate purchases.

As a consequence, the balance sheets of banks and their clients expand fast, implying that financial factors have an increased role in the current income of firms, households, and the economy in general. Foreign capital acts as a “financial accelerator”, (see Bernanke et al., 1996) where increases in collateral values make credit easier to obtain in an expansion and the greater availability of credit adds to expansionary forces. In a recession, the process works in reverse, exchange rate depreciations may cause credit crunches. A key catalyst for these effects in CDEs is mispricing of currency risk.

Agents who borrow in foreign currency are exposed to unhedged currency risk, and typically are not willing or able to hedge this risk. As a consequence, exchange rate movements have a direct impact on the net wealth of domestic agents, because the value of domestic assets in the non-tradable sector is at best unrelated and at worst negatively correlated to currency movements. All domestic agents are impacted, not only those who borrow in foreign currency, because exchange rate movements affect lending conditions and the value of domestic assets.

Banks may attempt to hedge currency risk by matching foreign assets and liabilities on balance sheets, either because of basic precautionary motives or regulatory requirements. However, such hedging may be illusionary since, usually, all of the banks’ capital is denominated in domestic currency. This means that the relative value of foreign currency assets and liabilities, especially in the credit risk of the clients loans, fluctuate with the exchange rate. We may term such hedging as first order currency hedging.

For financial institutions in CDEs that have to maintain risk sensitive minimum capital, additional forces emerge. For the banks, a major direct cost of foreign currency lending is the corresponding increase in capital charges.

These capital charges are, however, dependent on the exchange rate.

- The size of the foreign component of the balance sheet is directly determined by the value of the currency
- The estimated credit risk of foreign liabilities is closely related to the debt principal, which is determined by the exchange rate, i.e. the exchange rate directly determines the cost of foreign currency lending for the banks and the cost of servicing for the clients.

If exchange rate risk is underestimated in credit risk assessments, loans are mispriced, and credit risk becomes too low in the calculation of the banks capital ratio. If a sudden depreciation in the exchange rate triggers bankruptcies, borrowers credit risk should reflect the exchange rate risk. Banks can purchase further insurance in futures or options markets, but that may simply shift the exchange rate risk to other domestic agents. Therefore, in a currency dependent economy, exchange rate fluctuations affect both the net asset position of domestic agents, and also banks which are first order currency risk hedged.

3.2 Dynamic Impact,

It is well known that that the financial system amplifies the real business cycle due to the failure of current risk measures to account for changes in risk through time, and poor incentive mechanisms that lead to suboptimal responses to changes in risk.⁶ The time dimension of systematic risk is generally ignored in bank internal loan ratings which leads banks to underestimate the true level of expected losses during an upswing in the economy, and then vice versa during downswing.

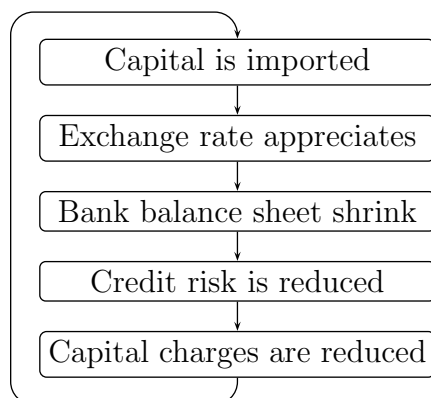
For currency dependent economies, exchange rate movements amplify the procyclicality inherent in banking regulations because the mispricing of currency risk, inherent in the current capital regulation, (see Section 2.3) gives banks incentives not to lend at optimal levels. The marginal cost of making currency linked loans is too low during upturns in the economy when the monetary policy response is contractionary and the real exchange rate is high, while the cost of making currency linked loans, and the cost of the existing stock of currency linked loans, is too high in downturns when monetary policy is expansionary and the real exchange rate is low.

⁶See e.g Borio et al. (2001), Berger and Udell (2003), Altman et al. (2002).

In a dynamic context, currency dependence can have a deeper and much more pronounced effect on the economies affected because if currency risk is mispriced, credit is mispriced. In CDEs there is a direct link between the mispricing of credit and mispricing of exchange rate risk. If exchange rate risk is mispriced, it gives rise to an externality whereby the foreign currency lending of one bank improves the capital charges of all other banks, including banks that do not engage in foreign currency lending. The reason is that the resulting exchange rate appreciation stimulates the economy and reduces the measured credit risk of most loans, including those denominated in domestic currency. This in turn gives banks incentives to lend excessively in booms, and contract lending too much in busts.

