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FINANCIAL DOLLARIZATION
IN EMERGING MARKET AND TRANSITION ECONOMIES

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ALINA C. LUCA

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FINANCIAL DOLLARIZATION IN EMERGING MARKET AND TRANSITION ECONOMIES

By

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ABSTRACT

FINANCIAL DOLLARIZATION
IN EMERGING MARKET AND TRANSITION ECONOMIES

By

Alina C. Luca

The dollarization of bank deposits and loans is widespread in emerging market and transition economies. Since levels of dollar deposits and loans vary widely across countries and over time, and dollarization is generally associated with potential costs, the causes and economic consequences of financial dollarization deserve thorough analysis.

This dissertation (1) examines the sources of dollarization of bank credit, (2) evaluates the economic effects of policy measures that attempt to restrict dollarization, and (3) assesses the effects of the regulation of foreign exchange and capital transactions on financial intermediation and capital outflows.

The first chapter, **"Credit Dollarization, Bank Currency Matching, and Real Activity"** models the link between financial dollarization and integration in the international goods market. This chapter develops a general equilibrium model of a small open economy with costly banking and firms that use both domestic currency and dollar loans to finance production. Dollar loans are used to pay for a foreign intermediate good, hence the link to economic integration. Credit dollarization in equilibrium depends on the characteristics of the production process and the relative returns on domestic currency and dollar instruments. Moreover, deposit dollarization can cause credit dollarization, as banks match by currency their deposits and loans. Finally, this chapter shows that policies that attempt to reduce dollarization will cause financial disintermediation.

To date, the contributions of firms and banks to the dollarization of credit remain relatively unexplained. The second chapter, **"Credit Dollarization: Is It Firms' or Banks' "Fault"?"**, based on joint work with Iva Petrova, is an empirical study of credit dollarization in transition economies. It separates the respective contributions of banks and firms to the dollarization process by grouping potential determinants into bank- and firm-specific (financial and mainly real) factors. Empirical results provide evidence that bank currency matching is the main driving force of credit dollarization. In addition, there is limited evidence that real dollarization causes financial dollarization. However, currency mismatches tend to be concentrated in the real sector.

The third chapter, **"Regulation, Financial Development, and Capital Flows"**, evaluates the effects of regulation of foreign exchange and capital transactions on the domestic and international activities of banks. It separates the effects of foreign exchange liberalization from capital outflows liberalization. Will banks provide more domestic credit and "go abroad" less when allowed to freely lend in dollars domestically? Empirical results provide evidence that the liberalization of foreign exchange operations increases the level of domestic credit. Surprisingly, the liberalization of domestic lending in dollars also increases banks' holdings of foreign assets. In addition, banks increase their holdings of foreign assets when capital outflows are liberalized.

To Mom and Dad, and Brosco, with love

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First, there were many years of study in my home country, Romania. Dedicated and very competent professors guided my steps from elementary school up to my undergraduate studies. They taught me mathematics and physics, structured my analytical and logical thinking, and helped me become who I am now. I am truly indebted to Professors Zoe Muresan, Piroi Eugenia, Tiberiu Superceanu, Gheorghe Lipovan, and Vasile Bivolaru. At Universitatea de Vest Timisoara, Professor Silviu Cerna taught my first course in macroeconomics and monetary policy. He was a true mentor and a role model for me as both an economist and a teacher.

After my undergraduate years in Romania, I came to the US to explore the world and the economics science. While working as a research assistant in the Clinical Center, the Institute for Managed Care, I met two great people, Professor Bill Given and Professor Cathy Bradley. Our regular discussions over lunches helped me stay sane and eat healthy, and provided me advice and guidance throughout my graduate studies.

Foremost, I am truly grateful to my advisor, Professor Rowena Pecchenino, for all the time and effort she spent with me. She has always been there for me, always willing to read one more draft of my papers, and provide valuable suggestions. Her friendship helped me get through the hard times and stay on the right track.

I would like to thank Professors Susan J. Linz, Ana María Herrera, and Geoffrey Booth, for serving on my dissertation committee, and for their advice. Susan and Ana

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have always provided suggestions and comments on my work, and had the patience to go over numerous drafts. Professor Booth provided valuable suggestions from a finance perspective.

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If I am who I am today, it is because of the lifetime support and encouragement from my parents, Georgeta and George. They have always encouraged me to follow my dreams, to challenge myself, and to aspire to more and better. For all the love and support over the years, and for believing in me, thank you!

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INTRODUCTION

Foreign currencies, such as the US dollar or the Euro are widely used in emerging market and transition economies[1] instead of or in addition to domestic currencies, for transaction, saving, or accounting purposes. The dollarization of the banking sector, denoted below by *financial dollarization*, occurs when a significant share of residents' deposits and loans with the domestic banks are denominated in foreign currencies.[2] The main two components of this phenomenon are deposit and credit dollarization.

Previous work on financial dollarization, as well as on currency substitution and external dollar debt highlights at least four potential costs associated with this phenomenon. First, domestic policies become much more complex and their effects on the economy weaker. The effects of monetary policy in a dollarized economy, for example, are transmitted through the balance sheet channel in addition to the traditional interest rate channel. Second, there is more macroeconomic volatility as changes in the exchange rates affect the value of the dollar assets, liabilities, costs, and returns (the balance sheet effects). Third, policy makers have fewer available policy instruments as dollar instruments (deposits and loans) introduce new effects that might work in opposite directions. Central bankers in highly-dollarized economies cannot choose between increasing the interest rate and devaluating the domestic currency, since the devaluation will negatively impact domestic agents with dollar liabilities. Fourth and most importantly, there is increased exposure to financial and currency crises when there are balance sheet mismatches in the economy in either the real or the financial sector.

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[1] "Emerging markets" refers mainly to Latin American economies, which are in general highly-dollarized, while "transition economies" denotes the Central and Eastern European and Central Asian economies.

[2] "Dollar" denotes foreign currencies and not necessarily the US dollar. Thus, dollarization refers to the use of foreign currencies in general.

Potential benefits, such as increased financial intermediation and more saving and investment instruments available to domestic agents are often neglected. Contrary to the previous work which highlights the costs, this dissertation focuses on the benefits of financial dollarization. It also examines, theoretically and empirically, the sources of dollar bank credit and discusses the resulting policy implications for emerging market and transition economies. Furthermore, it examines the effects of the regulation of foreign exchange and capital transactions on financial intermediation and capital outflows.

The first chapter, **"Credit Dollarization, Bank Currency Matching, and Real Activity"**, explores the link between financial dollarization and integration in the international intermediate goods market. It addresses the following two questions. First, what can explain the high levels of dollar credit observed in emerging market and transition economies? Second, what are the policy implications of this phenomenon?

This chapter develops a general equilibrium model of a small open economy with predetermined exchange rate and no restrictions on goods and capital flows. The economy is composed of households, firms, banks, and the government. There is only one final good that is produced and consumed in the economy, which is also internationally traded.

The main economic agents are banks and firms. Banks derive a benefit when they match by currency their deposits and loans. Hence, there is currency matching in the banking sector. Firms use dollar loans to finance the imports of a foreign intermediate good and domestic currency loans to pay for a domestic intermediate good. Thus, financial dollarization is directly linked to the real sector.

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Credit dollarization in equilibrium depends on the characteristics of the production process: the relative price and the elasticity of substitution of the domestic and foreign inputs in the production function, as well as the relative returns on domestic currency and dollar instruments.

Results from the model demonstrate that the higher is the integration in the international intermediate goods market, the higher are the dollarization levels. Furthermore, policies that attempt to reduce financial dollarization will cause financial disintermediation. In addition, factors that affect the demand side of the economy, such as a change in household preference for dollar deposits, will be transmitted to the production side and thus change the level of credit dollarization. Hence, deposit dollarization can create credit dollarization as banks match the currency of their deposits and loans.

The second chapter, **"Credit Dollarization: Is It Firms' or Banks' "Fault"?"**, based on joint work with Iva Petrova, is an empirical study of credit dollarization in transition economies. It separates the contributions of banks and firms to the dollarization of credit by grouping potential determinants into bank- and firm-specific (financial and mainly real) factors.

To date, the respective contributions of banks and firms to the dollarization process remain relatively unexplored. Most studies that analyze financial dollarization start from the presumption that credit dollarization is bank-determined. Whether dollarization comes mainly from the financial sector or from the real sector has important policy implications. First, it indicates if there are balance sheet mismatches in the

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economy. Second, it shows in which sector of the economy they are concentrated and which sector (if any) policy makers should target in order to contain dollarization.

The empirical analysis uses a newly-assembled dataset for twenty-two transition economies for the period 1990 – 2001, with data mostly available for the second part of the period. Bank-specific factors include indicators of asset and liability management and currency matching, profitability, concentration, and risk management. Firm-specific factors are the measures of real dollarization[3] and access to alternative financing sources. Macroeconomic controls include factors that affect both firms and banks, such as indicators of overall hedging opportunities, liberalization and deregulation of the foreign exchange market, uncertainty and lack of credibility of domestic policies, and persistence effects.

Empirical results provide evidence that bank currency matching is the main driving force of credit dollarization. In addition, there is limited evidence that real dollarization causes financial dollarization. However, among the countries included in the analysis, currency mismatches tend to be concentrated in the real sector, which indirectly exposes the economy to financial and currency crises.

The third chapter, **"Regulation, Financial Development, and Capital Flows"**, evaluates the effects of regulation of foreign exchange and capital transactions on the domestic and international activities of banks. It separates the effects of foreign exchange liberalization from the effects of capital outflows liberalization. The main question of the chapter is if allowing banks to freely lend in dollars domestically will

[3] Real dollarization occurs when firms have returns and/or costs of production that are denominated in foreign currencies. That is, firms export the final good and/or use imported intermediate goods in the production of the final good.

make them provide more credit and "go abroad" less, and thus increase financial intermediation and reduce capital outflows. In addition, the chapter examines the determinants of foreign assets for banks in transition economies.

This chapter develops a simple theoretical minimum variance portfolio allocation model for a domestic bank. Bank liabilities are composed of deposits in domestic currency and dollars, while assets are composed of loans to residents in domestic currency and dollars, and foreign assets. There are separate regulation costs on dollar instruments and on holdings of foreign assets. The effects of changes in these regulation costs on bank lending and holdings of foreign assets are estimated using the same panel dataset employed in the second chapter.

Empirical results provide evidence that the liberalization of foreign exchange operations increases the level of domestic credit, possibly because of keeping domestic capital in the economy and discouraging capital flight. Limited evidence suggests that the liberalization of capital outflows, on the other hand, reduces financial intermediation. In addition, banks increase their holdings of foreign assets when capital outflows are liberalized. Surprisingly, the liberalization of domestic lending in dollars also increases banks' holdings of foreign assets.

Is a dollarized financial system better than none? This chapter suggests there is a disintermediation cost associated with restrictions on foreign exchange operations. Policy makers might have to weigh the potential costs of financial dollarization against the benefit of higher financial intermediation, and decide if they prefer a dollarized financial system to none.

CHAPTER 1

CREDIT DOLLARIZATION, BANK CURRENCY MATCHING, AND REAL ACTIVITY

1. Introduction

Financial dollarization, defined as the holding by residents of a significant share of bank deposits and loans denominated in foreign currencies, is a phenomenon present in most emerging market and transition economies (see Figure 1). Originally, this process was associated with macroeconomic instability: high inflation and sudden depreciation episodes. As a result, residents' confidence in the domestic currency was undermined, and they abandoned their domestic currency in preference for dollar instruments.[1] However, macroeconomic stability does not reverse dollarization. Financial dollarization continues to increase in most emerging economies (see Baliño et al. (1999), Honohan and Shi (2002), and Arteta (2002)), even after stabilization policies are implemented.[2]

There are several possible explanations for this increasing trend. First, the stabilization policies are not credible. Even if inflation has been curbed, people expect it to increase again in the future. Second, residents become used to holding dollar

[1] Following the current literature, I use the term "dollar" to refer to any foreign currency. I use both "financial dollarization" and "dollarization" to refer to partial dollarization of financial intermediation. The chapter does not address issues raised by the "full dollarization" case that is, the adoption of a foreign currency as a legal tender.

[2] Exceptions are several transition economies, where there were sharp declines in the level and share of dollar deposits and loans once the economy was stabilized.

instruments, which gives rise to persistence/hysteresis effects. Third, the process of financial dollarization is connected to international economic integration, and thus real sector dollarization[3] and trade dependence. Therefore, financial dollarization is a natural result of higher integration of the emerging economies in international goods and financial markets. I explore the last two explanations further in the chapter and abstract from any credibility issues.

A growing body of literature documents the risks imposed by financial dollarization and policy options in highly-dollarized economies.[4] However, only a few studies evaluate the determinants of dollarization of financial intermediation. In particular, deposit dollarization has been extensively studied in the context of currency substitution, while credit dollarization has only recently started to receive attention.[5]

Findings from three studies suggest that other factors, besides macroeconomic variables, have to be considered in order to explain financial dollarization in general, and credit dollarization in particular. Ize and Levy Yeyati (2003) evaluate the link between financial dollarization and macroeconomic uncertainty. They use a minimum variance

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[3] Real sector dollarization denotes a high pass-through from the exchange rate to the price level, due to either a high degree of openness of the economy (large tradable goods sector) or dollar pricing in the non-tradable goods sector (see Ize and Levy Yeyati (2003)).

[4] It is well accepted that financial dollarization complicates monetary policy and limits available policy instruments. For papers on the optimal exchange rate regime and monetary policy in economies with high levels of corporate debt dollarization, see Chang and Velasco (2001), Céspedes et al. (2000), Devereux, (2001) and (2002), and Ize and Levy Yeyati (2003). Furthermore, financial dollarization is believed to increase the fragility of the domestic banking sector, if firms and banks have unhedged dollar positions. A currency crisis might trigger a banking crisis as firms with unhedged dollar credit cannot repay their debt and banks become insolvent. For models of currency crises, based on balance sheet effects, see Krugman (1999), McKinnon and Pill (1999), Chinn and Kletzer (2001), and Aghion et al. (2001).

[5] Surprisingly enough, most existent studies examine the currency composition of external credit, even if this is almost completely denominated in foreign currencies. Domestic credit, however, shows much more cross-country and temporal variation, with respect to the currency of denomination. Domestic agents' incentives to borrow in dollars from abroad are examined by Schneider and Tornell (2001), Burnside et al. (2000), Martínez and Werner (2002), Caballero and Krishnamurthy (2002), and Jeanne (1999a), (1999b) and (2001), among others. The external borrowing in foreign currencies is also referred to as "the original sin" that is, the inability of emerging economies to borrow in their own currency (see Hausmann et al. (2001)).

portfolio (MVP) allocation model, in which agents compare the hedge benefits of domestic currency and dollar deposits and loans. Financial dollarization is caused by real sector dollarization, as well as by volatility of inflation and the real exchange rate. The levels of dollarization predicted by the MVP allocation model only partially match the actual dollarization levels for a sample of developed and developing economies. However, only data on deposit dollarization are used in the empirical analysis.

Arteta (2002) empirically evaluates the effect of the exchange rate regime on both deposit and credit dollarization. While deposit dollarization is higher in a floating than in a fixed exchange rate regime, credit dollarization does not seem to vary across regimes.

The importance of bank-specific factors for financial dollarization is highlighted by Catão and Terrones (2000). They evaluate the link between financial dollarization and banking cost, market structure, and regulatory parameters, in addition to macroeconomic variables. However, they model only the banking sector, and ignore the demand side of bank credit and deposits.

This chapter models the link between financial dollarization and integration in the international intermediate goods market. I use a general equilibrium model of a small open economy with firms, banks, households, and a government. Firms use both domestic currency and dollar loans to finance production. They operate in the traded-good sector and need a foreign intermediate good in addition to a domestic input to produce. Hence, there is real sector dollarization and trade dependence. Banks incur a cost to produce deposits and loans and derive a benefit when matching the currency of denomination of their "products". This generates currency matching in the banking industry.

The link that I model between financial dollarization and international economic integration can explain the increasing dollarization trend observed in practice and discussed above. As emerging market and transition economies become more integrated in the international goods markets, financial dollarization increases.[6] Moreover, I show that deposit dollarization, caused by a higher preference of residents for dollar deposits than domestic currency deposits, can create credit dollarization. Thus, factors that increase deposit dollarization end up increasing credit dollarization as banks match the currency of denomination of their deposits and loans.[7] To date, no other theoretical studies link bank currency matching to financial dollarization, thus allowing deposit dollarization to cause credit dollarization.[8]

I consider the effects of several domestic and external shocks on financial dollarization. I show that financial dollarization depends on macroeconomic variables, as well as bank- and firm-specific factors. Bank regulations and restrictions on dollar instruments do matter, as well as the characteristics of the production sector. To the extent that they vary across countries, so do the levels of credit dollarization. This chapter complements the existing literature, which explains financial dollarization based on macroeconomic variables only (see Ize and Levy Yeyati (2003)), or on both

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[6] There is empirical evidence of a link between financial and real sector dollarization. Honohan and Shi (2002) and Ize and Levy Yeyati (2003) find that deposit dollarization is associated with a high pass-through from exchange rate changes to the price level. Studies using firm-level data show that it is exporting firms and the firms in the traded goods sector, thus firms with returns indexed to the exchange rate, that borrow (mostly) in dollars (see Keloharju and Niskanen (2001) and Aguiar (2002)).

[7] The hypothesis that banks match the currency of denomination of deposits and credit receives empirical support as well. Using a panel of fourteen Latin American countries, Barajas and Morales (2003) conclude that dollar deposits are the main driving force of dollar credit. Table 1 shows a similar trend in deposit and credit dollarization ratios for selected transition economies. Arteta (2002), however, finds that there are currency mismatches in the banking sector, and that they are amplified by floating exchange rate regimes.

[8] Calvo (2001) and (2002) refers to currency matching in the banking sector in connection to credit dollarization (which he denotes by "liability dollarization"), and suggests that bank deposit dollarization may induce bank loan dollarization, since banks try to match the currency composition of their assets and liabilities. However, he does not model the link formally.

macroeconomic and microeconomic variables, but in partial equilibrium (see Catão and Terrones (2000)).

Similarly to Ize and Levy Yeyati (2003), I find that restrictive measures on dollarization are counterproductive as they reduce the total domestic credit and thus output in the economy. However, I do not imply that financial dollarization should be encouraged, nor that measures should not be taken to control it. This process deserves further analysis, both on theoretical and empirical grounds. Therefore, I conclude that any restrictive policy measures must look beyond reducing dollarization as a goal in itself and evaluate financial dollarization in connection to the real activity.

The rest of the chapter is organized as follows. Section 2 presents the theoretical model. Section 3 examines the effects of changes in deposit dollarization (and other domestic and external shocks) on credit dollarization, and the transmission mechanism to the overall economy. In section 4 I discuss the economic effects of two policy measures that aim to reduce financial dollarization. Section 5 summarizes the results and presents possible extensions of the analysis.

2. A Model of Financial Dollarization

I use a rather standard model of an open economy with costly banking. I assume that banks use tradable resources in order to produce deposits and credit, and derive a benefit from matching the currency of denomination of their assets and liabilities. The model is an extension of Edwards and Végh (1997). I introduce dollar deposits and loans, in addition to those denominated in domestic currency, in order to examine financial dollarization.

All distortions in the economy are concentrated in the banking sector. Furthermore, this is an inside money economy. That is, households and firms do not hold cash; they need demand deposits to consume and loans to produce. By modeling an inside money economy, I can focus on the substitution between domestic currency and dollar deposits, as well as domestic currency and dollar loans, and abstract from the substitution between cash holdings and bank deposits, as well as internal funds and bank loans.

2.1. The Economy

Consider a small open economy with no restrictions on goods or capital flows. There is only one good produced and consumed, which is non-storable and internationally traded. The domestic price of this good, P_t, is given by the law of one price: $P_t = E_t P_t^*$, where E_t is the nominal exchange rate, expressed in units of domestic currency per dollar, and P_t^* is the dollar price of the good. Real variables will be expressed in terms of this good.

There is no uncertainty in the economy. All agents have perfect foresight, therefore the rate of devaluation of the exchange rate, $\varepsilon_t(\dot{E}_t / E_t)$, is predetermined. I do not model expectations about the exchange rate or the rate of change in the exchange rate explicitly. However, I assume that deposit dollarization depends on the rate of devaluation ε_t. Therefore, an increase in the rate of devaluation will increase dollarization of deposits as households demand more dollar deposits relative to domestic

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currency deposits. This implicitly captures the higher desirability of dollar deposits in an economy with a higher rate of devaluation as a way to preserve the value of deposits.

I assume perfect capital mobility. Consequently, the uncovered interest parity condition holds: $i_t = i_t^* + \varepsilon_t$, where i_t is the domestic nominal interest rate and i_t^* is the foreign nominal interest rate. Domestic inflation $\pi_t(\dot{P}_t / P_t)$ is equal to $\varepsilon_t + \pi_t^*$, where $\pi_t^*(\dot{P}_t^* / P_t^*)$ is foreign inflation. By Fisher's equation, the real interest rate, r, is the same across the world, and I assume it constant: $r = i_t - \pi_t = i_t^* - \pi_t^*$. Without loss of generality, I assume that foreign inflation equals zero: $\pi_t^* = 0$.

There are no nominal rigidities in the model. I introduce the role for deposits and loans through two deposit-in-advance and two credit-in-advance constraints. I assume that households pay a fixed proportion of their consumption with dollar deposits, and that this proportion depends on the rate of devaluation and a "preference for dollar deposits" variable. On the production side of the economy, I assume that firms produce the final good using a constant elasticity of substitution (CES) technology, and both domestic labor and a foreign good as factors of production. Wages are paid with domestic currency credit, while imports of the intermediate good are paid with dollar credit. Labor is inelastically supplied, thus the domestic factor of production is scarce relative to the foreign. The currency composition of domestic debt is endogenously determined and follows from the assumptions of credit segmentation and trade dependence.