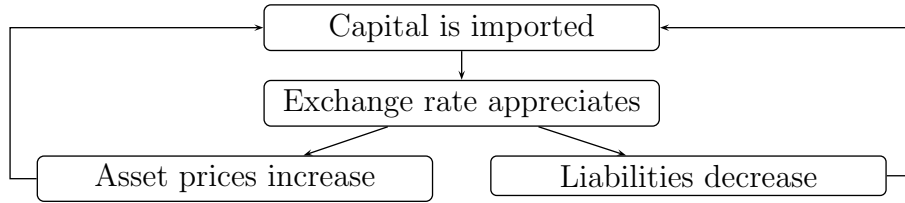
Two distinct wealth effects arise from currency dependence, giving rise to feedback loops;

The bank wealth effect Exchange rate appreciations reduce the value of foreign assets and liabilities on the bank's balance sheet and boost its equity ratio since it is denominated in domestic currency. Thus, the capital charges arising from foreign currency lending decrease, which will directly reduce the cost of funding for the banks.



The client wealth effect Exchange rate appreciations benefit those carrying unhedged currency risk, in particular the bank's clients, whose booked value of foreign debt will be reduced. Thus their collateral rises, improving their risk rating, and increasing demand for new loans.

For agents borrowing in foreign currency, exchange rate appreciations lower the amount of liabilities and inflate the value of assets, further fueling the demand for foreign credit.



These effects are further described in Example 1.

Example 1 Consider a CDE, where the exchange rate is 10, i.e., it takes 10 pesos to buy one USD. Suppose a bank in that country borrows \$1000 abroad and relends it to a domestic client. Assuming negligible credit risk, the risk weighted capital charge is 80 pesos. Consider both the impact of the exchange rate appreciating to 8, as we ride up the bubble, or collapsing to 15 as the bubble bursts.

	Loan Amount		Exchange rate	Capital	
	USD	Peso		required	actual
	1000	10000	10	800 peso	800 peso
<i>Exchange rate appreciates</i>	1000	8000	8	640 peso	800 peso
<i>Exchange rate depreciates</i>	1000	15000	15	1200 peso	800 peso

When the exchanges appreciates the local currency value of the loan drops, and the bank is left with excessive capital of 160, which can be used to further expand lending, the financial accelerator effect. However, if the exchange rate drops to 15, the bank has capital shortfall of 400 pesos.

The client and the bank wealth effects are mutually reinforcing, increasing demand for domestic assets, including domestic currency, leading to a further currency appreciation. As the net asset position is increased, and the economy heats up, an increasing number of informed agents build up an expectation of a currency depreciation. Nobody wants to be the last to hedge, and a large number of agents may attempt to reverse their positions simultaneously. As a result, the exchange rate may fall drastically as domestic agents try to hedge their currency risk by acquiring foreign assets and/or selling domestic assets.

Rapid exchange rate depreciation causes the value of debts and assets to move in opposite directions, leading to wealth destruction and credit crunch.⁷ The pattern of the bubble corresponds to the “up by the stairs, down by the elevator” effect. The currency appreciation and wealth creation is usually gradual, and the depreciation and wealth destruction fast and violent. A theoretical explanation for such a chain of events is provided by the global games model of Morris and Shin (1998).

As a consequence, currency dependence amplifies business cycles and is therefore procyclical. This procyclicality is present regardless of whether the economy as a whole is exchange rate hedged, or not. It does not matter whether banks raise foreign denominated funds in international capital markets, foreign currency deposits of domestic retail clients, or simply make currency indexed loans.

The presence of risk sensitive capital requirements will amplify this procyclicality unless currency risk is properly measured. It is likely that currency risk is underestimated during the boom and overestimated during the bust. Since capital buffers reflect credit risk, and hence currency risk, banks will hold too little capital prior to the crash and too much capital after the crash. This serves as to further amplify the procyclicality inherent in risk sensitive banking regulations such as Basel–II Accord.

3.3 The Dual Nature of the Exchange Rate for Monetary Policy

Monetary policy in CDEs is especially challenging because of the importance of the exchange rate. For example, the textbook response of raising interest rates to slow down an overheating economy, will also appreciate the currency. Most CDEs are relatively open to foreign trade and the monetary authority must, to a large degree, rely on the exchange rate to counteract inflationary pressures both with regard to profit in the export sector and pass-through. At the same time, the exchange rate determines the cost of lending in terms of capital charge in the financial sector, as discussed in Section 3.1.