The economy is composed of households, firms, banks, and a government. Households own the firms and banks, consume the final good, and provide labor. In

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order to consume, households need to keep bank deposits. Firms produce the final good using domestic labor and a foreign input. They need bank credit to pay the cost of the working capital, both the domestic and foreign factors of production. Banks produce deposits and loans in both domestic currency and dollars, and can borrow or lend abroad. The government plays a passive role. It chooses the rate of devaluation and the reserve requirement ratios for both dollar and domestic currency deposits.

Any agent in the economy can hold internationally traded bonds. This assumption introduces capital mobility and allows for instantaneous adjustment in the case of a shock. There are no dynamics in this setup. The economy is always in steady state equilibrium.

2.2. Households

Households consume the final good and provide labor inelastically (they have a time endowment assumed fixed and equal to 1). Their lifetime utility is

$$\int_0^\infty \log c_t \exp(-\beta t) dt, \tag{2.1}$$

where c_t is real consumption and β is the subjective discount rate.[9]

Households must pay for consumption with checks drawn on domestic currency and dollar deposits. Their need for deposits is introduced through two deposit-in-advance (DIA) constraints. A fraction of consumption, s_t, has to be paid with dollar deposits (d_t^*), the rest has to be paid with domestic currency deposits (d_t)

[9] Following the current literature, I assume from now on β to be equal to r, in order to avoid unnecessary dynamics.

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(2.2) $$d_t^*(1+\varepsilon_t) \geq s_t c_t,$$

(2.3) $$d_t \geq (1-s_t)c_t.$$

Condition (2.2) includes the devaluation of the exchange rate from the moment the dollar deposits are created until they are used to pay for consumption.

The deposit dollarization ratio, calculated as the ratio of dollar deposits to total deposits is therefore equal to s_t

(2.4) $$DD_t = \frac{d_t^*(1+\varepsilon_t)}{d_t + d_t^*(1+\varepsilon_t)} = \frac{s_t c_t}{c_t} = s_t.$$

The existing literature on deposit dollarization shows that households shift to dollar deposits following episodes of sudden depreciation as their confidence in domestic currency is undermined. Furthermore, as they become used to holding dollar deposits, dollarization remains high even after stabilization policies are implemented. That is, there are persistence/hysteresis effects.[10] While I do not explicitly model the uncertainty with respect to the exchange rate or the rate of devaluation, I try to capture the two effects presented above by assuming that deposit dollarization depends on the rate of devaluation ε_t and a "preference for dollar deposits" variable A_t:

(2.5) $$DD_t = s_t = \frac{1+\varepsilon_t}{1+\varepsilon_t + \frac{1}{A_t}}.$$

The deposit dollarization ratio $DD_t(s_t)$ is increasing in the rate of devaluation ε_t and the preference for dollar deposits A_t. When $A_t \to 0$, households do not "like"

[10] Persistence/hysteresis effects are described by several studies: Guidotti and Rodriguez (1992) and Uribe (1997) for currency holdings, Honohan and Shi (2002), Ize and Levy Yeyati (2003), and Baliño et al. (1999) for bank deposits, and Arteta (2002) for both bank deposits and credit.

dollar deposits and hold only domestic currency deposits. Thus, the dollarization ratio is zero. As A_t increases, the deposit dollarization ratio increases, and the effect on dollarization of a change in the rate of devaluation decreases. Hence, hysteresis effects arise.

Households hold demand deposits, both domestic currency and dollar denominated, and an internationally traded bond. Their financial wealth in real terms, a_t^h, is given by

$$a_t^h = b_t^h + d_t + d_t^*(1+\varepsilon_t), \tag{2.6}$$

where b_t^h denotes bond holdings.

Households' flow constraint is then

$$\dot{a}_t^h = r a_t^h + w_t + \Omega_t^f + \Omega_t^b + \tau_t - c_t - (i_t - i_t^d)d_t - (i_t - \varepsilon_t - i_t^{d*})d_t^*(1+\varepsilon_t), \tag{2.7}$$

where i_t^d and i_t^{d*} are nominal interest rates paid for domestic currency and dollar deposits, w_t is the real wage, Ω_t^f and Ω_t^b are dividends from firms and banks, respectively, and τ_t denotes government transfers. Eq. (2.7) highlights the opportunity costs of holding deposits, $(i_t - i_t^d)$ and $(i_t - \varepsilon_t - i_t^{d*})$, respectively. I consider only the cases where these costs are non-negative, $i_t \geq i_t^d$ and $i_t - \varepsilon_t \geq i_t^{d*}$; that is, households hold deposits for liquidity reasons only. Thus Conditions (2.2) and (2.3) hold with equality.

The household's lifetime budget constraint is obtained by integrating forward Eq. (2.7), taking into account Conditions (2.2) and (2.3), and imposing the transversality condition

$$a_0^h + \int_0^\infty \{w_t + \Omega_t^f + \Omega_t^b + \tau_t - c_t[1 + (i_t - i_t^d)(1 - s_t) + (i_t - i_t^{d*} - \varepsilon_t)s_t]\} \exp(-rt)dt = 0. \tag{2.8}$$

Households choose consumption c_t, for all $t \in [0,\infty]$, so as to maximize lifetime utility Eq. (2.1), subject to the lifetime budget constraint Eq. (2.8), given the initial financial wealth a_0^h and the time paths of $\varepsilon_t, i_t, i_t^d, i_t^{d*}, w_t, \Omega_t^f, \Omega_t^b, \tau_t$.

The first-order condition is

$$\frac{1}{c_t} = \lambda[1 + (1 - s_t)(i_t - i_t^d) + s_t(i_t - \varepsilon_t - i_t^{d*})], \tag{2.9}$$

where λ is the time-invariant marginal utility of net wealth. Eq. (2.9) states that the marginal utility of consumption has to be equal to the marginal utility of wealth times the effective price of consumption. The price of consumption, in real terms, is higher than one, due to the additional cost of holding deposits in domestic currency and dollars for liquidity reasons.

2.3. Firms

Consider a representative firm that produces output y_t according to a CES technology, using both domestic and foreign factors of production

$$y_t = (n_t^{1-\frac{1}{\sigma}} + l_t^{1-\frac{1}{\sigma}})^{\frac{\sigma}{\sigma-1}}, \tag{2.10}$$

where l_t denotes domestic labor, n_t denotes a foreign input, and σ is the elasticity of substitution, $0 < \sigma < 1$. I assume that firms have to use bank loans to pay for their working capital. [11] Furthermore, I assume credit segmentation, that is, the domestic input has to be paid with domestic currency loans z_t, and the foreign input with dollar loans z_t^*. The two credit-in-advance constraints are

$$z_t \geq w_t l_t, \tag{2.11}$$

$$z_t^*(1+\varepsilon_t) \geq p_t n_t, \tag{2.12}$$

where p_t denotes international terms of trade (the foreign price of the intermediate good in terms of the foreign price of the final good) and is exogenous. Condition (2.12) includes the devaluation of the exchange rate from the moment dollar loans are granted until they are used to pay for the imported input.

Firm's real financial wealth a_t^f consists of bond holdings b_t^f and bank credit

$$a_t^f = b_t^f - z_t - z_t^*(1+\varepsilon_t). \tag{2.13}$$

Thus, the flow constraint condition is

$$a_t^f = ra_t^f + y_t - w_t l_t - p_t n_t - \Omega_t^f - (i_t^l - i_t)z_t - [i_t^{l*} - (i_t - \varepsilon_t)]z_t^*(1+\varepsilon_t), \tag{2.14}$$

where i_t^l and i_t^{l*} are nominal interest rates on domestic currency and dollar credit, respectively.

[11] The retained earnings are equal to zero, since firms are assumed to distribute in each period the profits as dividends.

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The opportunity costs, $i_t^l - i_t$ for domestic currency credit, and $i_t^{l*} - (i_t - \varepsilon_t)$ for dollar credit, are assumed non-negative. Thus $i_t^l \geq i_t$ and $i_t^{l*} \geq (i_t - \varepsilon_t)$, and firms demand only as much bank credit as they need to finance production. Conditions (2.11) and (2.12) hold with equality.

Firm's present discounted value of lifetime dividends is obtained by integrating forward Eq. (2.14), taking into account Conditions (2.11) and (2.12), and imposing the transversality condition

$$\begin{aligned} &\int_0^\infty \Omega_t^f \exp(-rt)dt \\ &= a_0^f + \int_0^\infty \{y_t - w_t l_t - p_t n_t - (i_t^l - i_t) z_t - [i_t^{l*} - (i_t - \varepsilon_t)] z_t^* (1 + \varepsilon_t)\} \exp(-rt)dt. \end{aligned} \tag{2.15}$$

The firm chooses labor, l_t, and a foreign input, n_t, so as to maximize the present discounted value of dividends Eq. (2.15), given the initial financial wealth a_0^f and the time paths of $w_t, p_t, \varepsilon_t, i_t, i_t^l, i_t^{l*}$.

The first-order conditions are

$$l_t^{-\frac{1}{\sigma}} (n_t^{1-\frac{1}{\sigma}} + l_t^{1-\frac{1}{\sigma}})^{\frac{1}{\sigma-1}} = w_t [1 + i_t^l - i_t], \tag{2.16}$$

$$n_t^{-\frac{1}{\sigma}} (n_t^{1-\frac{1}{\sigma}} + l_t^{1-\frac{1}{\sigma}})^{\frac{1}{\sigma-1}} = p_t [1 + i_t^{l*} - (i_t - \varepsilon_t)] . \tag{2.17}$$

Eqs. (2.16) and (2.17) state that firms equate the marginal productivity of labor to the marginal cost of a unit of labor, and the marginal productivity of the foreign input to its marginal cost. The costs stemming from the credit-in-advance constraints add up to the cost of labor and the foreign input.

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I define the credit dollarization ratio as the ratio of dollar bank credit to total bank credit, and calculate it using Conditions (2.11) and (2.12)

$$CD_t = \frac{z_t^*(1+\varepsilon_t)}{z_t + z_t^*(1+\varepsilon_t)} = \frac{p_t n_t}{p_t n_t + w_t l_t}. \tag{2.18}$$

The credit dollarization ratio can be expressed as follows, using Eqs. (2.16) and (2.17)

$$CD_t = \frac{1}{1+\left(\frac{w_t}{p_t}\right)^{1-\sigma}\left(\frac{1+i_t^{l*}-(i_t-\varepsilon_t)}{1+i_t^l-i_t}\right)^{\sigma}}. \tag{2.19}$$

Eq (2.19) shows that the level of credit dollarization in an economy is higher the higher the relative cost of the foreign input to labor and the lower the relative opportunity cost of dollar to domestic currency credit. In Section 3 I consider the effects of both domestic and external shocks on the dollarization levels.

2.4. Banks

Banks take deposits from households and lend to firms. Their assets consist of foreign bonds, b_t^b, domestic currency and dollar credit to firms, z_t and z_t^*, respectively, and reserves with the government, both for domestic currency and dollar deposits, h_t and h_t^*, respectively. Their liabilities consist of domestic currency and dollar deposits, d_t and d_t^*, respectively. Banks' net wealth, a_t^b, is given by

$$a_t^b = b_t^b + h_t + h_t^*(1+\varepsilon_t) + z_t + z_t^*(1+\varepsilon_t) - d_t - d_t^*(1+\varepsilon_t). \tag{2.20}$$

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Banks are modeled as productive units.[12] They use tradable resources to produce deposits and loans.[13] Moreover, deposits and loans are jointly produced, and an increase in the level of deposits reduces the marginal cost of credit. Thus I assume there are economies of scope in the banking industry. [14]

The banking cost function is the following

$$\eta(d_t, z_t) + K_t \eta(d_t^*, z_t^*),$$

where K_t is the relative cost of dollar to domestic currency deposits and loans, and the cost function is separable across currencies. Thus, economies of scope between deposits and loans are assumed positive within currencies and negligible across currencies[15]

$$\eta_{dz} < 0,\ \eta_{d^*z^*} < 0,\ \eta_{dz^*} = 0,\ \eta_{d^*z} = 0.$$

The cost function satisfies

$$\eta(0,0) = 0,\ \eta_d(0, z_t) = 0,\ \eta_z(d_t, 0) = 0,\ \eta_{d^*}(0, z_t^*) = 0,\ \eta_{z^*}(d_t^*, 0) = 0,$$

and the usual monotonic and convexity assumptions, for all d_t, d_t^*, z_t, $z_t^* > 0$

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[12] For models of costly banking, see Fisher (1983), Diaz-Gimenez et al. (1992), Edwards and Végh (1997), Catão and Terrones (2000), Catão and Rodriguez (2000), and Burnside et al. (2000).

[13] These are costs to service deposits and credit, to rent buildings, use ATMs, evaluate creditors, etc.

[14] The assumption of economies of scope, deposits and loans are complements in the cost function, can be interpreted as a competitive advantage of banks as inside lenders. According to Fama (1985), the cost of making loans to depositors is lower than for non-depositors. The ongoing history of a borrower as a depositor can be useful in assessing credit worthiness and lowering monitoring costs. The empirical evidence on banking economies of scope, however, is hardly conclusive. It seems to be agreement among economists that "if economies of scope exist, they are expected to be small" (Pulley et al. (1993), p.1). However, most empirical studies refer to US or other developed economies (see Mester (1994), Mester et al. (2001), and Santos (1998)). Banking economies of scope are likely to be higher in emerging markets.

[15] This assumption is similar to Catão and Terrones (2000). Financial intermediaries usually adopt hedging strategies. It might be the case that banks keep different balance sheets for deposits and loans denominated in different currencies. Or that there are some regulations that encourage banks to match the denomination of deposits and loans by imposing a cost on banks with mismatched portfolios.

$$\eta_d > 0,\ \eta_{d^*} > 0, \eta_z > 0,\ \eta_{z^*} > 0,\ \eta_{dd} > 0,\ \eta_{d^*d^*} > 0,\ \eta_{zz} > 0,\ \eta_{z^*z^*} > 0.$$

The economic interpretation for this cost function is that banks have to give up $\eta(d_t, z_t) + K_t\eta(d_t^*, z_t^*)$ resources in order to produce d_t units of domestic currency deposits, d_t^* units of dollar deposits, z_t units of domestic currency credit and z_t^* units of dollar credit. The variable K_t captures any regulation of or restrictions on dollar deposits and loans.

Banks' flow constraint is

(2.21)
$$a_t^b = ra_t^b + (i_t^l - i_t)z_t + [i_t^{l*} - (i_t - \varepsilon_t)]z_t^*(1+\varepsilon_t) + (i_t - i_t^d)d_t + (i_t - \varepsilon_t - i_t^{d*})$$
$$d_t^*(1+\varepsilon_t) - i_t h_t - (i_t - \varepsilon_t)h_t^*(1+\varepsilon_t) - \eta(d_t, z_t) - K_t\eta(d_t^*, z_t^*) - \Omega_t^b.$$

Banks gain the difference between the bond interest rate and the deposit and credit interest rates. They incur the production cost and the opportunity cost for required reserves. Assuming that the government does not pay any interest on reserves, banks will not hold any excess reserves in either the domestic currency or in dollars

(2.22a)
$$h_t = \delta_t d_t,$$

(2.22b)
$$h_t^* = \delta_t^* d_t^*,$$

where δ_t and δ_t^* are the required reserve ratios for domestic currency and dollar deposits respectively.

Bank's present discounted value of lifetime dividends is obtained by integrating forward Eq. (2.21) and imposing the transversality condition

$$\int_0^{\infty} \Omega_t^b \exp(-rt)dt$$

(2.23)
$$= a_0^b + \int_0^{\infty} \{(i_t^{l} - i_t)z_t + [i_t^{l*} - (i_t - \varepsilon_t)]z_t^*(1+\varepsilon_t) + (i_t - i_t^d)d_t + [(i_t - \varepsilon_t) - i_t^{d*})]$$
$$d_t^*(1+\varepsilon_t) - i_t h_t - (i_t - \varepsilon_t)h_t^*(1+\varepsilon_t) - \eta(d_t, z_t) - K_t\eta(d_t^*, z_t^*)\}\exp(-rt)dt.$$

Banks choose the level of domestic currency and dollar deposits, d_t and d_t^*, respectively, the level of reserves h_t and h_t^*, and domestic currency and dollar credit, z_t and z_t^*, respectively, in order to maximize the present discounted value of dividends Eq. (2.23), subject to the minimum reserve constraints Eqs. (2.22a) and (2.22b), given the initial assets a_0^b and the time paths of ε_t, i_t, i_t^l, i_t^{l*}, i_t^d, i_t^{d*}, δ_t, δ_t^*, K_t.[16]

The first-order conditions from the maximization problem are

$$i_t^l - i_t = \eta_z(d_t, z_t), \tag{2.24}$$

$$i_t^{l*} - (i_t - \varepsilon_t) = K_t\eta_{z^*}(d_t^*, z_t^*), \tag{2.25}$$

$$i_t - i_t^d = i_t\delta_t + \eta_d(d_t, z_t), \tag{2.26}$$

$$(i_t - \varepsilon_t) - i_t^{d*} = (i_t - \varepsilon_t)\delta_t^* + K_t\eta_{d^*}(d_t^*, z_t^*). \tag{2.27}$$

Eqs. (2.24) - (2.27) reflect the distortions from the economy. If there were no cost to "produce" credit, competitive banks would equate the lending rates to the nominal bond rate (taking into account the rate of devaluation, for the dollar credit). Therefore, the lending spreads depend on the marginal cost of credit. The deposit spreads depend on

[16] Banks' dividends do not necessarily have to be zero. This is a sensible assumption for emerging economies in general, and transition economies in particular.

the marginal cost of deposits and the additional cost of holding unremunerated reserves with the central bank.

2.5. Government

The government is modeled similarly to Edwards and Végh (1997). It plays the role of both monetary and fiscal authorities.

The government chooses the rate of devaluation ε_t and the reserve requirement ratios for domestic currency and dollar deposits, δ_t and δ_t^*, respectively. It receives interest on its bond holdings, b_t^g, and seignorage revenue, $\pi_t h_t$, and makes lump sum transfers, τ_t, to households. Government's net asset holdings a_t^g are

$$a_t^g = b_t^g - h_t - h_t^*(1+\varepsilon_t). \tag{2.28}$$

Government's flow constraint is given by

$$\dot{a}_t^g = r a_t^g + i_t h_t + (i_t - \pi_t) h_t^*(1+\varepsilon_t) + \eta(d_t, z_t) + K_t \eta(d_t^*, z_t^*) - \tau_t. \tag{2.29}$$

I have assumed the banking cost to be a private, but not a social, cost.[17] Thus, the government's lifetime constraint is as follows, imposing the transversality condition

$$a_0^g + \int_0^\infty [\dot{h}_t + \pi_t h_t + \dot{h}_t^*(1+\varepsilon_t) + \eta(d_t, z_t) + K_t \eta(d_t^*, z_t^*) - \tau_t] exp(-rt) dt = 0. \tag{2.30}$$

[17] Edwards and Végh (1997) show how this assumption simplifies the analysis by making the size of the banking sector irrelevant.

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2.6. Competitive Equilibrium

There are no intrinsic dynamics in this economy. The economy is in steady-state equilibrium as long as the exogenous variables are constant over time. The adjustment to changes in exogenous variables is instantaneous and the economy moves to a new steady-state equilibrium.

The labor market equilibrium condition is $l_t = 1$. Perfect capital mobility implies that $i_t = i_t^* + \varepsilon_t$, and perfect mobility in the goods market (the law of one price) implies that $\pi_t = \pi_t^* + \varepsilon_t$. Since I have assumed foreign inflation to be zero, domestic inflation is equal to the rate of devaluation.

I denote the economy's net stock of bonds by k_t. The economy's flow constraint (equilibrium current account condition) is derived using Eqs. (2.7), (2.14), (2.21) and (2.29)

$$\dot{k}_t = rk_t + y_t - c_t - p_t n_t . \tag{2.31}$$

The economy's resource constraint is derived from Eqs. (2.8), (2.15), (2.23) and (2.30), imposing the transversality condition

$$k_0 + \int_0^\infty (y_t - c_t - p_t n_t) exp(-rt) dt = 0 . \tag{2.32}$$

In equilibrium, the financial dollarization ratios are given by Eqs. (2.4), (2.5), (2.18) and (2.19)

$$DD_t = s_t = \frac{1 + \varepsilon_t}{1 + \varepsilon_t + \frac{1}{A_t}}$$

$$CD_t = \frac{z_t^*(1+\varepsilon_t)}{z_t + z_t^*(1+\varepsilon_t)} = \frac{1}{1+\left(\frac{w_t}{p_t}\right)^{1-\sigma}\left(\frac{1+i_t^{l*}-(i_t-\varepsilon_t)}{1+i_t^l-i_t}\right)^{\sigma}}.$$

The currency composition of deposits varies with the rate of devaluation of the exchange rate and households' preference for dollar deposits. When residents have a strong preference for dollar deposits, a decrease in the rate of devaluation will have only a small effect on deposit dollarization. Thus deposit dollarization depends on the initial conditions in the economy and is likely to show persistence effects.

The currency composition of credit, on the other hand, depends on the relative cost and elasticity of substitution between the foreign and domestic factors of production, as well as the lending interest rate spreads. Thus credit dollarization varies with both bank- and production-specific factors. Changes in deposit dollarization affect credit dollarization through changes in the interest rate spreads.

3. Impact of Domestic and External Shocks on Financial Dollarization

In this section, I examine how financial dollarization varies with changes in the rate of devaluation of the exchange rate, preference of residents for dollar deposits, regulation on dollar instrument holdings, and international terms of trade.

Timing is important. At the beginning of the period, households and banks determine the level of domestic currency and dollar deposits. Similarly, firms and banks determine the level of domestic currency and dollar loans. Banks "produce" the required domestic currency deposits and credit. A shock hits then the economy. Households use

all deposits to consume; firms use all credit to produce, and then sell the final good on the domestic or international market.

The economy is initially in steady-state equilibrium. When the shock hits, the economy adjusts immediately and reaches the new steady-state equilibrium. I examine these effects by comparative static analysis.

3.1. Impact of a Change in Households' Preference for Dollar Deposits

Consider an exogenous increase in households' preference for dollar deposits, measured by A_t. This variable captures all factors other than changes in the exchange rate that make dollar deposits more "desirable". For example, residents might get used to holding dollar instead of domestic currency deposits.[18] Another way to think about this change is to compare economies with different persistence effects, everything else equal, and see if they exhibit different patterns of financial dollarization.

In addition to the effects on financial dollarization, I study the propagation of shock from the consumption to the production sides and examine the overall effects on the economy.

Proposition 1: *An increase in households' preference for dollar deposits, A_t, causes an increase in deposit dollarization, DD_t. Dollarization of credit, CD_t, increases if the following (sufficient) condition holds*

(3.1)
$$p_t(1 + K_t \eta_{z^*}) \leq \sigma^{\frac{1}{1-\sigma}}.$$

[18] Or, residents of transition economies might switch to holding Euro deposits, in preparation for the accession to the European Union.

Real output increases unambiguously; the effect on the real wage, however, is ambiguous. Consumption and thus welfare increases if the following condition holds

$$(3.2) \qquad [(r+\varepsilon_t)\delta_t + \eta_d] - (r\delta_t^* + K_t\eta_{d^*}) > d_t^* K_t \eta_{d^* d^*} - d_t \eta_{dd}.$$

Proof: See Appendix.

The algebraic derivation of the results is provided in the Appendix. In this section, I present the interpretation of the effects and transmission mechanism for the preference shock.

An increase in the preference for dollar deposits directly increases deposit dollarization. As households use more dollar deposits to pay for consumption, holdings of dollar deposits increase. The increase in preference for dollar deposits tends to reduce domestic currency deposits; the indirect effect from a possible increase in consumption might work in the opposite direction. Thus the effect on domestic currency deposits is ambiguous. While more dollar deposits tend to increase consumption, potentially less domestic currency deposits tend to reduce it. Condition (3.2) states that consumption increases if the effective cost of domestic currency deposits, relative to that of dollar deposits, is higher than the increase in the marginal cost of dollar deposits, relative to the increase in the marginal cost of domestic currency deposits. Therefore, whether households consume more or less depends on how costly it is for them to substitute domestic currency with dollar deposits, and how costly it is for banks to produce more dollar deposits relative to domestic currency deposits.

The shock is transmitted to the production side through the banking sector. Banks jointly produce deposits and credit, and they match them by currency of denomination. The cost of dollar credit decreases as more dollar deposits are produced. Holdings of

dollar loans increase. However, it is not clear what happens to holdings of domestic currency loans, and thus to credit dollarization. Condition (3.1) states that credit dollarization is more likely to increase, the lower the marginal cost of the foreign intermediate good and the higher the elasticity of substitution between inputs in the production function. The intuition for this result is as follows. As dollar loans cost less, firms demand more of those, and then use the dollar loans to import more foreign input. With more foreign intermediate good, production increases. The lower is the cost of an additional unit of foreign good, the higher is firms' demand for imports, and thus the higher is the demand for dollar loans. As firms substitute labor with the foreign factor of production, demand for labor falls. Labor is supplied inelastically, thus the real wage tends to drop. The income effect from the increase in output, however, tends to increase wages. The higher the substitution effect, the more likely wages are to drop. As domestic currency loans are used to pay wages, the higher is the substitution effect, the lower firms' demand for domestic currency loans.

To summarize, an increase in deposit dollarization, due to a shift in households' preference from domestic currency to dollar deposits, might lead to an increase in credit dollarization as firms substitute domestic for foreign intermediate goods.[19] Hence, credit dollarization is associated with higher integration in the intermediate goods market.

If Condition (3.1) does not hold, the effect on credit dollarization is ambiguous. Thus I show that deposit and credit dollarization do not necessarily move in tandem;

[19] Intuitively, the results would be similar if I assumed elastic labor supply. The key assumption that drives the results is that the domestic factor is scarce relative to the foreign factor of production. Production can increase only if imports of intermediate goods increase. This assumption is reasonable for most small open emerging economies (major oil-supplier countries, for example Russia, are not considered).

bank- and firm-specific factors, such as banking cost, restrictions on dollar instruments, as well as the characteristics of the production process matter.

While output increases, the effect on the real wage is ambiguous.[20] Welfare is measured by households' consumption. Thus the effect on welfare is ambiguous. Whether the overall economy is better off with more financial dollarization depends on how costly dollar deposits are for households and banks, relative to domestic currency deposits.

3.2. Impact of a Change in the Rate of Devaluation

Assume there is an exogenous change in the rate of devaluation, that is, ε_t increases. Then the following proposition holds:

Proposition 2: *An increase in the rate of devaluation, ε_t, causes an increase in deposit dollarization, DD_t. Dollarization of credit, CD_t, increases if the following (sufficient) condition holds*

$$p_t(1+K_t\eta_{z^*}) \leq \sigma^{\frac{1}{1-\sigma}}.$$

Real output and real wage increase. Consumption and thus welfare increase if the following condition holds

$$(3.3) \qquad \{[(r+\varepsilon_t)-(1+\varepsilon_t+\frac{1}{A_t})]\delta_t+\eta_d\}-(r\delta_t^*+K_t\eta_{d^*})>(1-A_t(1+\varepsilon_t+\frac{1}{A_t})$$
$$d_t^*K_t\eta_{d^*d^*}-d_t\eta_{dd}.$$

[20] The real wage can be interpreted as the return to any domestic factor of production. Rather than considering labor, I could have looked at any non-traded intermediate good, and assumed that in each period residents have a fixed endowment of this good.

Proof: See Appendix.

The intuition for these results is as follows. An increase in the rate of devaluation has direct effects on both the consumption and production sides of the economy. First, the nominal interest rate increases, thereby raising the opportunity cost of holding deposits and loans. Second, the value (in domestic currency) of dollar deposits and loans increases. On the consumption side, there is the additional effect of households demanding more dollar deposits as they become more desirable. In addition, there are indirect effects from the consumption to the production side and vice versa, transmitted through the banking cost. I assume the indirect effects to be small relative to the direct effects (see Appendix).

Consider the production side. After the shock, dollar loans cost more, but their value in domestic currency increases. I show in the Appendix that the valuation effect dominates the cost effect. Hence, while actual holdings of dollar loans decrease, the level of dollar credit in the economy increases. As the value of dollar loans increases and the relative price of the intermediate good does not change, firms can import more and produce more. As the demand for labor increases and labor is inelastically supplied, real wage increases. Consequently, the demand for domestic currency loans increases.

Effects on credit dollarization are ambiguous as the level of both dollar and domestic currency credit increases. However, a sufficient condition for CD_t to increase is given by Condition (3.1). The lower the marginal cost of the foreign input and the higher the elasticity of substitution between inputs in the production function, the more likely credit dollarization is to increase. Thus, the lower the cost of an additional unit of

foreign good, the higher the demand of firms for imports and the higher the demand for dollar loans.

Things are more ambiguous, however, on the consumption side. I have assumed that deposit dollarization increases with the rate of devaluation. The return to dollar deposits relative to domestic currency deposits increases. So does their value. In addition, households want to hold more of their deposits as dollar deposits. There is a negative effect as well, from the increase in the opportunity cost for both dollar and domestic currency deposits as the nominal interest rate increases. The final effect on the level of domestic currency and dollar deposits is ambiguous.

The increase in deposit dollarization due to the increase in the value of dollar deposits has a positive effect on consumption. The higher cost of both types of deposits, however, has a negative effect. Consumption increases or decreases, depending on which effect is larger. I show that consumption increases if Condition (3.3) holds. This condition is similar to Condition (3.2). In addition, it includes the valuation effects for deposits and required reserves.

Condition (3.3) states that consumption (welfare) increases if the effective cost of domestic currency deposits, relative to that of dollar deposits, is higher than the increase in the marginal cost of dollar deposits, relative to the increase in the marginal cost of domestic currency deposits. The cost of required reserves for dollar deposits increases with a devaluation of the exchange rate. The value of the dollar deposits, however, decreases. Ultimately, the effect on consumption, and thus on welfare, depends on how costly it is for households to substitute domestic currency with dollar deposits, and how

costly it is for banks to produce more dollar deposits, relative to domestic currency deposits.

3.3. Impact of a Change in Restrictions on Dollar Instruments

Consider an exogenous change in the relative banking cost of dollar to domestic currency deposits and loans, measured by K_t. This can be interpreted as an increase in the regulation of or restrictions on dollar instruments. The effects on the economy are as follows.

Proposition 3: *An increase in restrictions on dollar deposits and loans, K_t, has, by assumption, no effect on deposit dollarization, DD_t. Credit dollarization, CD_t, decreases if the following (sufficient) condition holds*

$$p_t(1 + K_t \eta_{z^*}) \leq \sigma^{\frac{1}{1-\sigma}}.$$

Real output, real wage, and consumption decrease. Since consumption decreases, welfare decreases as well.

Proof: See Appendix.

The change in regulations has a direct impact on both the production and consumption sides of the economy. On the production side, the banking cost to produce dollar loans increases. Thus the opportunity cost for firms to borrow in dollars increases, and holdings of dollar loans decrease. As dollar loans are used to pay for the foreign input, firms buy less foreign intermediate goods. Since they are already using all labor in the economy, they cannot substitute the foreign factor for the domestic factor of production. Therefore, production decreases, and real output drops. The income effect

dominates the substitution effect, and the real wage decreases. As firms need less domestic currency loans to pay wages, these holdings also decrease. Consequently, when dollar loans become more expensive relative to domestic currency loans the overall level of credit in the economy decreases. This result follows from the assumptions that the two types of loans jointly finance production and that the domestic factor is scarce relative to the foreign factor of production.[21]

The effects on credit dollarization are ambiguous, since both dollar and domestic currency credit decrease. However, Condition (3.1) provides a sufficient condition for dollar loans to decrease more, and thus for credit dollarization to drop. The lower the marginal cost of the foreign input and the higher the elasticity of substitution between inputs in the production function, the more likely credit dollarization is to decrease.

On the consumption side, as the cost of producing dollar deposits increases, their return decreases. Thus dollar deposit holding drop. However, since deposit dollarization does not change (there is no substitution of dollar deposits with domestic currency deposits), consumption has to decrease, triggering a decrease in holdings of domestic currency deposits.[22]

3.4. Impact of an External Supply Shock

Suppose there is a shock to terms of trade, that is, the relative price, p_t, of the foreign factor of production increases. Then the following proposition holds.

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[21] These are reasonable assumptions for emerging economies, especially for the case of transition economies, where there is credit segmentation (see Bonin (2001)) and domestic resources are scarce.

[22] In a more general case, deposit dollarization decreases as more restrictions on dollar deposits are imposed. Intuitively, as banks have less dollar deposits, the marginal cost of credit increases even more than without the effect from deposit dollarization. Thus credit dollarization is even more likely to drop. Output still falls. However, the effect on consumption and thus welfare might become ambiguous.

Proposition 4: *An increase in terms of trade, p_t, has, by assumption, no effect on deposit dollarization, DD_t. Credit dollarization, CD_t, increases if the following (sufficient) condition holds*

$$p_t(1+K_t\eta_{z^*}) \leq (1-\sigma)^{\frac{1}{1-\sigma}}. \tag{3.4}$$

The real wage decreases unambiguously; the effects on real output and consumption are ambiguous. However, a sufficient condition for real output, consumption and thus welfare to decrease is

$$p_t(1+K_t\eta_{z^*}) \geq (1-\sigma)^{\frac{1}{1-\sigma}}. \tag{3.5}$$

Proof: See Appendix.

On the production side, as the cost of the foreign input and thus the production cost increases, demand of firms for labor falls. Since labor supply is inelastic, the real wage falls. [23] This triggers a fall in the demand for domestic currency loans. Thus holdings of domestic currency loans decrease.

The effects on real imports of intermediate goods and real output depend on the marginal cost of the foreign input and the elasticity of substitution between factors of production. The higher is the marginal cost of the foreign input, the higher is the effect on output of an increase in the input price. The higher the elasticity of substitution is, the higher the drop in volume of imports as their price increases.

There are two opposite effects on holdings of dollar loans. One is caused by the increase in the price of imports, the other by a potential decrease in the volume of

[23] Real wage falls even if labor supply were elastic, just not perfectly elastic.

imports. Depending on which effect is larger, credit dollarization might increase or decrease. A sufficient condition for CD_t to increase is given by Condition (3.4). It states that the lower is the marginal cost of the foreign input and the lower is the elasticity of substitution between inputs in the production function, the more likely credit dollarization is to increase.[24]

The shock is propagated to the consumption side through the change in banking costs. The lower level of domestic currency loans increases the marginal cost of domestic currency deposits. Holdings by residents of domestic currency deposits decrease. If Condition (3.5) holds, less dollar loans are produced and following the same reasoning, dollar deposit holdings decrease. Thus consumption decreases. However, if Condition (3.4) does not hold, and more dollar deposits are produced, the effect on consumption is ambiguous. Additional dollar deposits tend to increase consumption, while less domestic currency deposits tend to decrease it. Consequently, the effect on consumption is ambiguous.

3.5. Determinants of Credit Dollarization

This section summarizes the effects of domestic and external shocks on credit dollarization. Financial dollarization is connected to the real sector through the real dollarization and trade dependence assumptions. However, the way it responds to shocks

[24] Consider the two extremes cases: $\sigma \rightarrow 0$ and $\sigma \rightarrow 1$. In the first case, the Leontief technology, an increase in p_t increases CD_t as the price of the foreign input increases, and factors cannot be substituted one for the other. In the second case, the Cobb-Douglas technology, the effect on CD_t is ambiguous. As p_t increases, firms want to substitute foreign input for domestic labor. Domestic labor is supplied inelastically, however, thus real imports and output decrease.

depends on firm- and bank-specific factors, such as banking cost, bank currency matching and the characteristics of the production sector.

Assume first that the marginal cost of the foreign input is small and the elasticity of substitution is large. Then both an increase in households' preference for dollar instruments and an increase in the devaluation rate raise financial dollarization. However, the transmission mechanism for the two shocks differs. Higher preference for dollar deposits and thus higher deposit dollarization triggers higher credit dollarization due to bank currency matching. Higher rate of devaluation increases both deposit and credit dollarization directly.

Restrictive measures on dollar instruments, on the other hand, reduce credit dollarization (while leaving, by assumption, dollar deposits unchanged).[25]

Assume now that the marginal cost of the foreign factor is still small, but the elasticity of substitution is also small. Then higher terms of trade increase credit dollarization.

The model predicts that the more integrated is an economy in the international intermediate goods market, the more likely it is to respond to an increase in deposit dollarization with an increase in credit dollarization. Similarly, there is more credit dollarization in economies with higher rates of devaluation of the exchange rate and less restrictions on holdings of dollar instruments.

[25] Intuitively, a decrease in deposit dollarization would amplify the downturn in dollar loans.

4. Policies that Aim to Reduce Financial Dollarization

Governments in emerging markets might be concerned with the high level of dollarization and attempt to reduce it. These restrictive policies can be ill advised as they can end up having disintermediation effects.

Consider the increase in the regulation of dollar instruments, which increases the cost of dollar deposits and loans. In section 3.3, I present the intuition for the resulting drop in the total credit, real output, and consumption. To summarize, since dollar credit is used to finance imports of foreign intermediate goods, any restriction on its level limits the access to foreign goods. When the economy has limited domestic resources, which is the case for most emerging markets, total credit and real output decrease. A sufficient condition for credit dollarization to decrease is Condition (3.1). Thus, while regulatory measures might contain credit dollarization, they do have adverse disintermediation effects.

Alternatively, consider a decrease in the rate of devaluation. The government can reduce the rate of devaluation in an attempt to stabilize the economy. This policy might directly target dollarization of the banking sector. Suppose first that there is no dollarization. Then the only channel through which the effects are transmitted to the economy is the interest rate channel. A decrease in the rate of devaluation decreases the nominal interest rate, and thus the cost of consumption and production. Consumption and real output increase.

When the economy is partially dollarized, however, things can be very different. In section 3.2 I show the effects of an increase in the rate of devaluation. When a stabilization policy is implemented, the balance sheet channel, in addition to the interest

rate channel, propagates the effects within and across sectors.[26] Dollar deposits are now less desirable and households substitute them with domestic currency deposits. Thus deposit dollarization decreases. If Condition (3.3) holds, consumption increases.

The cost of dollar loans is lower now, but so is their value in domestic currency. As less foreign factor of production is purchased, less final good is produced and less domestic currency loans are demanded. Holdings of both dollar and domestic currency loans decrease. Credit dollarization decreases if Condition (3.1) holds. While the stabilization policy might reduce financial dollarization, it unambiguously reduces the total credit and real output in the economy.

5. Conclusions

Recent studies highlight the high degree of banking sector dollarization in many emerging economies. Macroeconomic uncertainty, which was originally believed to be the main cause of dollarization, is no longer able to explain its trend and patterns. In emerging market and transition economies, residents continue to use dollar deposits and loans, even after successful stabilization policies are implemented. Furthermore, several recent empirical studies identify an increasing trend in dollarization.

This chapter shows the connection between financial dollarization and international economic integration. As emerging economies become more integrated in the international goods markets over time, financial dollarization increases. Furthermore, I show that financial dollarization depends on macroeconomic variables, as well as bank-

[26] As the debt of firms is partially denominated in dollars, a change in the rate of devaluation of the exchange rate modifies the value of debt.

and firm-specific factors. Bank regulations and restrictions on dollar instruments do matter, as well as the characteristics of the production sector. To the extent that these vary across countries, so do the levels of credit dollarization. Finally, I show that deposit dollarization might cause credit dollarization as banks match the currency of denomination of their deposits and loans.

If financial dollarization is indeed a result of integration and globalization forces, then policies that attempt to reduce it might be ill advised. I show how an increase in regulation of dollar instruments and a decrease in the rate of devaluation end up hurting the economy by causing financial disintermediation.

The chapter can be extended in several ways by relaxing some of the assumptions of the model. First, I assume that deposit dollarization depends only on the rate of devaluation of the exchange rate and the "preference for dollars" of residents. This simplification keeps the analysis tractable. However, some effects from credit to deposit dollarization might be missing. The analysis could be extended to explicitly model households' choice between the two types of deposits.

Second, I assume a representative firm that uses domestic currency and dollar loans to jointly finance production. Different firms might use different types of loans. Therefore, a possible extension of the model is to introduce heterogeneous firms, and to allow firms to use either domestic currency or dollar credit, or both.

Third, I assume that banks derive a benefit from matching by currency deposits and loans. Banks could instead match the currency of denomination of their assets and liabilities. In that case, more dollar deposits might lead to more holdings of foreign bonds, and the link between deposits and loans becomes weaker.

Finally, the implications of the model should be tested empirically as more data on credit dollarization become available. Does financial dollarization depend on the real sector and the characteristics of the banking sector? Further research on both theoretical and empirical grounds is needed to shed lights on these issues. Until that research is done, however, practitioners should be cautious when attempting to restrict dollarization.

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APPENDIX

A. First-Order Conditions and Comparative Static Analysis

Using the perfect capital mobility assumption and Fisher's equation, the nominal domestic interest rate, i_t, can be expressed in terms of the rate of devaluation, ε_t, and the constant real foreign interest rate, r, (foreign inflation was assumed equal to zero)

(A.1) $$i_t = r + \varepsilon_t .$$

The first-order condition for household's optimization problem is given by Eqs. (A.1), (2.4) and (2.9)

(A.2) $$\frac{1}{c_t} = \lambda[1 + \frac{1/A_t}{1+\varepsilon_t + 1/A_t}(r + \varepsilon_t - i_t^d) + \frac{\varepsilon_t}{1+\varepsilon_t + 1/A_t}(r - i_t^{d*})],$$

and holdings of domestic currency and dollar deposits are given by Conditions (2.2) and (2.3) and Eq. (2.4)

$$d_t = \frac{1/A_t}{1+\varepsilon_t + 1/A_t} c_t ,$$

$$d_t^*(1+\varepsilon_t) = \frac{\varepsilon_t}{1+\varepsilon_t + 1/A_t} c_t .$$

The first-order conditions for firm's optimization problem are given by Eqs. (2.16) and (2.17). Using Eq. (A.1), they can be expressed in the following way

$$l_t^{-\frac{1}{\sigma}} (n_t^{1-\frac{1}{\sigma}} + l_t^{1-\frac{1}{\sigma}})^{\frac{1}{\sigma-1}} = w_t[1 + i_t^l - (r + \varepsilon_t)],$$

$$n_t^{-\frac{1}{\sigma}} (n_t^{1-\frac{1}{\sigma}} + l_t^{1-\frac{1}{\sigma}})^{\frac{1}{\sigma-1}} = p_t[1 + i_t^{l*} - r]$$

Use the labor market equilibrium condition to obtain

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(A.3) $$(n_t^{1-\frac{1}{\sigma}} + 1)^{\frac{1}{\sigma-1}} = w_t[1 + i_t^{l} - \varepsilon_t - r],$$

(A.4) $$n_t^{-\frac{1}{\sigma}}(n_t^{1-\frac{1}{\sigma}} + 1)^{\frac{1}{\sigma-1}} = p_t[1 + i_t^{l*} - r] .$$

Holdings of domestic currency and dollar loans are given by Conditions (2.11) and (2.12), and using the labor market equilibrium condition

$$z_t = w_t,$$

$$z_t^*(1 + \varepsilon_t) = p_t n_t .$$

The first-order conditions for bank's optimization problem are given by Eqs. (2.23) - (2.26). Use then Eq. (A.1) to obtain the following conditions

(A.5) $$i_t^l - (r + \varepsilon_t) = \eta_z(d_t, z_t),$$

(A.6) $$i_t^{l*} - r = K_t \eta_{z^*}(d_t^*, z_t^*),$$

(A.7) $$(r + \varepsilon_t) - i_t^d = (r + \varepsilon_t)\delta_t + \eta_d(d_t, z_t),$$

(A.8) $$r - i_t^{d*} = r\delta_t^* + K_t \eta_{d^*}(d_t^*, z_t^*).$$

Eqs. (A.2) - (A.8) can be used to express c_t, z_t, and z_t^* in terms of the exogenous variables only

(A.9) $$\frac{1}{\lambda}\frac{1}{c_t} = 1 + \frac{A_t}{1 + \varepsilon_t + A}\{(r + \varepsilon_t)\delta_t + \eta_d[\frac{A_t}{1 + \varepsilon_t + A}c_t, z_t]\} + \frac{(1 + \varepsilon_t)}{1 + \varepsilon_t + A}\{r\delta_t^* + K_t\eta_{d^*}[\frac{c_t}{1 + \varepsilon_t + A_t}, z_t^*)\},$$

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$$z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}[1+K_t\eta_{z^*}(\frac{c_t}{1+\varepsilon_t+1/A_t},z_t^*)] = z_t p_t^{\frac{1-\sigma}{\sigma}}$$
$$\{1+\eta_z[\frac{1/A_t c_t}{1+\varepsilon_t+1/A_t},z_t]\},$$

(A.11)
$$1+z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}}p_t^{-(\frac{1-\sigma}{\sigma})} = p_t^{\sigma-1}[1+K_t\eta_{z^*}(\frac{c_t}{1+\varepsilon_t+1/A_t},z_t^*)]^{\sigma-1}.$$

The effects on consumption c_t and the levels of domestic currency and dollar credit, z_t and z_t^*, respectively, are calculated for shocks to the following: (1) the preference variable A_t, (2) the rate of devaluation of the exchange rate ε_t, (3) the regulation variable K_t, and (4) terms of trade p_t. I apply the implicit function theorem to Eqs. (A.9) - (A.11) and use Cramer's rule to calculate the effects of shocks.