One of the main implication of currency dependence on monetary policy transmission is that domestic interest rate increases may not lead to overall higher financial costs, because of the widespread use of foreign currency loans. Thus, the conventional channel of monetary policy, becomes gradually weaker as the level of currency dependence increases, for reasons discussed

⁷This is similar to the twin crisis scenarios discussed by Kaminsky and Reinhart (1999) where a collapse in the exchange rate leads a banking crisis

in Section 3.2. As a consequence, while interest rate increases and the resulting exchange rate appreciation will raise the cost of loans denominated in domestic currency, and reduce the competitiveness of the export sector, it will also increase private wealth and stimulate foreign currency lending. This implies that the interest rate channel of monetary policy is rather weak, since interest rate changes simultaneously discourage and encourage borrowing, and does little to constrain banks experiencing rapid improvements of their equity position and lower capital charges. Similarly, an expansionary policy in times of crisis is likely to backfire with a further depreciation of the exchange rate and wealth destruction. A key factor in this is the precise form of banking regulations and the incentive provided to the banking sector.

The duality of the exchange rate with the respect to monetary policy and financial regulation is the cause of a conflict between price and financial stability. An inflation targeting central bank can be successful in the short-term, while at the same time its contractionary policy interventions not only pass-by but actively encourage growing imbalances in the financial sector.⁸

In fact, as argued by Borio and White (2004), episodes of financial instability with serious macroeconomic costs have been more frequent in recent times of price stability, than when inflation was more prevalent, both in developed and emerging markets. This suggests that financial and price stability objectives may be in conflict with each other, the so-called “paradox of credibility”.⁹

The problem of the joint maintenance of price and financial stability may be especially challenging in CDEs since the effects of the exchange rate on the financial sector may be so strong as to crowd out the conventional effects of monetary policy on the real economy.¹⁰

Examples of this can be obtained by theoretical and empirical studies of financial crisis, where currency crisis precedes banking crisis.¹¹ In some cases, monetary policy response were procyclical since authorities were forced to respond to negative shocks with a monetary contraction and higher interest rates to shore up the exchange rate against massive outflows of foreign currency. This was the case in the Asian crisis, where a sudden reversal of

⁸For discussion of this specific issue as well as on question on managed floating for inflation targeting see Caputo and Tokman (2004) for Chile and Minella et al. (2003) for Brazil

⁹see Borio and Lowe (2002), Borio and White (2004) and Goodfriend (2003).

¹⁰An example is “fear of floating” whereby a emerging market economy engages in exchange rate interventions and adjustments of the interest rates in order to manage the currencies such as to preserve financial stability, (Calvo and Reinhart, 2000; Hausmann et al., 2001)

¹¹See the “twin crisis” discussion in (see Kaminsky and Reinhart, 1999).

capital flows and an exchange rate shock affected the balance sheets of all other sectors of the economy holding foreign currency denominated debts. In other cases, such as Russia, Turkey, and Argentina, the financial weakness of the sovereign triggered financial distress in domestic banks which held large amounts of government short-term obligations on their balance sheets. In all cases, a depreciation of the exchange rate weakened the asset side leading to a meltdown in the financial sector.¹²

The alternative, which is for the central bank to buy foreign currency, is also likely to be ineffective unless they are accompanied by interest rate increases or if domestic and foreign assets are imperfect substitutes and the central bank has sizeable foreign reserves to spend on the endeavor.¹³ The central bank may of course, at some cost, prefer to build up foreign reserves to hedge against a sudden outflow, although such policy can only have a short-term effect. In addition, political and moral hazard considerations are likely to make central banks reluctant to intervene in financial markets. Non-sterilized purchases are equivalent to monetary loosening and thus are procyclical.

4 Policy Options

4.1 What is the Objective?

The exchange rate in currency dependent economies constitutes a link between monetary policy and capital regulations aimed at financial stability, whereby one policy objective may be in conflict with the other. This begs the question, what options do the monetary policy authorities have?

The case for an integrated financial stability and monetary policy is controversial, especially for large developed economies. For example, as argued by Gruen et al. (2003) the identification of asset price bubbles and the timing of policy responses is likely to be challenging, while Bean (2003) maintains that it would be difficult to determine the size of the optimal monetary policy response to bubbles. In addition, political and moral hazard considerations are likely to make central banks reluctant to intervene in financial markets. These issues are controversial and several authors including Borio and Lowe

¹²For an overview of these episodes and the specific role of the “balance sheet effect” or “currency mismatch”, see e.g. Goldstein and Turner (2004), Allen and Saunders (2003) conclude that “almost all recent crisis episodes were marked by currency mismatch exposures”

¹³For discussion of this specific issue see Borio (1997) or Albenoja (2003)

(2002), Bordo and Jeanne (2002), Dupor (2002) and Cecchetti et al. (2000), have argued that central banks should ‘lean against the wind’ by raising interest rates in the face of emergent asset booms.