I calculate the determinant of the following system and I denote it by Δ (the ordering of the variables is c_t, z_t, and z_t^*)

$$\begin{vmatrix} -\frac{1}{1+\varepsilon_t+1/A_t}[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t+1/A_t)^2 + (1/A_t)^2\eta_{dd}+(1+\varepsilon_t)K_t\eta_{d^*d^*}] & -1/A_t\eta_{dz} & -(1+\varepsilon_t)K_t\eta_{d^*z^*} \\ \frac{1}{1+\varepsilon_t+1/A_t}[z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}K_t\eta_{d^*z^*} - 1/A_t z_t p_t^{\frac{1-\sigma}{\sigma}}\eta_{dz}] & -p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z+z_t\eta_{zz}) & \frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}} (1+K_t\eta_{z^*}+\sigma z_t^* K_t\eta_{z^*z^*}) \\ \frac{1}{1+\varepsilon_t+1/A_t}(1-\sigma)p_t^{\sigma-1} (1+K_t\eta_{z^*})^{\sigma-2}K_t\eta_{d^*z^*} & 0 & (1-\sigma)p_t^{\sigma-1}[\frac{1}{\sigma}z_t^{*\frac{1-2\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} p_t^{\frac{(1-\sigma)^2}{\sigma}}+(1+K_t\eta_{z^*})^{\sigma-2}K_t\eta_{z^*z^*}] \end{vmatrix}$$

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Below I assume that η_{dz} and $\eta_{d^*z^*}$ are not too large compared to η_{dd}, η_{zz}, $\eta_{d^*d^*}$, and $\eta_{z^*z^*}$.[27] That is, there are economies of scope within currencies, but they are not too large. Then Δ can be shown to be positive.

The cost function is assumed strictly convex, thus the following conditions hold

$$\eta_{dd}\eta_{zz} - \eta_{dz}^{\ 2} > 0,$$

$$\eta_{d^*d^*}\eta_{z^*z^*} - \eta_{d^*z^*}^{\ 2} > 0.$$

A.1. Proof of Proposition 1

Use the following vector, to calculate the effects of a change in A_t on consumption, c_t, domestic currency credit, z_t, and dollar credit, z_t^*

$$\begin{pmatrix} \frac{1}{(1+\varepsilon_t+1/A_t)^2}(1+\varepsilon_t)\{[(r+\varepsilon_t)\delta_t+\eta_d - r\delta_t^* - K_t\eta_{d^*}] \\ (1+\varepsilon_t+1/A_t)+1/A_t c_t\eta_{dd} - c_t K_t\eta_{d^*d^*}\} \\ \\ \frac{c_t}{(1+\varepsilon_t+1/A_t)^2}(1+\varepsilon_t)[z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} K_t\eta_{d^*z^*} + z_t p_t^{\frac{1-\sigma}{\sigma}}\eta_{dz}] \\ \\ \frac{c_t}{(1+\varepsilon_t+A_t)^2}(1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-2}K_t\eta_{d^*z^*} \end{pmatrix}$$

The effect of an increase in the preference for dollar deposits on real consumption is

[27] An example of a cost function that satisfies all these assumptions is the translog function.

$$\frac{\partial c_t}{\partial A_t} =$$

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$$\frac{\partial z_t}{\partial A_t} = -$$

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$$\frac{\partial c_t}{\partial A_t} = \frac{1}{(1+\varepsilon_t + 1/A_t)^2} \frac{(1-\sigma)p_t^{\sigma-1}}{\Delta} \{\{-(1+\varepsilon_t)[(r+\varepsilon_t)\delta_t + \eta_d - r\delta_t^* - K_t\eta_{d^*}]$$

$$(1+\varepsilon_t + 1/A_t) + 1/A_t c_t \eta_{dd} - c_t K_t \eta_{d^* d^*}\} p_t^{\frac{1-\sigma}{\sigma}} (1+\eta_z + z_t\eta_{zz})[\frac{1}{\sigma} z_t^{*\frac{1-2\sigma}{\sigma}}$$

$$p_t^{-(\frac{1-\sigma}{\sigma})^2} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2} K_t \eta_{z^* z^*}] + 1/A_t c_t (1+\varepsilon_t) z_t p_t^{\frac{1-\sigma}{\sigma}}$$

$$\eta_{dz}^2 [\frac{1}{\sigma} z_t^{*\frac{1-2\sigma}{\sigma}} p_t^{-(\frac{1-\sigma}{\sigma})^2} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2} K_t \eta_{z^* z^*}] -$$

$$c_t (1+K_t\eta_{z^*})^{\sigma-2} K_t^2 \eta_{d^* z^*}^2 \frac{1}{\sigma}(1+\varepsilon_t) p_t^{\frac{1-\sigma}{\sigma}} (1+\eta_z + z_t\eta_{zz}) - 1/A_t \eta_{dz}\eta_{d^* z^*}$$

$$c_t K_t \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} (1+\varepsilon_t)^{\frac{1}{\sigma}} p_t^{1-\sigma}\}.$$

If the following condition holds

$$(r+\varepsilon_t)\delta_t + \eta_d + \frac{1/A_t c_t}{1+\varepsilon_t + 1/A_t}\eta_{dd} > r\delta_t^* + K_t\eta_{d^*} + \frac{c_t}{1+\varepsilon_t + 1/A_t} K_t \eta_{d^* d^*},$$

then $\frac{\partial c_t}{\partial A_t} > 0$. If this condition does not hold, then consumption decreases.

The effect of a change in A_t on domestic currency loans is

$$\frac{\partial z_t}{\partial A_t} = \frac{1}{(1+\varepsilon_t + 1/A_t)^2} \frac{(1-\sigma)p_t^{\sigma-1}}{\Delta} \{(1+\varepsilon_t + 1/A_t)(1+\varepsilon_t) K_t^2 \eta_{d^* z^*}^2 (1+K_t\eta_{z^*})^{\sigma-2}$$

$$c_t z_t p_t^{\frac{1-\sigma}{\sigma}} \eta_{dz} + (1+\varepsilon_t + 1/A_t)^2 \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} (1+\varepsilon_t)^{\frac{1}{\sigma}} p_t^{\sigma-1} K_t \eta_{d^* z^*} [1 + (r+\varepsilon_t)\delta_t +$$

$$\eta_d + \frac{1/A_t}{1+\varepsilon_t + 1/A_t} c_t \eta_{dd}] - [\frac{1}{\sigma} z_t^{*\frac{1-2\sigma}{\sigma}} p_t^{-(\frac{1-\sigma}{\sigma})^2} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2}$$

$$K_t \eta_{z^* z^*}] (1+\varepsilon_t + 1/A_t)^2 z_t (1+\varepsilon_t) p_t^{\frac{1-\sigma}{\sigma}} \eta_{dz} [1 + r\delta_t^* + K_t\eta_{d^*} + \frac{c_t}{1+\varepsilon_t + 1/A_t}$$

$$K_t \eta_{d^* d^*}]\}.$$

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A sufficient condition for z_t to increase when A_t increases is

$$z_t \eta_{dz} [1 + r\delta_t^* + K_t \eta_{d^*} + \frac{c_t}{1+\varepsilon_t + 1/A_t} K_t \eta_{d^* d^*}] <$$
$$z_t^* K_t \eta_{d^* z^*} [1 + (r+\varepsilon_t)\delta_t + \eta_d + \frac{1/A_t c_t}{1+\varepsilon_t + 1/A_t} \eta_{dd}].$$

The effect on dollar loans is

$$\frac{\partial z_t^*}{\partial A_t} = (1 + K_t \eta_{z^*})^{\sigma-2} K_t \eta_{d^* z^*} \frac{1}{(1+\varepsilon_t + 1/A_t)^2} \frac{(1-\sigma) p_t^{\sigma-1}}{\Delta} \{[1 + (r+\varepsilon_t)\delta_t +$$
$$\eta_d + \frac{1/A_t}{(1+\varepsilon_t + 1/A_t)^2} c_t \eta_{dd}] p_t^{\frac{1-\sigma}{\sigma}} (1 + \eta_z + z_t \eta_{zz})(1+\varepsilon_t + 1/A_t)^2 -$$
$$1/A_t (1+\varepsilon_t + 1/A_t) p_t^{\frac{1-\sigma}{\sigma}} z_t c_t \eta_{dz}^2 \}.$$

This effect is positive. Thus dollar loans always increase when A_t increases.

The effect on credit dollarization can be determined using the following formula

$$\frac{\partial CD_t}{\partial A_t} = \frac{1+\varepsilon_t}{\Delta} \frac{1}{[z_t + z_t^*(1+\varepsilon_t)]^2} [z_t \frac{\partial z_t^*}{\partial A_t} - z_t^* \frac{\partial z_t}{\partial A_t}]. \quad \text{(A.12)}$$

By substituting for the changes in dollar and domestic currency loans, a sufficient condition for CD_t to increase is

$$p_t (1 + K_t \eta_{z^*}) \leq (1-\sigma)^{\frac{1}{1-\sigma}}.$$

Imports of intermediate good increase as $n_t = z_t^*(1+\varepsilon_t)/p_t$ and z_t^* increases. According to Eq. (2.10), the real wage is equal to domestic currency loans, thus the effect on real wage is ambiguous. Output increases, since $y_t = (n_t^{1-\frac{1}{\sigma}} + 1)^{\frac{\sigma}{\sigma-1}}$ and n_t increases.

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A.2. Proof of Proposition 2

The description of the effects is similar to the preference shock. The effects on consumption, domestic currency, and dollar credit are presented firstly; the impact on the rest of the variables is discussed afterwards.

I use the following vector, to calculate the effects of a change in ε_t on c_t, z_t, and z_t^*

$$\begin{pmatrix} \frac{1}{(1+\varepsilon_t+1/A_t)^2}\{1/A_t(1+\varepsilon_t+1/A_t)[r\delta_t^* + K_t\eta_{d^*} - (r+\varepsilon_t)\delta_t - \eta_d] + \\ 1/A_t(1+\varepsilon_t+1/A_t)^2\delta_t - (1/A_t)^2 c_t\eta_{dd} - (1+\varepsilon_t)c_t K_t\eta_{d^*d^*}\} \\ \\ \frac{1}{(1+\varepsilon_t+1/A_t)^2}[z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}} c_t K_t\eta_{d^*z^*} - 1/A_t z_t p_t^{\frac{1-\sigma}{\sigma}} c_t\eta_{dz} - \\ (1+\varepsilon_t+1/A_t)^2\frac{1}{\sigma}z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}}(1+K_t\eta_{z^*})] \\ \\ \frac{1}{(1+\varepsilon_t+1/A_t)^2}(1-\sigma)p_t^{\sigma-1}[(1+\varepsilon_t+1/A_t)^2\frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1-2\sigma}{\sigma}} p_t^{\frac{-(1-\sigma)^2}{\sigma}} - \\ c_t(1+K_t\eta_{z^*})^{\sigma-2}K_t\eta_{d^*z^*} \end{pmatrix}$$

The effect of an increase in the rate of devaluation on real consumption is

$$\frac{\partial c_t}{\partial \varepsilon_t} = \frac{1}{(1+\varepsilon_t + 1/A_t)^2} \frac{(1-\sigma)p_t^{\sigma-1}}{\Delta} \{[1/A_t(1+\varepsilon_t + 1/A_t)[(r+\varepsilon_t)\delta_t + \eta_d - r\delta_t^* -$$

$$K_t\eta_{d^*}] - 1/A_t(1+\varepsilon_t + 1/A_t)^2\delta_t + (1/A_t)^2 c_t\eta_{dd} + (1+\varepsilon_t)c_t K_t\eta_{d^*d^*}$$

$$p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z + z_t\eta_{zz})[\frac{1}{\sigma}z_t^{*\frac{1-2\sigma}{\sigma}} p_t - (\frac{1-\sigma}{\sigma})^2 (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2}$$

$$K_t\eta_{z^*z^*}] - (1/A_t)^2 c_t z_t p_t^{\frac{1-\sigma}{\sigma}} \eta_{dz}^2 [\frac{1}{\sigma}z_t^{*\frac{1-2\sigma}{\sigma}} p_t - (\frac{1-\sigma}{\sigma})^2 (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} +$$

$$(1+K_t\eta_{z^*})^{\sigma-2} K_t\eta_{z^*z^*}] - (1+\varepsilon_t)K_t^2\eta_{d^*z^*}^2 p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z + z_t\eta_{zz})c_t$$

$$(1+K_t\eta_{z^*})^{\sigma-2} - 1/A_t\eta_{dz}\frac{1}{\sigma}(1+\varepsilon_t + 1/A_t)^2 z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} p_t^{1-\sigma}\eta_{z^*z^*}$$

$$K_t + (1+\varepsilon_t)K_t\eta_{d^*z^*} p_t^{1-\sigma}(1+\eta_z + z_t\eta_{zz})(1+\varepsilon_t + 1/A_t)^2 \frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}}$$

$$- 1/A_t\eta_{dz}\eta_{d^*z^*}c_t K_t \frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}} p_t^{1-\sigma}\}.$$

Consumption increases when ε_t increases if the following condition holds

$$\{[(r+\varepsilon_t) - (1+\varepsilon_t + \frac{1}{A_t})]\delta_t + \eta_d\} - \{r\delta_t^* + K_t\eta_{d^*}\} >$$

$$[(1 - A_t(1+\varepsilon_t + \frac{1}{A_t})d_t^* K_t\eta_{d^*d^*} - d_t\eta_{dd}].$$

If the above condition does not hold, then consumption decreases.

The effect of a change in ε_t on domestic currency loans is

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$\frac{\partial z_t^*}{\partial \varepsilon_t}$ =

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$$\frac{\partial z_t}{\partial \varepsilon_t} = \frac{1}{(1+\varepsilon_t + 1/A_t)^3} \frac{(1-\sigma)p_t^{\sigma-1}}{\Delta} \{[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t + 1/A_t)^2 + (1/A_t)^2 \eta_{dd} +$$

$$(1+\varepsilon_t)K_t\eta_{d^*d^*}]\,(1+\varepsilon_t + 1/A_t)^2 \frac{1}{\sigma} z_t^{*\frac{1}{\sigma}} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} p_t^{1-\sigma} K_t \eta_{z^*z^*} +$$

$$[1 + r\delta_t^* + K_t\eta_{d^*} + 1/A_t\delta_t]\,(1+\varepsilon_t + 1/A_t)^2 K_t \eta_{d^*z^*} \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} (1+\varepsilon_t)^{\frac{1}{\sigma}}$$

$$p_t^{1-\sigma} + 1/A_t z_t p_t^{\frac{1-\sigma}{\sigma}} \eta_{dz} [\frac{1}{\sigma} z_t^{*\frac{1-2\sigma}{\sigma}} p_t^{-\frac{(1-\sigma)^2}{\sigma}} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1 + K_t\eta_{z^*})^{\sigma-2}$$

$$K_t\eta_{z^*z^*}] - (1+\varepsilon_t + 1/A_t)^2 K_t^2 \eta_{d^*z^*}^2 \frac{1}{\sigma} z_t^{*\frac{1}{\sigma}} (1+\varepsilon_t)^{\frac{1}{\sigma}} p_t^{1-\sigma} -$$

$$K_t\eta_{dz}\eta_{d^*z^*} 1/A_t (1+\varepsilon_t + 1/A_t)^2 \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} z_t (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} p_t^{1-\sigma}\}.$$

This effect is positive, thus domestic currency loans always increase when the rate of devaluation increases.

The effect on dollar loans is the following

$$\frac{\partial z_t^*}{\partial \varepsilon_t} = \frac{1}{(1+\varepsilon_t + 1/A_t)^3} \frac{(1-\sigma)p_t^{\sigma-1}}{\Delta} \{-[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t + 1/A_t)^2 + (1/A_t)^2 \eta_{dd} +$$

$$(1+\varepsilon_t)K_t\eta_{d^*d^*}]\,(1+\varepsilon_t + 1/A_t)^2 \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} (1+\varepsilon_t)^{\frac{1-2\sigma}{\sigma}} p_t^{1-\sigma}(1 + \eta_z + z_t\eta_{zz}) +$$

$$p_t^{\frac{1-\sigma}{\sigma}} (1 + \eta_z + z_t\eta_{zz})(1 + K_t\eta_{z^*})^{\sigma-2} K_t \eta_{d^*z^*} (1+\varepsilon_t + 1/A_t)^2 [1 + r\delta_t^* +$$

$$K_t\eta_{d^*} + 1/A_t\delta_t] + (1/A_t)^2 (1+\varepsilon_t + 1/A_t)^2 \eta_{dz}^2 \frac{1}{\sigma} z_t^{*\frac{1-\sigma}{\sigma}} z_t (1+\varepsilon_t)^{\frac{1-2\sigma}{\sigma}} p_t^{1-\sigma} +$$

$$1/A_t (1+\varepsilon_t + 1/A_t)^2 K_t \eta_{dz}\eta_{d^*z^*} \frac{1}{\sigma} z_t^{*\frac{1}{\sigma}} (1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} p_t^{1-\sigma}\}.$$

The effect is negative; however, the effect on $z_t^*(1+\varepsilon_t)$ is positive. As both z_t and $z_t^*(1+\varepsilon_t)$ increase, I calculate the effect on CD_t using Eq. (A.12). Similar to the preference shock, a sufficient condition for CD_t to increase is

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$$p_t(1+K_t\eta_{z^*}) \leq (1-\sigma)^{\frac{1}{1-\sigma}}.$$

Imports of intermediate good increase since $n_t = z_t^*(1+\varepsilon_t)/p_t$ and $z_t^*(1+\varepsilon_t)$ increases. According to Eq. (2.10), the real wage is equal to domestic currency loans. Thus the real wage increases. Output increases since $y_t = (n_t^{1-\frac{1}{\sigma}} + 1)^{\frac{\sigma}{\sigma-1}}$ and n_t increases.

A.3. Proof of Proposition 3

Use the following vector to calculate the effects of a change in K_t on c_t, z_t, and z_t^*, respectively

$$\begin{pmatrix} (1+\varepsilon_t)\eta_{d^*} \\ -z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}\eta_{z^*} \\ -(1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-2}\eta_{z^*} \end{pmatrix}$$

The effect of an increase in restrictions of dollar instruments on real consumption is

$$\frac{\partial c_t}{\partial K_t} = \frac{1}{1+\varepsilon_t + 1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}\{-(1+\varepsilon_t)\eta_{d^*}p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z + z_t\eta_{zz})$$

$$[\frac{1}{\sigma}z_t^{*\frac{1-2\sigma}{\sigma}}p_t^{-(\frac{1-\sigma}{\sigma})^2}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2}K_t\eta_{z^*z^*}] +$$

$$1/A_t\eta_{dz}p_t^{1-\sigma}\eta_{z^*}\frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2}\eta_{z^*}p_t^{\frac{1-\sigma}{\sigma}}$$

$$(1+\eta_z + z_t\eta_{zz})(1+\varepsilon_t)K_t\eta_{d^*z^*}\}.$$

Thus consumption decreases, and so do the levels of domestic currency and dollar deposits. However, deposit dollarization does not change, since it only depends on households' preference and rate of devaluation.

The effect of a change in K_t on domestic currency credit is

$$\frac{\partial z_t}{\partial K_t} = \frac{1}{1+\varepsilon_t + 1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}\{-[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t + 1/A_t)^2 + (1/A_t)^2\eta_{dd} + (1+\varepsilon_t)K_t$$

$$\eta_{d^*d^*}]\frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}p_t^{1-\sigma}\eta_{z^*} - (1+\varepsilon_t)K_t\eta_{d^*z^*}(1+K_t\eta_{z^*})^{\sigma-2}\eta_{z^*}$$

$$1/A_t z_t p_t^{\frac{1-\sigma}{\sigma}}\eta_{dz} + (1+\varepsilon_t)\eta_{d^*}[\frac{1}{\sigma}z_t^{*\frac{1-2\sigma}{\sigma}}p_t^{-(\frac{1-\sigma}{\sigma})^2}(1+\varepsilon_t)^{\frac{1-\sigma}{\sigma}} + (1+K_t\eta_{z^*})^{\sigma-2}$$

$$K_t\eta_{z^*z^*}]1/A_t z_t p_t^{\frac{1-\sigma}{\sigma}}\eta_{dz} + K_t\eta_{d^*z^*}\eta_{d^*}\frac{1}{\sigma}z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}+1}p_t^{1-\sigma}\}.$$

This effect is negative, thus domestic currency loans decrease when K_t increases. The effect on dollar loans is

$$\frac{\partial z_t^*}{\partial K_t} = \frac{1}{1+\varepsilon_t + 1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}(1+K_t\eta_{z^*})^{\sigma-2}\{-\eta_{z^*}[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t + 1/A_t)^2 + (1/A_t)^2$$

$$\eta_{dd} + (1+\varepsilon_t)K_t\eta_{d^*d^*}]p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z + z_t\eta_{zz}) + (1/A_t)^2\eta_{z^*}z_t p_t^{\frac{1-\sigma}{\sigma}}\eta_{dz}^2 +$$

$$K_t\eta_{d^*z^*}p_t^{\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)\eta_{d^*}](1+\eta_z + z_t\eta_{zz})\}.$$

The effect is negative. Since both z_t, and z_t^* increase, I calculate the effect on CD_t using Eq. (A.12). Similar to the two other shocks discussed before, a sufficient condition for CD_t to decrease is

$$p_t(1+K_t\eta_{z^*}) \leq (1-\sigma)^{\frac{1}{1-\sigma}}.$$

Imports of intermediate good decrease as $n_t = z_t^*(1+\varepsilon_t)/p_t$ and z_t^* decreases. According to Eq. (2.10), the real wage is equal to domestic currency loans, thus the real wage decreases. Output decreases, since $y_t = (n_t^{1-\frac{1}{\sigma}} + 1)^{\frac{\sigma}{\sigma-1}}$ and n_t decreases.

A.4. Proof of Proposition 4

Use the following vector to calculate the effects of a change in p_t on c_t, z_t, and z_t^*

$$\begin{pmatrix} 0 \\ z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}(1+K_t\eta_{z^*}) \\ (1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-1}-1 \end{pmatrix}$$

The effect of a shock to terms of trade on real consumption is

$$\frac{\partial c_t}{\partial p_t} = \frac{1}{1+\varepsilon_t+1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}\{1/A_t z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}\eta_{dz}(1+K_t\eta_{z^*}+z_t^* K_t\eta_{z^*z^*})-$$

$$(1+\varepsilon_t)K_t\eta_{d^*z^*}p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z+z_t\eta_{zz})[(1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-1}-1]\}.$$

A sufficient condition for consumption to decrease is

$$p_t(1+K_t\eta_{z^*}) \geq (1-\sigma)^{\frac{1}{1-\sigma}}.$$

The effect of a change in p_t on domestic currency loans is

$$\frac{\partial z_t}{\partial p_t} = \frac{1}{1+\varepsilon_t+1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}\{-[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t+1/A_t)^2+(1/A_t)^2\eta_{dd}+(1+\varepsilon_t)K_t$$

$$\eta_{d^*d^*}]z_t^{*\frac{1-\sigma}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}(1+K_t\eta_{z^*}+z_t^*K_t\eta_{z^*z^*})+(1+\varepsilon_t)^{\frac{1+\sigma}{\sigma}}K_t^2\eta_{d^*z^*}z_t^{*\frac{1}{\sigma}}+$$

$$(1+\varepsilon_t)K_t\eta_{d^*z^*}p_t^{\frac{1-\sigma}{\sigma}}(1/A_t)z_t\eta_{dz}[(1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-1}-1]\}.$$

This effect is negative, thus domestic currency loans always decrease when terms of trade increase.

The effect on dollar loans is

$$\frac{\partial z_t^*}{\partial p_t} = \frac{1}{1+\varepsilon_t+1/A_t}\frac{(1-\sigma)p_t^{\sigma-1}}{\Delta}\{[\frac{1}{\lambda}\frac{1}{c_t^2}(1+\varepsilon_t+1/A_t)^2+(1/A_t)^2\eta_{dd}+(1+\varepsilon_t)K_t\eta_{d^*d^*}]$$

$$p_t^{\frac{1-\sigma}{\sigma}}(1+\eta_z+z_t\eta_{zz})[(1-\sigma)p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-1}-1]-(1/A_t)^2z_tp_t^{\frac{1-\sigma}{\sigma}}\eta_{dz}^2[(1-\sigma)$$

$$p_t^{\sigma-1}(1+K_t\eta_{z^*})^{\sigma-1}-1]-(1/A_t)\eta_{dz}z_t^{*\frac{1}{\sigma}}(1+\varepsilon_t)^{\frac{1}{\sigma}}p_t^{\sigma-1}K_t\eta_{d^*z^*}(1-\sigma)\}.$$

If the following condition holds

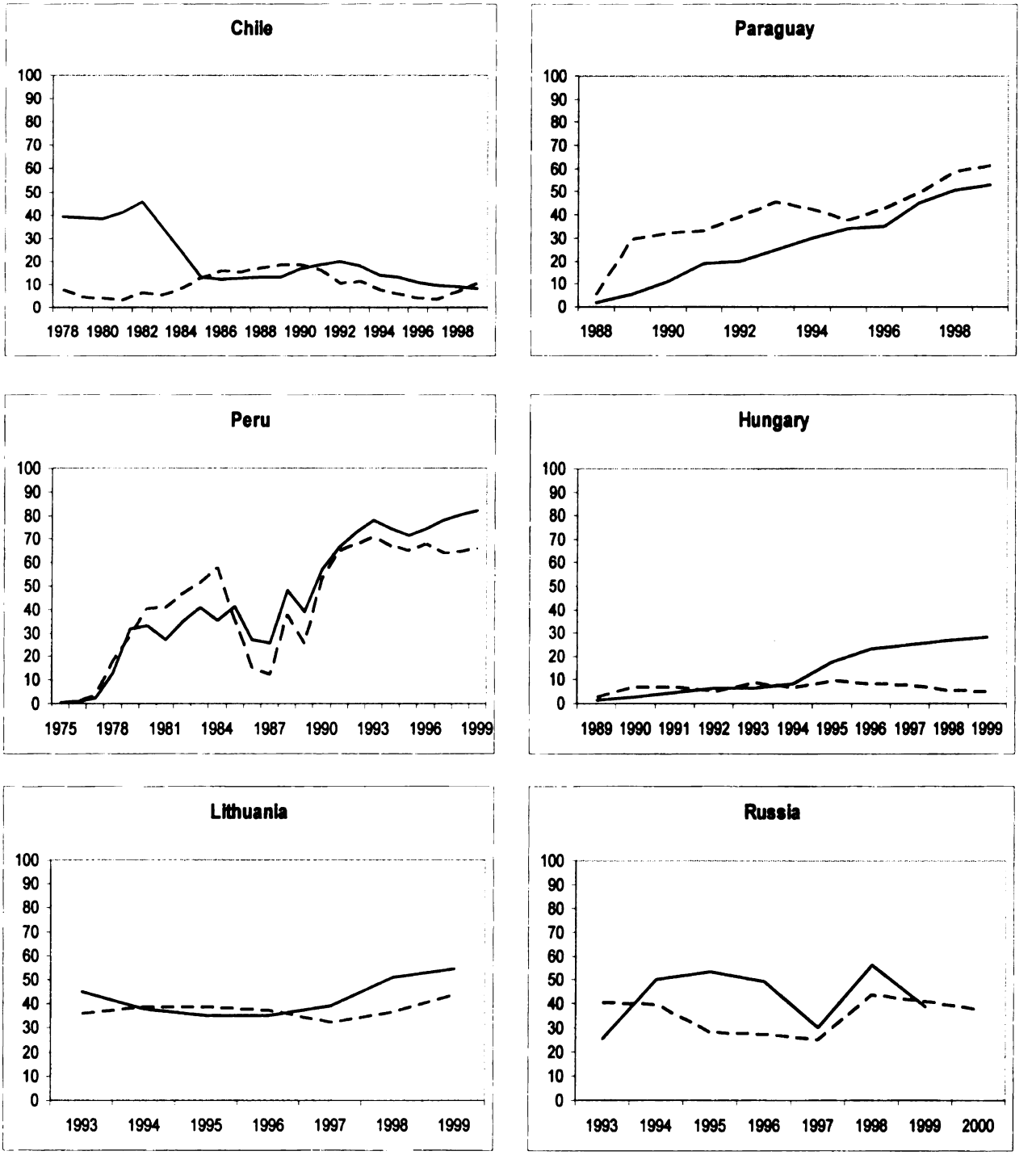
$$p_t(1+K_t\eta_{z^*}) \leq (1-\sigma)^{\frac{1}{1-\sigma}},$$

then z_t^* increases. This is also a sufficient condition for CD_t to increase, since z_t drops in all cases. If the above condition does not hold, z_t^* decreases, and the effect on CD_t is ambiguous.

The real wage decreases unambiguously. Output and imports decrease if z_t^* decreases, that is, if the above condition does not hold. If the condition holds, the effect on output and imports of intermediate goods is ambiguous.

Figure 1 Credit and Deposit Dollarization in Emerging Market and Transition Economies

(Credit Dollarization denoted by continuous line; Deposit Dollarization denoted by dotted line. Data are from Arteta (2002) and (2003)).



Credit Dollarization (%): Dollar Credit/Total Credit (to the resident private sector issued by resident banks)
Deposit Dollarization (%): Dollar Deposits/Total Deposits (of residents held in resident banks)

CHAPTER 2

CREDIT DOLLARIZATION IN TRANSITION ECONOMIES: IS IT FIRMS' OR BANKS' "FAULT"?

1. Introduction

Dollarization of bank deposits and loans is widespread in emerging market and transition economies. Since levels of foreign currency deposits and credit vary widely across countries and over time, the causes and consequences of financial dollarization deserve thorough analysis.[1]

Much of the current literature analyzes the risks imposed by financial dollarization and the policy options in highly-dollarized economies. It shows that financial dollarization complicates monetary policy and limits available policy instruments. However, only a few studies evaluate the determinants of dollarization. In particular, deposit dollarization has been theoretically and empirically studied in the context of currency substitution. Credit dollarization and the respective contributions of banks and firms to the dollarization process have received less attention. Is credit dollarization the outcome of a unilateral decision by domestic banks? Or is it driven by

[1] Financial dollarization occurs when a significant share of residents' domestic financial contracts (including deposits and loans) are denominated in foreign currencies, not necessarily the US dollar. Dollar deposits and loans denote all foreign currency deposits and loans. In addition, deposit dollarization and credit dollarization refer to the phenomenon of denominating deposits and loans in foreign currencies.

domestic firms' integration in the international goods market? This chapter attempts to shed light on these issues.

Currently, only two empirical studies, Arteta (2002) and Barajas and Morales (2003), analyze the determinants of credit dollarization. Arteta (2002) evaluates the effect of the exchange rate regime on credit dollarization (and more generally on bank currency matching of deposits and loans) for a sample of developing and transition economies. He finds that credit dollarization, unlike deposit dollarization, does not vary across exchange rate regimes.[2] Thus, volatility in the exchange rate cannot fully explain differences in dollarization patterns. Barajas and Morales (2003) use data on bank- and firm-specific factors, in addition to macroeconomic variables, for fourteen Latin American economies to explore possible biases introduced by domestic monetary policy into the decisions by banks and firms to lend and borrow in dollars. Their results indicate that both bank asset and firm liability allocation decisions are important determinants of dollarization. They also find limited evidence that the greater the volatility in the exchange rate, the lower the level of credit dollarization, at least in the short run.

This chapter extends the existing work on credit dollarization, first, by using a comprehensive, newly-assembled dataset on transition economies, and, second, by estimating and comparing the respective contribution of firms and banks to the financial dollarization phenomenon.

This work draws on two other literatures in economics and financial management. The first literature concerns the determinants of currency composition of corporate debt,

[2] He finds some limited evidence that credit dollarization decreases with a more flexible exchange rate regime. Overall, his paper provides evidence that a more flexible exchange rate regime tends to amplify bank currency mismatches as credit dollarization does not change (or it decreases), while deposit dollarization increases.

regardless of the source (domestic or foreign investors). It highlights firms' hedging behavior as a potential determinant of credit dollarization. A portfolio of loans denominated in more than one currency can provide an improved risk and cost position (see Cotner (1991)). In addition, empirical papers provide evidence that firms borrow in dollars for hedging reasons. Larger firms, and firms with exporting activities, borrow more in foreign currencies (see Aguiar (2002), and Martínez and Werner (2002), for evidence for firms from developing economies, Keloharju and Niskanen (2001), Kedia and Mozumdar (2002), and Giraldi and Hamaui (1991), for evidence for firms from developed economies).

The second literature studies the determinants of deposit dollarization. Macroeconomic factors, such as uncertainty and non-credible domestic policies, as well as persistence effects,[3] are found to play an important role for deposit dollarization (see Honohan and Shi (2002), and Ize and Levy Yeyati (2003)). In addition, safety nets for banks, such as insurance schemes and the presence of a lender of last resort, are also believed to encourage deposit dollarization (see Broda and Levy Yeyati (2003)). I control for these macroeconomic factors as they will most likely affect credit dollarization.

This chapter analyzes the respective contributions of banks and firms to the phenomenon of dollarization of credit in transition economies. Why do domestic banks in these countries lend in foreign currencies? Why do domestic firms borrow domestically in foreign currencies? Is credit dollarization mainly supply or demand-

[3] Historically high levels of dollar deposits might persist over time, even after the initial causes of dollarization (which are believed to be macroeconomic uncertainty and non-credible domestic policies) no longer exist.

driven? Ultimately, I would like to contribute to a better assessment of the risks associated with financial dollarization, and suggest what policy measures (if any) should be implemented to control or restrict it.

I use a newly-constructed dataset for twenty-two transition economies from Central and Eastern Europe and Central Asia, for the period 1990 - 2001, and group potential determinants into bank- and firm-specific (financial and mainly real) factors. Bank-specific factors include indicators of asset and liability management and currency matching, profitability, concentration, and risk management. As firm-specific factors, I use measures of real dollarization[4] and access to alternative financing sources. In addition, I include specific indicators of overall hedging opportunities, liberalization, and deregulation of the foreign exchange market, uncertainty and lack of credibility of domestic policies, and persistence effects, as well as measures of overall financial and economic development.

I estimate a reduced form equation, and use the pooled OLS estimator as a benchmark. I then extend the analysis and use the first difference and fixed effects estimators to control for unobserved heterogeneity. Main results seem to be robust across specifications.

Empirical results provide evidence that credit dollarization in transition economies is determined by banks' optimization decisions (asset and liability management variables). Banks match the currency of denomination of their assets and

[4] I define real dollarization as the denomination of the returns and costs of production for firms in foreign currencies. That is, firms export the final good and/or use imported intermediate goods in the production of the final good.

liabilities, that is, deposit dollarization drives credit dollarization, and net foreign assets represent a substitute for foreign currency loans to domestic firms.

In addition, there is limited evidence of firms hedging the currency of their returns of production and debt. A higher ratio of exports to GDP increases credit dollarization. More generally, the more integrated is the economy in the international goods market (higher trade to GDP ratio), the higher is credit dollarization. This result suggests that integration of international goods and financial markets, real and financial dollarization respectively, move in the same direction. It questions the previous (counterintuitive) finding (see Arteta (2002) and Barajas and Morales (2003)) that the openness of the economy has a negative effect on credit dollarization.

This chapter provides evidence that lack of credibility of monetary policy and macroeconomic uncertainty (measured by the central bank's net foreign reserves) raise dollarization levels. In addition, there is some evidence of persistence effects in credit dollarization. That is, historically high values of the devaluation/depreciation rate seem to lead to higher credit dollarization over time.

To summarize, banks in transition economies hedge against exchange rate risk by holding matched foreign exchange positions. However, as Ize and Parrado (2002) point out, as long as financial dollarization outpaces real dollarization, and this seems to be the case in transition countries, there is a currency mismatch somewhere in the economy. I show that banks pass the exchange rate risk to firms. This decreases banks' exposure to currency risk, but it increases their exposure to default risk, and ultimately the exposure of the economy to financial and currency crises (Krugman (1999) is the first author to focus on firm currency mismatches, and their role as a main ingredient in twin crises).

My results have several policy implications. Since macroeconomic credibility and past and current uncertainty have a positive effect on credit dollarization, reducing them would also reduce dollarization. Restrictions on dollar lending by domestic banks to residents, however, might lead to the "export" of deposits and financial disintermediation as banks want to have matched asset and liability positions, and could substitute dollar loans with foreign assets instead of domestic currency loans.

The remainder of the chapter is organized as follows. Section 2 reviews the theoretical background and presents the main hypotheses for the bank- and firm-related effects on credit dollarization. Section 3 outlines the econometric model and the estimation methods. Section 4 describes the data, while section 5 presents the empirical results. I perform several robustness tests in section 6. Section 7 discusses policy implications and directions for future work.

2. Conceptual Framework and Main Hypotheses

To assess the extent to which credit dollarization is mainly a financial (bank-determined) or a real (firm-determined) phenomenon, I separate potential determinants into 1) factors that affect only the supply of foreign currency credit (relative to domestic currency credit), 2) factors that affect only the demand for foreign currency credit (relative to domestic currency credit), and 3) factors that affect both demand and supply of credit, as well as additional controls.

2.1. Bank-specific Factors

2.1.1. Asset and Liability Management

I expect banks to match their foreign currency positions, either because they do not want to be exposed to the exchange rate risk, or because they are required to do so (open foreign exchange position limits are enforced), or both. Calvo (2001) and (2002) proposes bank currency matching as a possible explanation for the high levels of dollar loans in emerging economies, given that deposits are highly dollarized. Ize and Levy Yeyati (2003) also argue that banks hold foreign exchange matched positions, not only because of regulation requirements, but also because they are "generally adverse to assuming risk directly" (pg. 8).

An increase in deposit dollarization should increase credit dollarization as banks match the currency of denomination of their deposits and loans. If instead banks match by currency the level of overall assets and liabilities, which seems to often be the case in transition economies,[5] then an increase in foreign assets and a decrease in foreign liabilities[6] will both decrease credit dollarization. More generally, an increase in net foreign assets is expected to have a negative effect on credit dollarization as banks substitute foreign currency loans to domestic firms with foreign assets, for a given level of dollar deposits.

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[5] For several transition economies, there are limits imposed on the open foreign exchange positions, which refer to banks' balance-sheet foreign currency assets and liabilities in the corresponding foreign currencies and off-balance-sheet commitments related to foreign exchange buying and selling transactions.

[6] I can safely assume that foreign assets and liabilities are denominated entirely in foreign currencies. There is a trend in the economics literature that tries to explain the inability of emerging economies to borrow externally in their own currency, the so-called "original sin" (see Hausmann et al. (2001), who has identified this problem).

2.1.2. Profitability and Risk-taking Behavior

There is little guidance from previous theoretical and empirical work as to what to expect from the direction of effects of profitability, risk-taking behavior, and concentration on the currency of denomination of bank credit. Hence, my main goal is to determine *if* there is any evidence that these bank and firm characteristics are significantly related to credit dollarization.

I implicitly assume that all domestic agents, banks and firms, expect domestic currency to depreciate in the future. Hence, unless a firm's return is perfectly indexed to the exchange rate, the risk of default on foreign currency credit is higher than on domestic currency credit. For banks, foreign currency credit is riskier than domestic currency credit; the return is higher, provided that domestic currency indeed depreciates before the credit is repaid; however, the default risk is also higher.[7]

I hypothesize that less profitable banks are willing to incur higher risks. Hence, they extend more dollar loans. Also, "riskier" banks, banks with higher asset riskiness, will lend more in dollars.[8]

I also expect deposit insurance to have a positive effect on credit dollarization when dollar deposits are covered by the insurance scheme,[9] as it provides bailout guarantees for banks. According to the moral hazard hypothesis, banks are more likely to engage in excessive risk-taking (see Demirgüç-Kunt and Huizinga (2003) and Broda and

[7] Using a simple theoretical model, Arteta (2002) shows that the default risk for the dollar credit increases with the currency risk.

[8] I do not consider the effect of dollar lending on the profitability and riskiness of banks. Since I am interested in banks' characteristics prior to lending, I use lagged measures in my estimations.

[9] Data on deposit insurance in transition economies show that for all countries but the Czech Republic, prior to 2001, the insurance scheme also covers the dollar deposits.

Levy Yeyati (2003)). The currency risk is shifted to the borrowers, and this ultimately increases the default risk.

2.1.3. Concentration

The effect of bank concentration on credit dollarization is not straightforward. Drawing on previous work, I can identify two alternative explanations, and ultimately the expected effect is ambiguous.

Catão and Terrones (2000) theoretically show that the higher the concentration in the banking industry, the lower the equilibrium dollarization levels. The higher banks' market power, the more they will exercise it in lending. Naturally, banks' market power is higher for borrowers that do not have access to direct borrowing from abroad (denoted below as "external borrowing"). These are borrowers in the non-traded goods sector, or borrowers that do not have traded collateral. Thus, they demand domestic currency credit. Therefore, concentration tends to increase lending in domestic currency and reduce lending in dollars.

An alternative explanation is that high concentration of banks will lead to more credit dollarization due to implicit bailout guarantees. The more concentrated the banking sector is, the higher is the probability that a bank will be bailed out should a bank run happen (as the risk of a systemic financial collapse is higher). This encourages excessive risk-taking by banks,[10] and if indeed "riskier" banks lend more in dollars, it should lead to higher dollarization in equilibrium.

[10] The argument is similar to the case of deposit insurance, whose simple existence might generate moral hazard.

2.2. Firm-specific Factors

2.2.1. Liability Management

Firms that have access to alternative sources of external finance are expected to rely less on credit from domestic banks. Hence, I expect firms' credit from abroad to have a negative effect on credit dollarization, since I believe that external loans are a substitute for foreign currency loans from domestic banks.