The main policy problem for monetary policy in CDEs is that regardless of the clarity of policy objectives, outcomes may be ambiguous. The central bank may want to react both to inflationary pressure and growing imbalance in the financial sector but the transmission of the policy is distorted or delayed depending on bank capital and capital regulations. Thus the key challenge for CDEs is improving the effectiveness of the monetary policy channel, which must take into consideration current capital regulations, and the Basel–II Accord.

A key tool for maintaining financial stability is capital requirements, especially if capital charges are risk weighted, as will be required by Basel–II. While the general objective is clear, such capital charges are procyclical, and hence there is less agreement about specific implementations.

The problem of procyclicality is likely to be worse for CDEs than for larger currency areas because of the externalities induced by foreign currency lending. Because the exchange rate risk mispricing is countercyclical, bank capital is too low in upturns, and too high during crisis. While those problems could be minimized if it was possible to measure currency risk accurately, at the moment risk management technology is not sufficiently advanced to be able to deliver a reasonable answer, because it would require a reliable statistical model of bubbles, see Section 2.3.

4.2 Capital Charges can be Countercyclical

Several proposals have been made to mitigate some of the effects of currency dependence.¹⁴ However, in a world of free financial flows, it is hard to see how currency dependence could be mitigated by artificially imposed restrictions on the behavior of markets. Currency dependence is the result of the optimization of private agents and is the optimal response to the conditions concerning secondary liquidity, risk aversion etc. in international financial markets. The key issue is how to internalize the effects of currency dependence in the lending behavior of banks, without unduly affecting markets, in

¹⁴For example, (see e.g. Krueger, 2000) either making foreign currency debt unenforceable in the courts of the respective countries or constraining lending in foreign currency to developing economies. Eichengreen et al. (2003) have argued for an emerging market index to be created composed of an inflation indexed basket of about 20 currencies of the largest developing currencies to which foreign should be linked.

particular, how capital regulations can be employed to reverse the procyclicality induced by currency dependence.

A key factor in this procyclicality is a requirement that banks denominate their capital in domestic currency, leading them to under-appreciate exchange rate risk in the calculation of their capital in normal times, and overestimate it during crisis.

This procyclicality could be made countercyclical if capital charges arising from foreign currency lending were denominated in the same foreign currency. If a bank in a currency dependent economy lends \$1000 in USD domestically, the risk weighted capital from such lending should be USD \$80. Consider Example 1 with such a calculation of capital.

Example 2 *Suppose that the bank in Example 1 had to denominate capital in the same currency, then*

	Loan Amount		Exchange rate	Capital	
	USD	Peso		required	actual
	1000	10000	10	\$ 80	\$ 80
<i>Exchange rate appreciates</i>	1000	8000	8	\$ 80	\$ 80
<i>Exchange rate depreciates</i>	1000	15000	15	\$ 80	\$ 80

In this case, required capital is not affected by the exchange rate, so the bank's behavior will not be procyclical.

The implications of such a calculation of capital would be:

Capital charges are relatively countercyclical because the internalization of currency risk into the capital margin of banks, reduces the capital ratio and increases the capital cost of foreign currency lending in times of booming asset markets, and lessens the severity of loan contraction during crisis

Monetary policy is more effective since interest rate changes have a direct relationship with the level of banking activity, via the impact on bank capital due to exchange rate changes

A lower cost of maintaining foreign reserves since the central bank can keep lower levels of currency reserves, because it does not need to sterilize inflows due to foreign currency lending, nor maintain as high a cushion for times of crisis

This simple alteration of the capital accords, will also decrease the risk of a currency depreciation draining the equity position of the banking system during turmoil in the financial system, which is a key risk factor arising from the interplay between currency dependence and minimum capital regulations. This in turn reduces the need for the demand for government sponsored bailouts of the banking system during crisis, as in the Scandinavian and Asian crisis of the 1990s. The real impact of financial crisis would be reduced, as well as the cost of maintaining financial stability.

Such capital charges may be resisted by banks, since they directly affect their profitability. However, banks generally maintain significant capital in excess of regulatory demands, and our proposed way of calculating capital would reduce both idiosyncratic and systemic risk, and thus reduce the need to carry excess capital.