On the other hand, it is possible that the access to external borrowing is conditional on domestic borrowing in dollars. Foreign lenders (who presumably have less information on domestic firms) might extend loans only to those that have already received a dollar loan from domestic banks (which presumably have more information). If this is the case, then external loans and foreign currency loans from domestic banks are complements, and more credit dollarization will lead to more external credit. [11]

Barajas and Morales (2003) show that for the case of firms in Latin American economies, external credit is a substitute for the domestic foreign currency credit.

2.2.2. Hedging Behavior

Conventional wisdom suggests that firms tend to match the currency composition of their debt with that of costs and revenues. If this is the case, financial dollarization is a natural consequence of real dollarization.

[11] In this case, the level of credit dollarization would determine the level of external credit, and the external credit would be endogenous in the specification of credit dollarization. Aguiar (2002) shows a positive relation between domestic dollar credit and external equity. According to his paper, firms that issue equity abroad are also likely to borrow in dollars domestically. Testing the reverse causality is beyond the scope of this chapter.

First, firms might use imported intermediate goods in the production process, and thus want to hedge against the cost of interruption in the production process should the exchange rate change from the moment the loan is contracted and until it is used to pay for imports. If this is the case and foreign currency loans are indeed used to pay for imported goods, then I should see a positive effect of intermediate good imports on credit dollarization. Hence, the more dependent is the economy on foreign intermediate goods, the higher is the credit dollarization.[12]

Second, firms with exporting activities, and thus returns denominated in foreign currencies, are hedged against currency risk if they also borrow in foreign currency. The higher are the exports, relative to domestic production, the more dollarized the economy should be. Studies that use firm level data find evidence that the productive structure matters for the corporate debt currency composition.[13]

Regardless of what firms hedge against, production interruptions or currency risk, the trade openness of the economy, broadly defined as total trade per GDP, should have a positive effect on credit dollarization (see also Ize and Parrado (2002)). Therefore, I expect real dollarization to cause financial dollarization.[14] This is the opposite effect from what previous empirical work using aggregate data finds. Both Arteta (2002) and Barajas and Morales (2003) find that openness has a negative impact on dollarization.

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[12] Delgado et al. (2002) also mention the import financing as a possible explanation for domestic lending in foreign currency.

[13] Aguiar (2002) and Martínez and Werner (2002) use data on Mexican firms, and show that exporting firms borrow more in foreign currencies. Kedia and Mozumdar (2002) find that US firms performing foreign operations borrow more in foreign currencies. Keloharju and Niskanen (1997) also find evidence for the hedging explanation using data on Finnish firms. Giraldi and Hamaui (1991) show that the currencies used to settle international trade determine the currency composition of debt for Italian firms.

[14] Ize and Levy Yeyati (2003) reach a similar conclusion using a MVP (minimum variance portfolio) model. Real dollarization is however measured by the pass-through coefficient of exchange rate changes on prices.

Their result is counterintuitive (and contrary to what studies using firm level data find), and suggests either an omitted variable or an aggregation bias.

In addition to the share of imports, exports, and total trade, in GDP, I consider changes in international prices, and their effects on dollar credit. I expect an increase in import prices to increase firms' borrowing in dollars, if firms use dollar credit for import financing. An increase in export prices should also increase credit dollarization, if exporting firms finance (an increase in) production using dollar loans.

Another firm characteristic that should matter for the currency composition of firm liabilities is firm size. Previous work finds evidence that large firms borrow more in dollars, since they can better diversify and manage risks than small firms.[15] Thus I expect the average size of firms in the economy to have a positive effect on credit dollarization.

2.2.3. Profitability and Risk-taking Behavior

The effects of firm characteristics, other than size, on equilibrium dollarization levels are not straightforward. I hypothesize that less profitable firms and riskier firms will choose to borrow in foreign currencies, everything else equal. I believe that dollar loans are associated with a higher default risk. Therefore, firm profitability should have a negative effect and firm risk-taking behavior a positive effect on dollar credit.[16]

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[15] See Aguiar (2002), Martínez and Werner (2002), and Keloharju and Niskanen (1997). Martínez and Werner (2002) show that firm size matters more under fixed than under floating exchange rate regimes. When switching to a floating exchange rate regime, a firm's exporting activities become the most important determinant. Alternatively, Aguiar (2002) hypothesizes that firm size matters for debt dollarization due to a fixed cost to borrowing in dollars, which makes it worthwhile only for large firms.

[16] Similarly to the bank case, it is difficult to say a priori what the effect should be, due to a lack of theoretical and empirical work on the link between profitability and risk-taking behavior, on one hand, and dollar borrowing, on the other hand. Jeanne (1999) evaluates profitability in connection to dollar debt. However, he considers the reverse effect, from currency composition to profits. He models dollar debt as a

2.3. Macroeconomic Factors and Other Controls

2.3.1. Overall Hedging Opportunities

In countries where the currency forward market exists and is functional, economic agents can use it to hedge against currency risk. Therefore, I expect to see more borrowing and lending in foreign currencies, given that agents do not have to worry about unmatched foreign exchange positions.[17]

The exchange rate regime can play a similar role. The majority economists' view (see, for example, Burnside et al. (2000), Mishkin (1996), and Obstfeld (1998)) is that a fixed exchange regime offers implicit guarantees (implicit exchange rate insurance) and eliminates the need to hedge against the currency risk, provided that it is credible. This implies that over time a more flexible exchange rate should reduce credit dollarization.[18] It also suggests that across countries the levels of dollarization should be higher in countries with fixed exchange rate regimes, when controlling for any credibility issues.

2.3.2. Restrictions on the Foreign Exchange Operations

Regulations of the foreign exchange market should play an important role in explaining the levels and patterns of dollarization in emerging market and transition

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commitment device. According to his model, firms that borrow in dollars put in higher effort and end up being more profitable. Aguiar (2002), however, shows that in the wake of devaluation, the presence of dollar debt reduces firms' net wealth. Neither of these studies indicates if a priori more profitable firms will borrow in dollars or domestic currency, everything else equal.

[17] Burnside et al. (2000) argue that the forward market can be used to alleviate the bank currency mismatches, and banks can borrow in dollars, and lend in domestic currency. If this is the case, the effect on credit dollarization should be negative. A similar argument applies to exporting/importing firms: they can borrow in domestic currencies, and hedge against the currency risk using derivatives.

[18] Martínez and Werner (2002) find empirical support for this hypothesis, using micro data on Mexican firms. Arteta (2002), on the other hand, finds evidence that credit dollarization does not vary with the exchange rate regime (there is some limited evidence that it decreases for more flexible regimes, but this

economies. The more restrictions placed on lending domestically in dollars, the lower is the level of credit dollarization.[19] More generally, I hypothesize that the overall liberalization of trade and foreign exchange operations should have a positive effect on dollarization.

2.3.3. Level of Financial Development

Previous theoretical work suggests that the level of development of the financial sector has a negative effect on credit dollarization. Caballero and Krishnamurthy (2002) show that the less developed the domestic financial market is, the less domestic economic agents (with returns in domestic currency) value the insurance against currency risk offered by domestic currency credit, and the more likely they are to borrow in dollars. Another way to think about this effect is that more developed domestic banks internalize the currency risk better and prefer to lend to firms in domestic currency. In the above interpretations, financial development should reduce the dollarization of credit, everything else equal.

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result is not robust across specifications). Furthermore, he shows that currency mismatches in the banking sector increase with increased flexibility of the exchange rate regime.

[19] Delgado et al. (2002) describe the patterns for restrictions on foreign currency lending in emerging economies. The highly-dollarized economies tend to have no restrictions, while the prohibition of dollar lending is very rare. The requirement that dollar lending has to be approved by officials is most commonly used as a controlling mechanism. Alternative restrictions involve access to dollar credit only by firms with dollar returns and/or dollar payments.

2.3.4. Level of Economic Development

I expect overall economic development to reduce dollarization. Thus, GDP per capita should have a negative effect on the dollarization of credit. The argument is similar to that for overall financial development.

2.3.5. Overall Uncertainty, Lack of Credibility of Domestic Policies, and Persistence Effects

Higher uncertainty and lack of credibility of domestic policies should lead to higher dollarization levels, for both deposits and loans. Jeanne (2001) argues that the uncertainty with respect to domestic monetary policy increases the cost of borrowing/lending in domestic currency (the so called "peso effect") and the level of borrowing/lending in dollars. Similarly, Delgado et al. (2002) argue that uncertainty about potentially high future depreciation associated with a high real interest rate for domestic currency lending make foreign currency lending more attractive, regardless of the risks involved.

In general, higher inflation/devaluation might reduce the credibility of the domestic currency, and thus cause a switch from domestic currency deposits and loans to those denominated in foreign currency.[20]

An alternative measure of uncertainty and lack of credibility is the level of net foreign reserves held by the monetary authority. A higher level of reserves might signal

[20] Some authors (see Ize and Levy Yeyati (2003) and Ize and Parrado (2002)) argue that it is not the first moment, but the volatility of inflation and the real exchange rate that affect dollarization. I leave the estimation of volatility effects on credit dollarization for future work.

higher credibility in domestic currency, and higher sustainability of the monetary regime. This should have a negative effect on dollarization (see Ize and Parrado (2002)).

Historically high values of inflation and devaluation rates should positively affect dollarization if there are any persistence/hysterises effects in the dollarization variables. Higher past uncertainty with respect to the price and exchange rate level might have an impact in the present, if economic agents get used to borrowing in foreign currencies even after the uncertainty with respect to the domestic currency was curbed, or if the stabilization is not credible.

3. Econometric Model and Estimation Methods

I combine the (relative) demand and supply equations, and estimate the following reduced-form equation[21]

$$Credit\_Dollarization_{it} = \alpha' Bank\_Variables_{it} + \beta' Firm\_Variables_{it} + \gamma' Controls_{it} + \varepsilon_{it}.$$

Credit_Dollarization denotes the level of dollar credit (from domestic banks to domestic firms) in the economy, calculated as the ratio of foreign currency loans to total loans, or using a broader measure, as the ratio of foreign currency loans to total bank assets. *Bank_Variables* stands for the set of variables related to the banking sector, described further in Section 4.2, which identify the supply-side of credit dollarization. *Firm_Variables* denotes the set of variables related to the real sector, described in Section 4.3, which measure the demand-side of credit dollarization. *Controls* measures all other

[21] The cost of foreign currency (relative to domestic currency) credit is eliminated from the reduced-form equation. Data on foreign currency interest rates are very scarce (for some countries, they are entirely missing). Furthermore, I estimate the effects of bank- and firm-specific variables on equilibrium credit dollarization, rather than on supply and demand separately.

factors that affect both demand and supply of dollar credit, or which capture country-specific effects. Finally, ε is a disturbance term.

I use pooled OLS as the benchmark. I then extend the analysis and use the first difference and fixed effects estimators[22] to control for missing country-specific effects and check the robustness of my results to alternative specifications. I use alternative measures for dollarization and other variables to also check the robustness of results to alternative measures employed.

There are several methodological issues that need to be considered when estimating the above equation: 1) the identification problem; 2) persistence of credit dollarization; and 3) endogeneity.

In order to be able to assess the contribution of demand and supply to the dollarization of credit, I need to have (at least) one demand-specific measure that does not affect the supply of foreign currency credit, and (at least) one supply-specific measure that does not affect the demand for foreign currency credit. Out of all firm variables, the measures of integration in the international goods market, as well as the changes in the international commodity prices, should have no effect on banks' supply of credit. On the supply side, bank asset and liability management variables (measures of currency matching) should be exogenous to firms' demand for credit. Therefore, I believe my equation is well identified, and I can distinguish demand and supply effects on dollarization.

[22] The fixed effects estimator works better than the random effects estimator when using aggregate data since the independent variables are likely to be correlated with the errors (the missing country-specific effect).

The second issue is that there might be persistence in the measures of credit dollarization, since I use measures of stock (and not flow) of loans. However, bank loans in transition economies have a shorter maturity than in most developed economies.[23] I start with the pooled OLS, which I use as benchmark. In addition, I use first difference and fixed effects estimators to control for unobserved heterogeneity, and compare the results obtained across specifications. In all specifications, the standard errors are adjusted for heteroskedasticity and serial correlation to account for the persistence problem.

A final issue is the problem of endogeneity. Mainly, the measures of asset and liability management for banks and liability management for firms might be endogenous. While I can safely assume that deposit dollarization is supply-driven and hence exogenous,[24] the measure of banks' net foreign assets is probably endogenous. Furthermore, firms' external borrowing is probably endogenous. I control for these problems by using Instrumental Variable specifications, where lagged values of banks' net foreign assets and firms' external borrowing are used as IVs.

[23] For example, the average credit period for bank loans (denominated in either domestic or foreign currency) for a sample of large firms for the period 1990 – 2001 is 70 days. The median credit period is even lower: 49.5 days.

[24] Even deposit dollarization might be endogenous, if firms are required to hold correspondent deposits (they have to hold foreign currency deposits with domestic banks, in order to obtain foreign currency credit). I show how the results change if I use households' deposit dollarization instead of, or as an IV for, overall deposit dollarization.

4. Data

4.1. Credit Dollarization Data

I have constructed a new unbalanced panel dataset for twenty-two transition economies from Central and Eastern Europe and Central Asia, covering the period 1990 - 2001.[25] Data on credit dollarization are annual, and were collected from various central bank publications. For some countries, data starts in early 90s. However, for most countries, data covers the second half of the 90s (see Table 1).

Two measures of credit dollarization are employed. The first one is the ratio of foreign currency credit to total credit, from domestic banks to domestic enterprises. The second measure is the ratio of foreign currency credit to enterprises to total bank assets for domestic banks. The first measure captures the substitution between foreign currency and domestic currency credit, while the second measure captures the substitution of foreign currency credit with any other bank assets, either domestic or foreign, denominated in either domestic or foreign currency.

4.2. Bank-specific Variables

I use the following data on the domestic banking sector in transition economies to measure factors that affect the equilibrium level of dollarization through the relative supply of foreign currency credit (a detailed description of the variables and data sources are provided in the Data Appendix).

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[25] Currently, despite the recognized importance of credit dollarization, these data are not systematically collected. Only data on deposit dollarization are included in the IMF International Financial Statistics. Studies that use credit dollarization data are Arteta (2002) and Barajas and Morales (2003). Arteta has credit data for forty developing and transition economies (for some transition economies, he has more data, for others, I do), while Barajas and Morales (2003) have data for fourteen Latin American economies.

- *Deposit dollarization ratio.* The ratio of foreign currency deposits to total deposits, held by residents at domestic banks. Alternative measures employed are the ratio of foreign currency deposits to total bank assets, and the ratio of foreign currency deposits to total bank credit.
- *Banks' net foreign assets.* I use three alternative measures: the ratio of net foreign assets to total bank deposits, the ratio of net foreign assets to total bank assets, and the ratio of net foreign assets to total bank credit.
- *Interest rate spread.* The spread between the average lending interest rate and average deposit interest rate (over all currencies and maturities).
- *Banks' profits.* The ratio of banks' pre-tax profits to the total bank assets.
- *Banks' risk-taking behavior.* The ratio of banks' total risk assets to total assets.[26]
- *Deposit insurance.* I define a dummy variable that takes the value 1 if there is explicit deposit insurance, zero if there is not, and use it as a measure of risk-taking behavior of domestic banks.
- *Banks' concentration.* The total number of banks per million people. As an alternative measure, I use the number of foreign banks operating domestically per million people.

4.3. Firm-specific Variables

The following variables measure firm-specific effects, through the demand for credit, on equilibrium credit dollarization:

[26] See the Data Appendix for the description of how banks' total risk assets are measured.

- *Firms' external borrowing.* I use two alternative measures: the ratio of foreign loans to non-bank private enterprises to total domestic credit, and the ratio of foreign loans to non-bank private enterprises to GDP.
- *Trade.* The ratio of trade (total imports plus total exports) to GDP.
- *Imports of intermediate goods.* The ratio of intermediate goods imports to GDP. The ratio of raw material imports to GDP and other components of imports are used as alternative measures.
- *Exports.* The ratio of total exports to GDP.
- *Index of total commodities.* The index of fuel and non-fuel commodity prices, aggregated over all countries.
- *Index of industrial inputs.* The changes in prices of industrial inputs aggregated over all countries.
- *Change in the oil price.* The change in the average world oil price.
- *Average firm size.* The average size of large firms[27], calculated as the logarithm of average total assets per company. An alternative measure I employ is the average number of employees per company.
- *Firms' profit margin.* The average profit margin for large firms, calculated as the ratio of net profit after taxes to total sales for a given 12-month period.
- *Firms' leverage ratio.* The average leverage ratio for large firms, calculated as long-term funds with fixed interest to total capital.

[27] All data on firms' size, profit, and leverage ratios are aggregated from Amadeus (a financial database of large companies in transition economies) and refer to (up) to fifty largest companies in the economy (by total assets). For some countries, data on less than fifty firms were available.

4.4. Other Variables

- *Forward market.* A dummy variable that takes the value 1 if a forward market for foreign exchange exists and is functional, zero it does not exist or is underdeveloped.
- *Exchange rate regime*: Dummy variables differentiating between fixed, intermediate, and floating "de facto" exchange rate regimes. I use three different specifications. The first is the new IMF classification for "de facto" exchange rare regimes, introduced in 1997. The second classification is constructed by Bubula and Otker-Robe (2002), and combines the new IMF classification with additional IMF internal data/country information. The third classification is introduced by Reinhart and Rogoff (2002) and classifies the regimes taking into account information on parallel exchange markets.
- *Index of foreign exchange and trade liberalization.* This EBRD index takes values from 1 (lowest) to 4.3 (highest liberalization). Alternatively, I use a dummy variable that takes the value 1 if there are any repatriation or surrender requirements of export proceeds, zero otherwise. Additionally, I use a dummy variable that takes the value 1 if there is any tax imposed on foreign exchange transactions, zero otherwise.
- *Financial development.* The ratio of domestic credit to enterprises to GDP. Alternative measures used are the ratio of total domestic deposits to GDP, total M2 to GDP, as well as EBRD indices of banking sector and non-banking financial institutions reform, which take values from 1 (lowest) to 4.3 (highest development).
- *Economic development.* The GDP per capita.
- *Persistence effects.* The maximum historical monthly inflation and devaluation rates (see the Data Appendix).

- *Net foreign reserves.* The ratio of the central bank's net foreign reserves to GDP.

Other explanatory variables include the annual inflation rate, the annual devaluation rate, the EBRD index of initial conditions, and the shares of agriculture, industry, and service in the GDP.

5. Empirical Analysis

Table 2 reports descriptive statistics of the dependent and explanatory variables used in the estimations. A simple data analysis shows positive correlation of deposit and credit dollarization (0.585, P-value of 0.000). Net foreign assets, on the other hand, do not seem to be correlated with credit dollarization (-0.042, P-value of 0.607). Neither are the measures of bank profitability, concentration, and risk-taking behavior.[28, 29]

On the firm side, external borrowing to total domestic credit is not significantly correlated with credit dollarization (0.076, P-value of 0.350), while different measures of imports and exports are negatively but insignificantly correlated with dollarization. Firm's characteristics (profitability, size) are not correlated with dollarization.

5.1. Pooled OLS (POLS) Estimation

I use the pooled OLS (with errors adjusted for serial correlation and heteroskedasticity) as a benchmark for estimating the following equation

[28] The correlation between credit dollarization and the interest rate spread is 0.136 (with a P-value of 0.107), the correlation between credit dollarization and bank profitability is 0.136 (P-value = 0.416), the correlation between credit dollarization and bank riskiness is 0.034 (P-value = 0.678), and the correlation between credit dollarization and the total number of banks is -0.100 (P-value = 0.222).

[29] All measures of profitability and risk-taking behavior for both banks and firms are used as one-period lags, in order to avoid endogeneity problems.

$$Credit\_Dollarization_{it} = \alpha' Bank\_Variables_{it} + \beta' Firm\_Variables_{it} + \gamma' Controls_{it} + \varepsilon_{it}.$$

Table 3a presents the results when credit dollarization is measured as the ratio of dollar credit to total bank credit. Table 3b presents the results when scaling by total bank assets. There are four different specifications, (1) - (4), presented in each table. Notice that the sample size in Table 3b is by almost 25 percent smaller than in Table 3a.

In addition to the variables already described in Section 4, I use a dummy variable, which takes the value one for Croatia, zero otherwise. According to Bonin (2001), most loans in Croatia are indexed to the German mark/Euro. These loans are equivalent to foreign currency loans for the purpose of this chapter, but are instead recorded as domestic currency loans. This explains why in Croatia the average level of deposit dollarization is 69 percent, while credit dollarization is only 27 percent.[30]

Regardless of the measure used for credit dollarization, currency matching in the banking sector seems to be the main determinant of dollarization. Deposit dollarization has a large positive effect, while net foreign assets have a negative effect on credit dollarization. A one percentage point increase in deposit dollarization increases credit dollarization by 0.6 - 0.7 percentage points (see Table 3a), while a one percentage point increase in net foreign assets decreases credit dollarization by approximately 0.2 percentage points.[31] It seems to be the case that domestic banks substitute foreign assets for domestic dollar loans. This suggests that either the domestic deposits are exported or

[30] Alternatively, I estimate the model without data on Croatia, and obtain very similar results for all my specifications.

[31] Barajas and Morales (2003) also find a significantly positive effect of deposit dollarization on credit dollarization. However, the estimated magnitude is much larger: a one percentage point increase in deposit dollarization increases credit dollarization by around 0.9 percentage points.

that the foreign currency loans are financed with foreign funds, or both. Banks do seem to match the currency of denomination of their assets and liabilities.

There is some evidence of a positive effect of banks profitability and concentration (measured by the interest rate spread and the inverse of total number of banks respectively) on credit dollarization. Higher profitability of banks tends to increase the level of dollarization, which is the opposite effect from what I hypothesized. The total number of domestic banks, which is the inverse of banking industry concentration, seems to reduce credit dollarization. This might be consistent with the conjecture that more banks reduce the probability of bailout should a bank run occur, and thus reduce the excessive risk-taking by banks (assuming that dollar loans bear a higher total risk than domestic currency loans). However, these variables might be capturing missing country effects as the effects disappear when I use alternative specifications (see the results for the FD estimator, in Section 5.2). In addition, I would like to emphasize that my measures of profitability and concentration, both for banks and firms, are most likely poor and the effects should be interpreted with caution.

There is some evidence of a firm-determined component of credit dollarization. However, the effect varies across different measures and specifications. External borrowing by firms seem to increase dollarization when using the first measure of credit dollarization, while the effect becomes negative (but insignificant) with the second measure. I further explore this effect in Section 6.

There is also limited evidence that real dollarization leads to financial dollarization (see Table 3b). The effect, however, is very small: a one percentage point increase in total trade to GDP raises the ratio of dollar loans to total bank assets by only

0.07 percentage points, while a one percentage point increase in exports to GDP raises dollarization by 0.16 percentage points.

With respect to macroeconomic determinants of dollarization, I find evidence that current and past uncertainty and lack of credibility of policies encourage financial dollarization. Net foreign reserves to GDP, which I interpret as a measure of current credibility and policy sustainability has a strong negative effect. The maximum historical inflation, which measures past uncertainty and its persistence over time, has a positive effect with the broader measures of dollarization.

There is some marginal evidence that higher flexibility of the exchange rate reduces dollarization (especially when comparing flexible with fixed exchange rate regimes), which is consistent with the common belief that fixed exchange rate regimes provide implicit insurance against changes in the exchange rate.[32] Not surprisingly, the dummy for Croatia is very significant and has a large negative effect (see Table 3a).

5.2. First Difference (FD) Estimation

I expect there exist some persistence effects in my indicators of dollarization as they are measured as stock rather than flow variables. Also, I believe that the country effects are very important, and there might be regulatory effects, in addition to initial conditions/peculiarities of these economies, that I do not control for. When these missing effects are correlated with the variables of interest, the estimated coefficients are biased.

[32] I use Bubula and Otker-Robe classification in the benchmark specifications presented in this chapter Similar results are obtained with the new IMF and Reinhart and Rogoff classifications.

I test for serial correlation in the errors, and find that the autoregressive coefficient for the change in the initial errors (ε_{it}) is around 0.15. If initial errors were uncorrelated, this coefficient would be around -0.5. Not only are initial errors correlated, but also some serial correlation seems to be left even after taking first differences. Hence, FD (which assumes initial errors are integrated of order one) might provide more reliable results than the fixed effects estimator (which assumes initial errors are uncorrelated). I use both estimators, and compare the obtained effects.

Tables 4a and 4b show the estimation results for the FD estimation, with standard errors adjusted for serial correlation and heteroskedasticity. One drawback of the FD estimator is that the sample size decreases, since the first period observations are lost when taking differences. I will focus on the results presented in Table 4a, when credit dollarization is calculated as a ratio to total credit (I have less data on total bank assets, thus the sample size diminishes even more when scaling by it).

Currency matching is still the main driving force of dollarization. Deposit dollarization significantly increases and net foreign assets significantly decrease credit dollarization. However, bank profit and concentration variables, as well as firm variables, do not seem to have a significant effect on credit dollarization. External borrowing by firms, as well as trade and its components (exports and imports), still have a positive, but insignificant, effect.

The effect of the exchange rate regime dummies is even higher now, with higher flexibility of the exchange rate reducing credit dollarization. Similarly to the POLS estimation, net foreign reserves reduce credit dollarization. The difference from the POLS estimation is that the maximum historical devaluation rate increases dollarization,

while the historical inflation rate tends to decrease it. Finally, I can conclude that implicit insurance against changes in the exchange rate offered by a fixed exchange rate regime, lack of credibility of macroeconomic policies, and high past devaluations increase dollarization.

5.3. Fixed Effects (FE) Estimation

The third specification for my model is the fixed effects (within) estimation. This also controls for country effects, similar to the FD, while better capturing the effects of factors with less sample variation. Errors are adjusted for serial correlation and heteroskedasticity.[33]

The FE estimator (see Tables 5a and 5b) shows a similar picture with the POLS estimator. Currency matching in the banking sector, through deposits and foreign assets, drive credit dollarization.[34] In addition, higher profitability also leads to more loans in dollars, while bank concentration does not seem to have any effect.

On the firm side results are very similar to the POLS estimation. First, external borrowing by firms increases the amount of dollar loans they obtain domestically (see Table 5a). External loans and domestic foreign currency loans seem to be complements, not substitutes as I hypothesized. It might be the case that external lending is conditional on domestic lending, in which case my explanatory variable is endogenous. Second, total trade and exports appear to have a positive and sometimes significant effect on dollarization of credit. Thus, there is some limited evidence that real dollarization does

[33] Similar results are obtained when using a FE estimator with errors assumed to follow an autoregressive process of order one (AR(1)).

[34] Deposit dollarization has a positive effect, but is insignificant with the second measure of dollarization (see Table 5b).

indeed cause financial dollarization. However, the estimated effect is very small (see Table 5b).

There is mixed evidence for the exchange rate regime effects, while the lack of credibility of macroeconomic policies (proxied by net foreign reserves) still leads to higher dollarization. No persistence effects are found, but a large positive effect for the trend variable.

6. Robustness Tests

6.1. Endogeneity Issues

Summing up, all the evidence presented so far suggests the same conclusion: currency matching in the banking sector drives the dollarization of credit. I have also identified two effects coming from the firm side, mainly from real dollarization and firms' alternative sources of dollar loans. However, these effects are not that robust across alternative specifications. The question that rises is whether the results are driven by the potential endogeneity of asset and liability management variables.

To address this issue I proceed in two ways. First, I estimate the POLS using a one-period lag for banks' net foreign assets and firms' external borrowing instead of their contemporaneous values.[35] While the external borrowing becomes insignificant, net foreign assets have still a significant negative effect (and of similar magnitude as in Section 5.1). It is possible then that the access to external credit is conditional on borrowing in dollars from domestic banks; in this case, the causality is from credit

[35] I do not report the results in the chapter due to space constraints. However, they are available upon request.

dollarization to external borrowing. If this is the case, my model is well specified if I exclude firms' external borrowing from it. No results change when I do so.

Second, I estimate the model using Instrumental Variables (IV). I believe that past values of firms' external borrowing and bank holdings of external assets (external liabilities) are good measures of firms' access to external finance and banks' current holdings of external assets (external liabilities). Statistically, lagged values are indeed good IVs as they are very significant in the reduced-form first stage estimation.

The results for the 2SLS estimations are reported in Tables 6a and 6b. The standard errors are again adjusted for both serial correlation and heteroskedasticity. Net foreign assets are significantly negative again, and the effect is slightly larger with IV than with OLS. Firms' external borrowing, on the other hand, is never significant, and even in magnitude the effect becomes smaller.[36] The Hausman test does not reject the null hypothesis of exogeneity in external borrowing and foreign assets by firms and banks, respectively. Therefore, there is no evidence that the OLS and the IV estimations are significantly different. In addition, there is no evidence of serial correlation in the standard errors, which seems to suggest that the 2SLS in first moments is the correct way to proceed.

One might argue that deposit dollarization is endogenous as well, if firms are required to hold dollar deposits in order to receive dollar loans. I do not have any specific information if there is indeed such a requirement in transition economies. Even if there is not, unless banks make an immediate payment abroad or firms immediately sell

[36] Barajas and Morales (2003) find evidence of a negative effect on firms' external borrowing on domestic dollar borrowing. It might be the case that firms in Latin American economies have higher access to external financial markets than firms in transition economies, and they can indeed substitute dollar loans from abroad with dollar loans from domestic banks.

the dollars they obtain, dollar loans will at least temporarily increase the level of dollar deposits.

I define household deposit dollarization as the ratio of household dollar deposits to total household deposits, and use it as an IV for the total deposit dollarization ratio. Household deposit dollarization can be safely assumed to be uncorrelated to the errors in the main model, and thus exogenous. Furthermore, it has a strong positive effect on deposit dollarization in the reduced-form first stage regression. The effect of deposit dollarization on credit dollarization is still positive, but smaller and insignificant. However, the Hausman test fails to reject the null hypothesis of exogeneity in deposit dollarization. If instead I use a FE estimator with IVs, deposit dollarization is highly significant and positive, and the effect is even larger than without IVs.

In conclusion, IV estimates suggest that the results are not driven by potential endogeneity problems. Bank currency matching still remains the main driving force of credit dollarization, with the effect of net foreign assets becoming even larger, and a possibly smaller but still positive effect of deposit dollarization. As expected, firms' access to external borrowing is not significant at all, suggesting that the causality is from domestic to external borrowing, and not the other way around.

6.2. Alternative Specifications

To assess the robustness of these findings, I conduct several other tests. First, I use alternative measures for bank and firm variables. Second, I discuss the effects on dollarization of firm characteristics such as size, profitability, and risk-taking behavior,

which were not included in the main specifications. Third, I undertake additional sensitivity tests.

Besides the interest rate spread and the number of total banks, I use several other measures of bank profitability, concentration, and in addition riskiness, such as bank profits, number of foreign banks, bank risk-taking behavior, and deposit insurance (see the Data Appendix, for the description of these variables). While bank profits still have a positive but insignificant effect, suggesting that bank profitability might be positively linked to credit dollarization, all the other variables have mixed and insignificant effects.

On the firm side, I try alternative measures for external supply shocks, such as changes in import or export prices. Using the POLS estimator, changes in the oil price seems to positively affect dollarization in non oil producing countries, while the opposite is true for oil producing countries. However, the effect vanishes when I control for country-specific effects. Other prices do not seem to have a significant effect. I also test to see if dollar borrowing finances specific components of imports, or if firms in specific sectors are more prone to borrowing in dollars. For example, one might think that firms in the natural resource export sector might borrow more in dollars. The ratio of natural resource exports to GDP, while significantly positive when using the FE estimator, is insignificant when using all other estimators. To conclude, I cannot find any effect from the real side of the economy other than that coming from the overall level of imports and exports.

I do not include the firm characteristics variables (size, profitability, and riskiness) in the main estimations, due to missing data on these variables. However, I separately estimate the model controlling for these effects, and show they are all very

insignificant. As I have already indicated, my measures of bank and firm profitability and concentration are very poor. In addition, I might miss effects because of using aggregated data. Thus the results should be interpreted with caution. These findings rather suggest that better data have to be collected before these effects could be seriously studied.

Additional sensitivity tests I perform are the following:

- Using standardized coefficients for the FD estimator, to compare the magnitude of bank- and firm-specific effects.[37]
- Using the dollarization and net foreign assets variables, scaled by total credit instead of total deposits, to check if scaling by different variables changes the results.
- Using alternative regulatory measures: indicators of restrictions on domestic lending in foreign currencies,[38] forward market, repatriation or surrender requirements of the export proceedings, and tax on the foreign exchange transactions.
- Using alternative measures for the overall level of development of financial markets: domestic deposits to GDP, M2 to GDP, the index of banking reform, and the index of non-banking reform.
- Using year dummies for the time effects, instead of the time trend.

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[37] Changes in deposit dollarization and net foreign reserves still have the largest relative effect on credit dollarization: a one percent standard deviation increase in deposit dollarization raises credit dollarization by 0.446 standard deviations, and a one percent increase in net foreign reserves raises it by 0.378 standard deviations (P-value for both effects is 0.000). Among the firm variables, trade has the largest relative effect (0.120, but P-value=0.186). The exchange rate regime dummies and net foreign reserves have a significant negative impact: -0.228 (P-value=0.010), -0.241 (P-value=0.023), and -0.182 (P-value=0.014) respectively.

[38] Unfortunately, I have very limited data on foreign currency lending restrictions. Hence including this variable in the model reduces my sample size by half.

- Using the alternative classifications for the exchange rate regimes: the new IMF and the Reinhart and Rogoff (2002) classifications. In addition, I specify the exchange regimes as freely falling versus non-freely falling, to better capture the uncertainty associated with large movements of the exchange rate.
- Using a dummy variable for the oil producing countries.
- Using other controls for the overall level of development of the economy: GDP per capita, the index of initial conditions, the shares of agriculture, industry, and service in GDP.

None of these sensitivity tests changes the main results.

7. Conclusions and Future Extensions

Domestic banks in emerging markets and transition economies often grant dollar credit to residents instead of credit denominated in domestic currency. Is this credit dollarization phenomenon coming mostly from the financial side (banks), or from the real side (firms)? In the presence of financial dollarization without real dollarization, there exist balance sheet mismatches somewhere in the economy and the economy is highly exposed to financial and currency crises.

This chapter analyzes the respective contributions of banks and firms to credit dollarization, and suggest what policy measures (if any) should be implemented to control or restrict it. I group potential determinants into bank- and firm-specific (financial and mainly real) factors, and use a newly-assembled database for twenty-two transition economies.

I show that bank currency matching is the main driving force of credit dollarization. I find some evidence that real dollarization also causes financial dollarization, but this effect is relatively small. There are currency mismatches in these economies, and they seem to be concentrated in the real sector. Banks, who are supposed to do a better job at internalizing the exchange rate risk, just pass it over to firms. This decreases bank exposure to currency risk, but it increases their exposure to default risk, and ultimately the exposure of the economy to financial and currency crises.

Not surprisingly, my findings suggest that one way to reduce dollarization is to reduce macroeconomic uncertainty and lack of monetary policy credibility. Otherwise, as long as domestic deposits are highly dollarized, and banks want to match the currencies of their assets and liabilities, restrictions placed on dollar loans will most likely lead to "exports" of deposits and domestic disintermediation.

This chapter is one of the first attempts to empirically study credit dollarization. There are several possible extensions that deserve further consideration. First, I would like to extend the analysis to include other developing economies, especially Latin American countries where dollarization reaches very high levels. That would provide not only more data, but also the generality of the conclusions. Transition economies are a good starting point as they provide a lot of variation in data; this can also be a downside, since it is sometimes hard to separate one effect from the others.

Second, using disaggregated data, such as individual loan data, would provide better insights into the effect of firm and bank characteristics on financial dollarization.

Third, more empirical work in general is necessary to better identify both the determinants and the effects of financial dollarization, and to evaluate policy implications and the exchange rate exposure of various economic agents and the overall economy.

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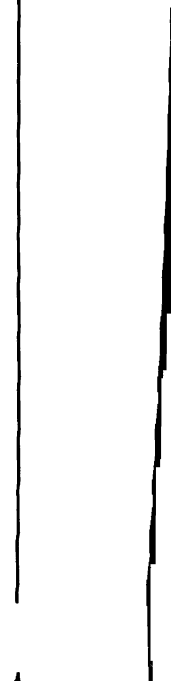

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APPENDIX

Data Definitions and Sources

Abbreviations: AREAER: IMF *Annual Report on Exchange Arrangements and Exchange Restrictions* (various issues). CB: Central Banks publications (various issues). IFS: International Monetary Fund *International Financial Statistics*. IMF_CP: IMF *Commodity Prices*. WB_DI: World Bank *Deposit Insurance Database*. WDI: World Bank *World Development Indicators*. EBRD: European Bank for Reconstruction and Development *Transition Reports* (various issues). BIS: Bank of International Settlements *International Banking Statistics*. UN: United Nations *Trade Statistics*.

I use two datasets which include information on individual firms and banks in transition economies. Amadeus provides data on firms' balance sheet and profit and loss account, while Bankscope provides data on banks' balance sheet and income statement.

I also use Bonin (2001) for data on total bank assets for several transition economies, as well as AREAER, Bubula and Otker-Robe (2002), and Reinhart and Rogoff (2002) for alternative classifications of the exchange rate regimes.

Variable	Definition	Source
Credit dollarization	Foreign currency denominated credit to total credit (total bank assets), from domestic banks to domestic enterprises, calculated as a percent. Data for a few countries include credit to individuals, financial enterprises and/or government.	CB
Deposit dollarization	Foreign currency denominated deposits to total deposits (total bank assets, or total credit) held by residents at domestic banks, calculated as a percent.	CB
Net foreign assets	Bank foreign assets minus bank foreign liabilities	IFS, CB

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	(line 21...ZF... - line 26C...ZF), as a percent of total bank deposits (total bank credit, or total bank assets).	
Interest rate spread	Average lending interest rate minus average deposit interest rate (over all currencies and maturities). Data for most countries is from EBRD.	EBRD, IFS, CB
Bank profits	Banks' pre-tax profits as a percent of total assets (line 6780*100/line 2025).	Bankscope
Bank risk-taking behavior	Banks' total risk assets as a percent of total assets (line 7480*100/line 2025). Total risk assets include: total loans (net), other listed securities, other securities, equity investments, investment securities, bonds, non-listed securities, other investments, deferred tax receivable, other non earning assets, and intangible assets.	Bankscope
Deposit insurance	Dummy variable=1 if there exists explicit deposit insurance, =0 if there does not.	WB_DI
Total number of banks	Total banks per million people.	EBRD
Number of foreign banks	Foreign banks per million people.	EBRD
External borrowing	Foreign claims on non-bank private enterprises as a percent of total domestic credit (GDP).	BIS (Table 9A, col. G)
Trade	Total trade (imports plus exports of goods and services) as a percent of GDP.	WDI
Imports of intermediate goods	Imports of intermediate goods (SITC2+SITC3+...+SITC7: crude materials, mineral fuels, oil and fats, chemicals, basic manufactures, and machinery and transport equipment) as a percent of GDP.	UN
Imports of raw materials	Imports of agricultural materials, fuels, and ores and metals, as a percent of GDP.	WDI
Exports	Total exports of goods and services as a percent of GDP.	WDI, IFS
Index of total commodities	The index of fuel and non-fuel commodity prices for all countries (1995=100).	IMF_CP
Index of industrial inputs	The changes in prices of industrial inputs for all countries (1995=100).	IMF_CP
Change in the oil price	Change in the average world crude spot price, USD/barrel (code 00176AAZZF).	IFS
Average firm size (total assets)	Logarithm of average total assets per company, average for (up) to 50 largest companies (by total assets).	Amadeus
Average firm size (no employees)	Number of employees, average for (up) to 50 largest companies (by total assets).	Amadeus

Variable	Definition	Source
Firm profit margin	Net profit after taxes as a percent of total sales for a given 12-month period, average for (up) to 50 largest companies (by total assets).	Amadeus
Firm leverage ratio	Long-term funds with fixed interest as a percent of total capital, average for (up) to 50 largest companies (by total assets).	Amadeus
Forward market	Dummy variable=1 if a forward market for foreign exchange exists and is functional, =0 if it does not exist or is underdeveloped.	AREAER
Fixed exchange rate regime Intermediate exchange rate regime Floating exchange rate regime	Dummy variables differentiating between fixed, intermediate, and floating exchange rate regimes. These are all measures of the "de facto" regimes, which might be very different from the "de jure" ones. I use three different specifications. The first is the new IMF classification for "de facto" exchange rare regimes, introduced in 1997. The second classification is constructed by Bubula and Otker-Robe (2002) and combines the new IMF classification with additional IMF internal data/country information. The third classification is introduced by Reinhart and Rogoff (2002) and classifies the regimes taking into account information on parallel exchange markets.	AREAER, Bubula and Otker-Robe (2002), Reinhart and Rogoff (2002)
Index of forex liberalization	Index of trade and foreign exchange rate system liberalization, =1 if widespread import and/or export controls or very limited legitimate access to foreign exchange, =2 if some liberalization of import and/or export controls, almost full current account convertibility in principle but with a foreign exchange regime that is not fully transparent (possibly with multiple exchange rates), =3 if removal of almost all quantitative and administrative import and export restrictions, almost full current account convertibility, =4 if removal of all quantitative and administrative import and export restrictions (apart form agriculture) and all significant export tariffs, insignificant direct involvement in exports and imports by ministries and state-owned trading companies, no major non-uniformity of customs duties for non-agricultural goods and services, full current account convertibility, =4.3 if standards and performance norms of advanced industrial economies, removal of most tariff barriers, WTO membership.	EBRD