5 Conclusion

Procyclicality may be the price we have to pay for prudent banking regulations, provided the procyclical effects are not too strong. In currency dependent economies, the externalities induced by the exchange amplifies the procyclical effects of capital adequacy regulations. However, a relatively simple alteration of the Basel-II Accord partly reverses the procyclicality. By requiring bank capital arising from foreign currency lending to be denominated in the same foreign currency, the magnitudes of excessive bank lending in booms, and credit crunches in crises are lowered.

Figure 1: Daily Mexican Peso — US Dollar Exchange Rate Returns

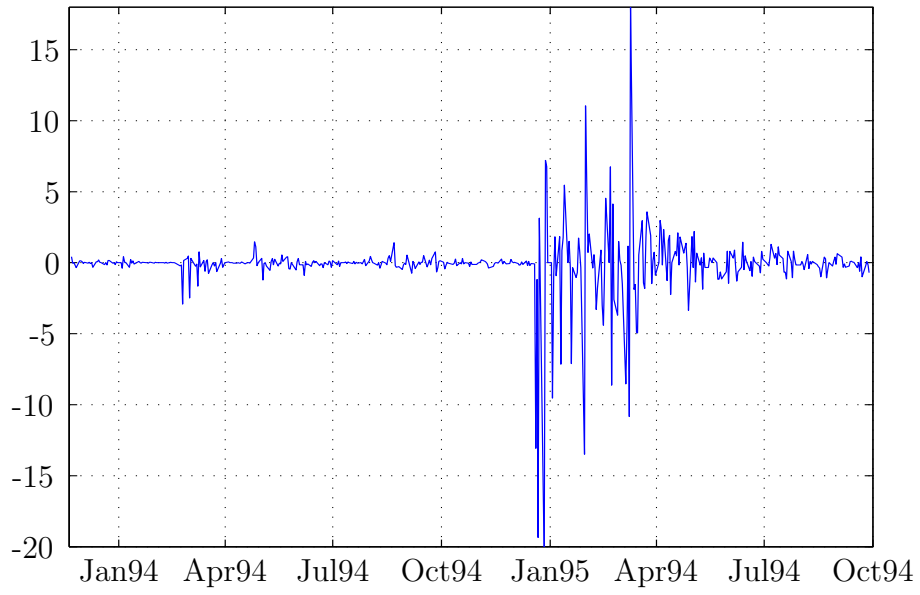
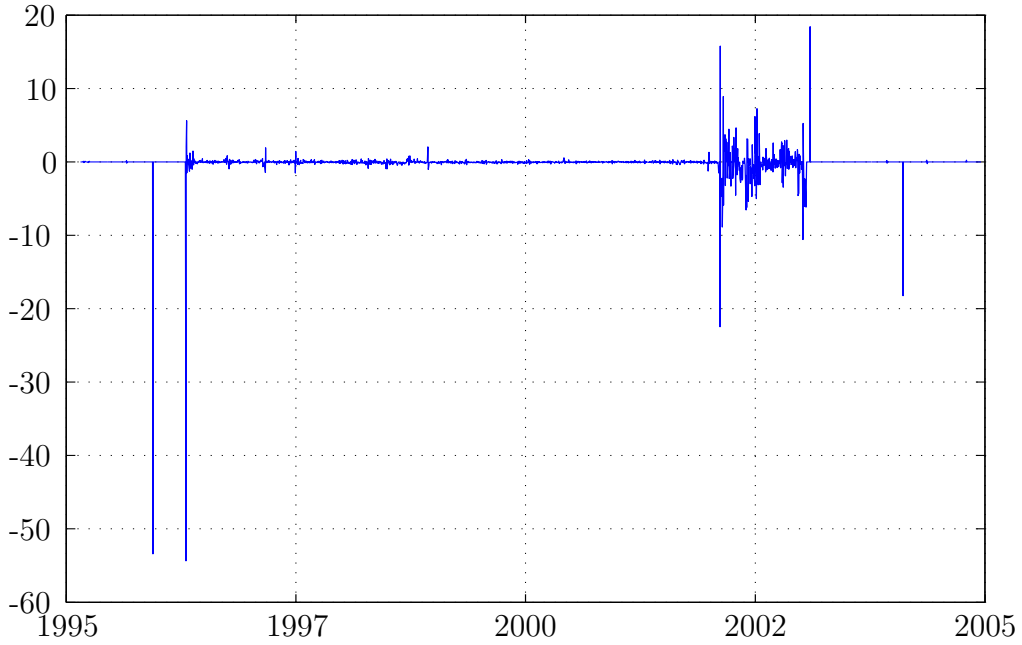


Figure 2: Daily Venezuela Bolivar — US Dollar Exchange Rate Returns



References

- Aikman, D. and Vlieghe, J. (2004). How much does bank capital matter? Bank of England Quarterly Bulletin, Spring.
- Albenoja, Z. (2003). Foreign exchange market intervention: A short review of transmission channels and practices. *Bangko Sentral Review*, July, vol V, no 2, pp 1-25.
- Allen, L. and Saunders, A. (2003). A survey of cyclical effects in credit risk measurement models. BIS Working Papers, no 126, January.
- Altman, E. I., Resti, A., and Sironi, A. (2002). The link between default and recovery rates: effects on the procyclicality of regulatory capital ratios. BIS Working Papers, no 113, July.
- Amato, J., Filardo, A., Galati, G., von Peter, G., and Zhu, F. (2005). Research on exchange rates and monetary policy: an overview. BIS Working Papers No 178.
- Artzner, P., Delbaen, F., Eber, J., and Heath, D. (1999). Coherent measure of risk. *Mathematical Finance*, 9 (3):203–228.
- Basel Committee (1996). *Amendment to the Capital Accord to Incorporate Market Risks*. Basel Committee on Banking Supervision.
- Basle Committee on Banking Supervision (1999). Capital requirements and bank behaviour: the impact of the Basel Accord. Working Paper no. 1, April.
- Bean, C. (2003). Asset prices, financial imbalances and monetary policy: are inflation targets enough? In Richards, T. and Robinson, T., editors, *In Asset prices and monetary policy*, Sydney. Reserve Bank of Australia Conference.
- Berger, A. and Udell, G. F. (2003). The institutional memory hypothesis and the procyclicality of bank lending behaviour. BIS Working Papers, no 125, January.
- Bernanke, B., Gertler, M., and Gilchrist, S. (1996). The financial accelerator and the flight to quality. *Review of Economics and Statistics*, 78 (1):1–15.
- Bernanke, B. S. and Lown, C. S. (1991). The credit crunch. Technical Report 1991:2, Brookings Papers On Economic Activity.

- Bordo, M. and Jeanne, O. (2002). Monetary policy and asset prices: does “benign neglect” make sense? Working Paper 02/225, IMF.
- Borio, C. (1997). Credit characteristics and the monetary policy transmission mechanism in fourteen industrial countries. In Alders, editor, *Monetary Policy in a Converging Europe*. Kluwer, Amsterdam.
- Borio, C., Furfine, C., and Lowe, P. (2001). Procyclicality of the financial system and financial stability: issues and policy options. Working Paper 1, BIS.
- Borio, C. and Lowe, P. (2002). Asset prices, financial stability and monetary stability: exploring the nexus. Working Paper 114, BIS.
- Borio, C. and White, W. (2004). Whither monetary and financial stability? the evolving nature of policy regimes. BIS Working Paper no 147.
- Calvo, G. and Reinhart, C. M. (2000). When capital inflows come to a sudden stop: Consequences and policy options. In Kenen, P. and Swoboda, A., editors, *Reforming the International Monetary and Financial System*, pages 175–201. International Monetary Fund, Washington DC.
- Calvo, G. and Reinhart, C. M. (2002). Fear of floating. *Quarterly Journal of Economics*, 117, 2:379–408.
- Caputo, R. and Tokman, A. (2004). Exchange rates and monetary policy: Some relevant issues discussed at the Central Bank of Chile. Paper presented at BIS Autumn Economists’ Meeting, 28-29 October, Basel.
- Carmichael, J. and Esho, N. (2003). Asset price bubbles and prudential regulation. Australian Prudential Regulation Authority, working paper 2003-03.
- Cecchetti, S., Genberg, H., Lipsky, J., and Wadhvani, S. (2000). Asset prices and central bank policy. Geneva Reports on the World Economy no 2: International Centre for Monetary and Banking Studies.
- Céspedes, L., Chang, R., and Velasco, A. (2000). Balance sheet effects and exchange rate policy. Technical Report Working Paper 7840, NBER, Cambridge, Mass.
- Daniélsson, J., Embrechts, P., Goodhart, C., Keating, C., Muennich, F., Renault, O., and Shin, H. S. (2001). An academic response to Basel

II. The New Basel Capital Accord: Comments received on the Second Consultative Package <http://www.bis.org/bcbs/cacomments.htm> or www.RiskResearch.org.

Daniélsson, J., Jorgensen, B. N., Sarma, M., and de Vries, C. G. (2005). Sub-additivity re-examined: the case for Value-at-Risk. unfinished working paper.

Daniélsson, J. and Shin, H. S. (2003). Endogenous risk. In *Modern Risk Management — A History*. Risk Books.

Dupor, W. (2002). Nominal price versus asset price stabilization. mimeo, Wharton School, University of Pennsylvania.

Eichengreen, B., Hausmann, R., and Panizza, U. (2003). Currency mismatches, debt intolerance and original sin: why they are not the same and why it matters. Technical report, NBER Working Papers, no 10036,.

Flandreau, M. and Sussman, N. (2004). Old sins: Exchange rate clauses and european foreign lending in the 19th century. Technical Report Discussion Papers 4248, CEPR.

Ganapolsky, E. (2003). Optimal fear of floating: The role of currency mismatches and fiscal constraints. Federal Reserve Bank of Atlanta Working Paper 2003-31.

Goldstein, M. and Turner, P. (2003). Controlling currency mismatches in emerging economies. Technical report, Institute of International Economics. draft.

Goldstein, M. and Turner, P. (2004). *Controlling Currency Mismatches in Emerging Markets*. IIE.

Goodfriend, M. (2003). Interest rate policy should not react directly to asset prices. In Hunter, W., Kaufman, G., and Pomerleano, M., editors, *Asset Price Bubbles: The Implications for Monetary, Regulatory, and International Policies*, chapter 31, pages 445–58. MIT Press.

Gruen, D., Plumb, M., and Stone, A. (2003). How should monetary policy respond to asset-price bubbles? In Richards, T. and Robinson, T., editors, *In Asset prices and monetary policy*, Sydney. Reserve Bank of Australia Conference.

Hausmann, R., Panizza, U., and Stein, E. (2001). Why do countries float the way they float? *Journal of Development Economics*, 66 (2):387–414.

- Jaudoin, O. (2001). Dynamic provisioning. Banque de France Bulletin, No. 95.
- Kaminsky, G. L. and Reinhart, C. M. (1999). The twin crises: The causes of banking and balance-of-payments problems. *American Economic Review*, 89:473–500.
- Krueger, A. (2000). Conflicting demands on the international monetary fund. *American Economic Review*, 90,2:38–42.
- Lowe, P. and Stevens, G. (2004). Procyclical financial behavior: What can be done? Mimeo, Reserve Bank of Australia.
- Minella, A., de Freitas, P., Goldfajn, I., and Muinhos, M. (2003). Inflation targeting in Brazil: constructing credibility under exchange rate volatility. Central Bank of Brazil Working Paper no 77, July.
- Morris, S. and Shin, H. S. (1998). Unique equilibrium in a model of self–fulling currency attacks. *American Economic Review*, 88:587 – 597.
- Poveda, R. (2000). Reform of the system of insolvency provisions. mimeo, Bank of Spain.
- Van den Heuvel, S. J. (2001). The bank capital channel of monetary policy. mimeo, University of Pennsylvania, finance.wharton.upenn.edu/~vdheuvel,.

INSTITUTE OF ECONOMIC STUDIES WORKING PAPERS 1987-2005

Formerly Iceland Economic Papers Series

Editor Tryggvi Thor Herbertsson

A complete list of IoES Working Papers and Reprints can be accessed on our World Wide Web site at <http://www.ioes.hi.is>

- W05:03 Jón Daníelsson and Ásgeir Jónsson: Countercyclical Capital and Currency Dependence
- W05:02 Alison L. Booth and Gylfi Zoega: Worker Heterogeneity, Intra-firm Externalities and Wage Compression
- W05:01 Tryggvi Thor Herbertsson and Martin Paldam: Does development aid help poor countries catch up?
- W04:12 Tryggvi Thor Herbertsson: Personal Pensions and Markets
- W04:11 Fridrik M. Baldursson and Sigurdur Johannesson: Countervailing Power in the Icelandic Cement Industry
- W04:10 Fridrik M. Baldursson: Property by ultimatum: The case of the Reykjavik Savings Bank
- W04:09 Ingólfur Arnarson: Analyzing Behavior of Agents of Economic Processes in Time
- W04:08 Otto Biering Ottosson and Thorolfur Matthiasson: Subsidizing the Icelandic Fisheries
- W04:07 Niels Vestergaard and Ragnar Arnason: On the Relationship between Greenland's Gross Domestic Product and her Fish Exports: Empirical Estimates
- W04:06 Ingolfur Arnarson: Modelling Fishery Management Schemes with an Olympic System Application
- W04:05 Ingolfur Arnarson and Pall Jensson: Adding the Sales Markets Dimension to Bio-Economic Models. The Case of Fishery Management
- W04:04 Edmund S. Phelps: Changing Prospects, Speculative Swings: Structuralist Links through Real Asset Prices and Exchange Rates
- W04:03 Ingolfur Arnarson: Analysing Behavior of Agents of Economic Processes in Time
- W04:02 Ron Smith and Gylfi Zoega: Global Shocks and Unemployment Adjustment
- W04:01 Fridrik M. Baldursson and Nils-Henrik M von der Fehr: Prices vs. quantities: public finance and the choice of regulatory instruments
- W03:06 Thorolfur Matthiasson: Paying paper by paper, the wage system of Icelandic University teachers explained
- W03:05 Gur Ofur and Ilana Grau: Bringing the Government hospitals into line: The next step of reform in the healthcare sector
- W03:04 Ingolfur Arnarson and Pall Jensson: The Impact of the Cost of the Time Resource on the Efficiency of Economic Processes
- W03:03 Torben M. Andersen and Tryggvi Thor Herbertsson: Measuring Globalization
- W03:02 Tryggvi Thor Herbertsson and J. Michael Orszag: The Early Retirement Burden: Assessing the Costs of the Continued Prevalence of Early Retirement in OECD Countries

- W03:01 Eirik S. Amundsen, Fridrik M. Baldursson and Jørgen Birk Mortensen: Price Volatility and Banking in Green Certificate Markets
- W02:10 Tryggvi Thor Herbertsson and Gylfi Zoega: A Microstate with Scale Economies: The Case of Iceland
- W02:09 Alison, L. Booth and Gylfi Zoega: Is Wage Compression a Necessary Condition for Firm-Financed General Training
- W02:08 Asgeir Jonsson: Exchange rate interventions in centralized labor markets
- W02:07 Alison, L. Booth, Marco Francesconi and Gylfi Zoega: Oligopsony, Institutions and the Efficiency of General Training
- W02:06 Alison L. Booth and Gylfi Zoega: If you're so smart, why aren't you rich? Wage inequality with heterogeneous workers
- W02:05 Gudmundur Magnusson and Saso Andonov: Basel Capital Adequacy Ratio and the Icelandic Banking Sector: Quantitative Impact, Structural Changes and Optimality Considerations
- W02:04 Tor Einarsson: Small Open Economy Model with Domestic Resource Shocks: Monetary Union vs. Floating Exchange Rate
- W02:03 Thorvaldur Gylfason: The Real Exchange Rate Always Floats
- W02:02 Fridrik M. Baldursson and Nils-Henrik M von der Fehr: Prices vs. Quantities: The Case of Risk Averse Agents
- W02:01 Tor Einarsson and Milton H. Marquis: Banks, Bonds, and the Liquidity Effect
- W01:11 Tor Einarsson: Small Open Economy Model with Domestic Resource Shocks: Monetary Union vs. Floating Exchange Rate
- W01:10 Tryggvi Thor Herbertsson: Shrinking Labour Forces and Early Retirement
- W01:09 Tryggvi Thor Herbertsson, Edmund Phelps, and Gylfi Zoega: Demographics and Unemployment
- W01:08 Tor Einarsson and Milton H. Marquis: Bank Intermediation and Persistent Liquidity Effects in the Presence of a Frictionless Bond Market
- W01:07 Tor Einarsson and Milton H. Marquis: Bank Intermediation over the Business Cycle
- W01:06 Thorvaldur Gylfason: Lessons from the Dutch Disease: Causes, Treatment and Cures
- W01:05 Tryggvi Thor Herbertsson and Gylfi Zoega: The Modigliani "Puzzle"
- W01:04 Gylfi Zoega and Yu-Fu Chen: Exchange Rate Volatility as Employment Protection
- W01:03 Asta Herdis Hall and Solveig Frida Johannsdóttir: Generational Equality in Iceland
- W01:02 Tryggvi Thor Herbertsson and J. Michael Orszag: The Costs of Early Retirement in the OECD
- W01:01 Tryggvi Thor Herbertsson: The Economics of Early Retirement
- W00:20 Helgi Tomasson: Monitoring the trading intensity of a stock market under infrequent trading
- W00:19 Helgi Tomasson: Computations of Bayesian Estimators in ARMA Models