Variable	Definition	Source
Foreign currency lending	Dummy variable=1 if domestic lending in foreign currency is free, =0 if it is prohibited or there are any restrictions imposed.	AREAER
Repatr/Surrend	Dummy variable=1 if there are any repatriation or surrender requirements of export proceeds, =0 otherwise.	AREAER
Exchange tax	Dummy variable=1 if there is any tax on foreign exchange transactions, =0 otherwise.	AREAER
Domestic credit	Domestic credit to enterprises as a percent of GDP.	CB
Domestic deposits	Total domestic deposits as a percent of GDP.	CB
M2	Money and quasi-money as percent of GDP ((line 34...ZF...+line 35...ZF...)*100/GDP).	IFS
Index of banking reform	Index of banking reform and interest rate liberalization, =1 if little progress beyond establishment of a two tier system, =2 if significant liberalization of interest rates and credit allocation, =3 if substantial progress in establishment of bank solvency and of a framework for prudential supervision and regulation, full interest rate liberalization with little preferential access to cheap refinancing, significant lending to private enterprises and significant presence of private banks, =4 if significant movement of banking laws and regulations towards BIS standards, well functioning banking competition and effective prudential supervision, significant term lending to private enterprises, substantial financial deepening, =4.3 if standards and performance norms of advanced industrial economies, full convergence of banking laws and regulations with BIS standards, provision of full set of competitive banking services.	EBRD
Index of non-banking reform	Index of securities markets and non-bank financial institutions development, =1 if little progress, =2 if formation of securities exchanges, market makers and brokers, some trading in government paper and/or securities, rudimentary legal and regulatory framework for the issuance and trading of securities, =3 if substantial issuance of securities by private enterprises, establishment of independent share registries, secure clearance and settlement procedures, and some protection of minority shareholders, emergence of non-bank	EBRD

	financial institutions (e.g. investment funds, private insurance and pension funds, leasing companies) and associated regulatory framework, =4 if securities laws and regulations approaching IOSCO standards, substantial market liquidity and capitalization, well-functioning non-bank financial institutions and effective regulation, =4.3 if standards and performance norms of advanced industrial economies, full convergence of securities laws and regulations with IOSCO standards, fully developed non-bank intermediation.	
GDP	GDP at market prices (current USD) per capita.	WDI
Net foreign reserves	Net reserves of the central bank as a percent of GDP (line 1L..DZF...*100/GDP).	IFS
Inflation rate	Percentage change in the index of consumer prices.	EBRD
Devaluation rate	Percentage change of the average exchange rate (expressed as domestic currency per USD, line RF..ZF...).	IFS
Maximum historical inflation	Maximum historical inflation rate, calculated as the maximum of all past monthly inflation rates (for which data are available) and current monthly inflation rate. The annual data is the historical maximum of monthly inflation rates at the end of the year.	IFS
Maximum historical devaluation	Maximum historical devaluation rate, calculated as the maximum of all past monthly devaluation rates (for which data are available) and current monthly devaluation rate. The annual data is the historical maximum of monthly devaluation rates at the end of the year.	IFS
Index of initial conditions	Index derived from factor analysis and represents a weighted average of measures for the level of development, trade dependence on CMEA, macroeconomic disequilibria, distance to the EU, natural resources endowments, market memory, and state capacity. Higher values denote more favorable starting positions. Data are from the EBRD Transition Report, 2000, pg. 21.	EBRD
Agriculture	The percent of value-added in agriculture in total GDP.	EBRD
Industry	The percent of value-added in industry in GDP.	EBRD
Services	The percent of value-added in the service sector in total GDP (GDP-share of agriculture-share of industry).	EBRD

Table 1 Country and Dollarization Data Coverage

Albania	1998 - 2001
Armenia	2000 - 2001
Azerbaijan	2000 - 2001
Bulgaria	1990 - 2001
Croatia	1993 - 2001
Czech Republic	1993 - 2001
Estonia	1993 - 2001
Georgia	1997 – 2001
Hungary	1992 - 2001
Kazakhstan	1996 - 2001
Kyrgyz Republic	1999 - 2001
Latvia	1994 - 2001
Lithuania	1993 - 2001
Macedonia	1995 - 2001
Moldova	1999 - 2001
Poland	1997 - 2001
Romania	1990 - 2001
Russia	1996 - 2001
Slovak Republic	1992 - 2001
Slovenia	1991 - 2001
Ukraine	1992 - 2001
Yugoslavia	1998 - 2001

Table 2 Summary Statistics

Dependent Variables

	Credit Dollarization (% of total credit)	**Credit Dollarization** (% of total bank assets)
Mean	38.192	11.878
Standard deviation	22.438	8.173
Number of observations	156	110

Explanatory Variables

Bank-specific Variables

	Deposit Dollarization (% of total deposits)	**Deposit Dollarization** (% of total bank assets)	**Deposit Dollarization** (% of total credit)
Mean	36.689	17.347	57.490
Standard deviation	18.431	9.697	58.868
Number of observations	172	120	156
	Net foreign assets (% of total deposits)	**Net foreign assets** (% of total bank assets)	**Net foreign assets** (% of total credit)
Mean	7.426	5.429	21.371
Standard deviation	36.826	10.760	73.084
Number of observations	167	118	154
	Interest rate spread (one period lagged)	**Bank profits** (% of total assets)	**Bank risk-taking** (%, risk assets/total assets)
Mean	21.475	2.532	57.705
Standard deviation	46.855	4.927	16.090
Number of observations	191	193	197
	Deposit insurance (dummy)	**Total number of banks** (per million people)	**Number of foreign banks** (per million people)
Mean	0.275	7.648	1.550
Standard deviation	0.447	6.086	1.321
Number of observations	272	213	191

Firm-specific Variables

	External borrowing (% of total credit)	**External borrowing** (% of GDP)	**Imports of interm goods** (% of GDP)
Mean	33.755	3.905	33.004
Standard deviation	49.074	5.334	14.208
Number of observations	152	202	145

Table 2 (cont'd)

Explanatory Variables

Firm-specific Variables

	Exports (% of GDP)	**Index of total commodities** (1995=100)	**Index of indust inputs** (1995=100)
Mean	41.133	95.538	85.349
Standard deviation	17.497	13.549	9.770
Number of observations	249	198	286

	Average firm size (log of total assets)	**Average firm size** (no of employees)	**Firm profit margin**
Mean	5.346	3840.958	3.408
Standard deviation	1.385	4487.276	5.132
Number of observations	95	85	89

	Firm leverage ratio
Mean	48.737
Standard deviation	45.560
Number of observations	80

Other Variables

	Forward market (dummy)
Mean	0.277
Standard deviation	0.448
Number of observations	238

Exchange rate regime- new IMF classification

	Fixed	**Intermediate**	**Floating**
Mean	0.304	0.103	0.591
Standard deviation	0.461	0.304	0.492
Number of observations	223	223	223

Exchange rate regime- Bubula&Otker-Robe classification

	Fixed	**Intermediate**	**Floating**
Mean	0.307	0.213	0.478
Standard deviation	0.462	0.410	0.500
Number of observations	234	234	234

Exchange rate regime- Reinhart&Rogoff classification

	Fixed	**Intermediate**	**Floating**
Mean	0.213	0.355	0.431
Standard deviation	0.410	0.479	0.496
Number of observations	225	225	225

Table 2 (cont'd)

Explanatory Variables

Other Variables

	Index of forex liberalization (from 1=lowest to 4.3=highest)	**Repatr/Surrend** (dummy)	**Net foreign resv** (% of GDP)
Mean	3.332	0.746	10.576
Standard deviation	1.092	0.435	6.700
Number of observations	241	217	214
	Domestic credit (% of GDP)	**M2** (% of GDP)	**GDP** (per capita)
Mean	19.849	28.824	2372.244
Standard deviation	15.816	19.635	1907.543
Number of observations	156	206	252
	Index of banking reform (from 1=lowest to 4.3=highest)	**Index of non-banking reform** (from 1=lowest to 4.3=highest)	
Mean	2.237	1.832	
Standard deviation	0.825	0.717	
Number of observations	241	241	
	Inflation rate (annual rate)	**Maximum historical inflation** (monthly rate)	
Mean	94.892	2292.606	
Standard deviation	424.972	5586.611	
Number of observations	154	196	
	Devaluation rate (annual rate)	**Maximum historical devaluation** (monthly rate)	
Mean	45.000	333.520	
Standard deviation	144.757	1042.129	
Number of observations	153	207	

Table 3a Pooled OLS

Dependent Variable: Credit Dollarization (% of Total Credit)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.611***	0.715***	0.610***	0.711***
(% of total deposits)	(0.186)	(0.193)	(0.204)	(0.199)
Net foreign assets	-0.261***	-0.201***	-0.227***	-0.203***
(% of total deposits)	(0.055)	(0.050)	(0.064)	(0.050)
Interest rate spread	0.053	0.068***	0.056	0.067***
(one period lagged)	(0.034)	(0.022)	(0.060)	(0.022)
Number of total banks		-0.742*	-0.721	-0.698
(per capita)		(0.413)	(0.495)	(0.408)
External borrowing	0.677*	0.630*	0.469	0.679**
(% of GDP)	(0.366)	(0.352)	(0.408)	(0.325)
Trade	0.019	0.023		
(% of GDP)	(0.081)	(0.085)		
Imports of intermediate goods			0.199	
(% of GDP)			(0.223)	
Exports				-0.010
(% of GDP)				(0.172)
Index of forex liberalization	5.221	0.420	2.195	0.376
	(3.932)	(4.266)	(5.266)	(4.037)
Intermediate exchange rate regime	-4.471	-6.844	-2.999	-7.318
	(5.994)	(5.531)	(5.322)	(5.402)
Floating exchange rate regime	-4.659	-10.035*	-5.910	-10.363*
	(6.921)	(5.327)	(6.004)	(5.266)
Net foreign reserves	-0.827***	-0.958***	-1.149***	-0.918***
(% of GDP)	(0.242)	(0.273)	(0.339)	(0.248)
Domestic credit	-0.416*	-0.188	-0.399	-0.182
(% of GDP)	(0.233)	(0.191)	(0.234)	(0.183)
Inflation rate	-0.003	-0.007**	-0.0010	-0.007**
	(0.003)	(0.003)	(0.016)	(0.002)
Maximum historical inflation	-0.000			
	(0.000)			
Croatia	-34.496***	-35.443***	-29.315**	-35.872**
	(8.943)	(9.387)	(10.594)	(8.883)
Trend	2.026	2.125*	2.119	2.129*
	(1.175)	(1.183)	(1.254)	(1.176)
_cons	-4.155	14.805	11.669	16.851
	(14.062)	(15.530)	(15.639)	(15.890)
Obs.	136	139	115	139
Adjusted R-squared	0.691	0.690	0.713	0.689

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 3b Pooled OLS

Dependent Variable: Credit Dollarization (% of Total Bank Assets)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.242	0.294**	0.372**	0.288**
(% of total bank assets)	(0.166)	(0.131)	(0.138)	(0.125)
Net foreign assets	-0.355***	-0.360***	-0.501***	-0.347**
(% of total bank assets)	(0.094)	(0.084)	(0.053)	(0.081)
Interest rate spread	-0.066	0.023	0.038	0.020
(one period lagged)	(0.062)	(0.059)	(0.069)	(0.061)
Number of total banks		-0.444**	-0.332*	-0.498**
(per capita)		(0.188)	(0.160)	(0.188)
External borrowing	0.053	-0.037	-0.057	-0.081
(% of GDP)	(0.099)	(0.0845)	(0.128)	(0.084)
Trade	0.034	0.070**		
(% of GDP)	(0.033)	(0.031)		
Imports of intermediate goods			0.093	
(% of GDP)			(0.098)	
Exports				0.162**
(% of GDP)				(0.059)
Index of forex liberalization	-0.881	-1.098	-2.525	-0.426
	(1.724)	(1.234)	(1.757)	(1.237)
Intermediate exchange rate regime	0.325	0.784	-0.148	0.518
	(2.236)	(1.849)	(1.895)	(1.694)
Floating exchange rate regime	-2.249	-1.705	-1.622	-1.979*
	(2.129)	(1.253)	(1.449)	(1.065)
Net foreign reserves	-0.344**	-0.350**	-0.310**	-0.413***
(% of GDP)	(0.154)	(0.126)	(0.132)	(0.123)
Domestic credit	-0.044	-0.080	-0.013	-0.081
(% of GDP)	(0.062)	(0.055)	(0.044)	(0.051)
Inflation rate	0.018	-0.006	-0.007	-0.006
	(0.014)	(0.013)	(0.017)	(0.013)
Maximum historical inflation	0.004***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Croatia	-4.153	-3.043	-7.164	-2.175
	(5.106)	(4.083)	(4.065)	(4.086)
Trend	0.5742	0.327	0.317	0.395*
	(0.378)	(0.213)	(0.333)	(0.208)
_cons	8.098	11.005*	17.845**	8.981
	(7.422)	(6.022)	(6.513)	(6.312)
Obs.	99	99	94	99
Adjusted R-squared	0.678	0.731	0.765	0.744

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 4a First Difference Estimator

Dependent Variable: Credit Dollarization (% of Total Credit)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.638***	0.596***	0.411**	0.582***
(% of total deposits)	(0.133)	(0.127)	(0.190)	(0.133)
Net foreign assets	-0.175***	-0.182***	-0.173*	-0.186***
(% of total deposits)	(0.043)	(0.044)	(0.082)	(0.043)
Interest rate spread	0.021*	-0.005	0.051	-0.006
(one period lagged)	(0.012)	(0.008)	(0.032)	(0.008)
Number of total banks		0.468		
(per capita)		(0.807)		
External borrowing	0.271	0.276	0.292	0.252
(% of GDP)	(0.172)	(0.175)	(0.244)	(0.179)
Trade	0.108	0.103		
(% of GDP)	(0.070)	(0.067)		
Imports of intermediate goods			0.133	
(% of GDP)			(0.138)	
Exports				0.191
(% of GDP)				(0.144)
Index of forex liberalization	-1.067	0.969	-1.349	0.859
	(2.400)	(2.269)	(4.573)	(2.127)
Intermediate exchange rate regime	-5.708**	-4.058	-0.438	-3.802
	(2.491)	(2.746)	(2.993)	(2.638)
Floating exchange rate regime	-6.069**	-4.451*	-3.011	-4.358**
	(2.322)	(2.240)	(4.316)	(2.085)
Net foreign reserves	-0.517*	-0.584*	-0.234	-0.593*
(% of GDP)	(0.267)	(0.327)	(0.295)	(0.318)
Domestic credit	-0.239	-0.146	-0.205	-0.166
(% of GDP)	(0.178)	(0.169)	(0.201)	(0.164)
Inflation rate	-0.002**	0.003	-0.025***	0.002
	(0.001)	(0.002)	(0.007)	(0.002)
Maximum historical inflation	-0.010***			
	(0.003)			
Maximum historical devaluation		0.321**	0.523**	0.306**
		(0.154)	(0.208)	(0.144)
Trend	-0.673	-0.605	-0.102	-0.608
	(0.460)	(0.448)	(0.463)	(0.440)
_cons	8.762	7.911	2.526	7.833
	(5.222)	(5.036)	(5.323)	(4.963)
Obs.	115	115	93	115
Adjusted R-squared	0.413	0.423	0.326	0.419

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 4b First Difference Estimator

Dependent Variable: Credit Dollarization (% of Total Bank Assets)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.131	0.125	0.113	0.126
(% of total bank assets)	(0.117)	(0.114)	(0.102)	(0.112)
Net foreign assets	-0.228***	-0.244***	-0.338***	-0.239***
(% of total bank assets)	(0.063)	(0.052)	(0.051)	(0.050)
Interest rate spread	0.045	0.046	0.047	0.048
(one period lagged)	(0.041)	(0.043)	(0.039)	(0.043)
Number of total banks		0.148		
(per capita)		(0.361)		
External borrowing	-0.053	-0.027	-0.063	-0.024
(% of GDP)	(0.083)	(0.109)	(0.055)	(0.103)
Trade	-0.008	-0.009		
(% of GDP)	(0.030)	(.028)		
Imports of intermediate goods			-0.061	
(% of GDP)			(0.050)	
Exports				-0.032
(% of GDP)				(0.070)
Index of forex liberalization	-0.118	-0.027	-1.968	-0.044
	(1.279)	(1.522)	(2.044)	(1.547)
Intermediate exchange rate regime	0.373	1.790	1.426	1.916
	(1.165)	(1.567)	(1.337)	(1.724)
Floating exchange rate regime	0.355	2.033	1.189	2.081
	(1.552)	(2.128)	(1.904)	(2.225)
Net foreign reserves	-0.050	-.024	-0.022	-0.033
(% of GDP)	(0.080)	(0.102)	(0.070)	(0.082)
Domestic credit	0.097	0.103	0.191**	0.103
(% of GDP)	(0.070)	(0.075)	(0.067)	(0.074)
Inflation rate	-0.011	-0.012	-0.010	-0.013
	(0.010)	(0.010)	(0.007)	(0.010)
Maximum historical inflation	-0.003			
	(0.002)			
Maximum historical devaluation		0.179**	0.180	0.188*
		(0.083)	(0.104)	(0.092)
Trend	0.110	0.142	0.274	0.155
	(0.224)	(0.203)	(0.195)	(0.215)
_cons	-0.323	-0.751	-1.893	-0.927
	(2.529)	(2.226)	(2.248)	(2.400)
Obs.	83	83	77	83
Adjusted R-squared	0.380	0.388	0.498	0.385

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 5a Fixed Effects Estimator

Dependent Variable: Credit Dollarization (% of Total Credit)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.616***	0.603***	0.664***	0.565***
(% of total deposits)	(0.188)	(0.182)	(0.247)	(0.175)
Net foreign assets	-0.176**	-0.183**	-0.167*	-0.160**
(% of total deposits)	(0.086)	(0.076)	(0.093)	(0.074)
Interest rate spread	0.045**	0.045***	0.067	0.044**
(one period lagged)	(0.021)	(0.016)	(0.084)	(0.017)
Number of total banks		-0.149		
(per capita)		(1.366)		
External borrowing	0.513**	0.513**	0.444	0.497**
(% of GDP)	(0.228)	(0.249)	(0.268)	(0.214)
Trade	0.110	0.108		
(% of GDP)	(0.141)	(0.150)		
Imports of intermediate goods			0.370	
(% of GDP)			(0.292)	
Exports				0.292
(% of GDP)				(0.267)
Index of forex liberalization	0.247	1.203	-4.712	-1.456
	(3.111)	(2.928)	(6.010)	(2.990)
Intermediate exchange rate regime	2.076	3.296	5.173	1.411
	(3.949)	(4.535)	(4.965)	(4.075)
Floating exchange rate regime	-5.730*	-4.560	-4.803	-7.469*
	(3.378)	(3.825)	(6.196)	(3.949)
Net foreign reserves	-1.285***	-1.352***	-1.293**	-1.422***
(% of GDP)	(0.463)	(0.506)	(0.547)	(0.485)
Domestic credit	-0.363	-0.343	-0.336	-0.232
(% of GDP)	(0.311)	(0.322)	(0.365)	(0.287)
Inflation rate	-0.003*	-0.002	-0.005	-0.004**
	(.002)	(0.003)	(0.022)	(0.002)
Maximum historical inflation	-0.003			
	(0.006)			
Maximum historical devaluation		0.093		
		(0.181)		
Trend	2.433**	2.335*	2.312*	2.607**
	(1.213)	(1.292)	(1.294)	(1.174)
_cons	9.235	-16.643	19.852	9.194
	(26.212)	(43.889)	(32.271)	(20.867)
Obs.	136	136	115	140
Adjusted R-squared	0.874	0.874	0.880	0.877

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 5b Fixed Effects Estimator

Dependent Variable: Credit Dollarization (% of Total Bank Assets)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.136	0.108	0.137	0.1262
(% of total bank assets)	(0.209)	(0.224)	(0.208)	(0.196)
Net foreign assets	-0.358***	-0.317***	-0.406***	-0.363***
(% of total bank assets)	(0.127)	(0.105)	(0.090)	(0.119)
Interest rate spread	0.081	0.090	0.113*	0.071
(one period lagged)	(0.062)	(0.069)	(0.065)	(0.061)
Number of total banks		0.072		
(per capita)		(0.532)		
External borrowing	-0.022	-0.018	-0.032	-0.049
(% of GDP)	(0.067)	(0.090)	(0.117)	(0.064)
Trade	0.088**	0.078*		
(% of GDP)	(0.044)	(0.044)		
Imports of intermediate goods			0.043	
(% of GDP)			(0.083)	
Exports				0.290**
(% of GDP)				(0.083)
Index of forex liberalization	-0.131	-0.142	-4.518	0.025
	(2.773)	(2.452)	(3.107)	(2.683)
Intermediate exchange rate regime	0.617	-2.584	3.183*	0.767
	(2.330)	(2.675)	(1.599)	(2.255)
Floating exchange rate regime	-0.566	-3.932	1.330	-0.622
	(2.421)	(2.881)	(2.260)	(2.315)
Net foreign reserves	-0.306*	-0.208	-0.117	-0.320**
(% of GDP)	(0.164)	(0.210)	(0.124)	(0.157)
Domestic credit	-0.083	-0.115	0.005	-0.056
(% of GDP)	(0.118)	(0.117)	(0.088)	(0.109)
Inflation rate	-0.021	-0.021	-0.027	-0.019
	(0.014)	(0.015)	(0.016)	(0.014)
Maximum historical inflation	0.006			0.007
	(0.005)			(0.005)
Maximum historical devaluation		0.065		
		(0.215)		
Trend	0.644**	0.713***	0.816**	0.672**
	(0.260)	(0.270)	(0.324)	(0.283)
_cons	-1.350	-2.913	19.406	-3.782
	(6.429)	(16.970)	(11.681)	(6.273)
Obs.	99	99	94	99
Adjusted R-squared	0.839	0.833	0.868	0.846

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 6a IV Regressions

Dependent Variable: Credit Dollarization (% of Total Credit)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.564***	0.673***	0.560**	0.668***
(% of total deposits)	(0.198)	(0.205)	(0.219)	(0.209)
Net foreign assets	-0.324***	-0.245***	-0.255***	-0.246***
(% of total deposits)	(0.079)	(0.062)	(0.073)	(0.063)
Interest rate spread	0.032	0.107**	0.089	0.099**
(one period lagged)	(0.046)	(0.048)	(0.059)	(0.047)
Number of total banks		-1.187***	-1.167**	-1.131***
(per capita)		(0.400)	(0.414)	(0.398)
External borrowing	0.439	0.419	0.054	0.466
(% of GDP)	(0.476)	(0.433)	(0.451)	(0.398)
Trade	0.029	0.044		
(% of GDP)	(0.085)	(0.092)		
Imports of intermediate goods			0.376*	
(% of GDP)			(0.194)	
Exports				0.0213
(% of GDP)				(0.185)
Index of forex liberalization	5.683	-0.531	0.382	-0.372
	(4.172)	(4.547)	(4.608)	(4.362)
Intermediate exchange rate regime	-4.067	-8.038	-2.600	-8.768
	(5.919)	(5.278)	(4.788)	(5.160)
Floating exchange rate regime	-4.498	-10.3163**	-5.675	-10.906**
	(6.985)	(5.015)	(5.557)	(4.982)
Net foreign reserves	-0.813***	-0.836***	-1.207***	-0.809***
(% of GDP)	(0.268)	(0.292)	(0.306)	(0.284)
Domestic credit	-0.483*	-0.255	-0.426*	-0.242
(% of GDP)	(0.256)	(0.191)	(0.233)	(0.182)
Inflation rate	0.007	-0.021	-0.010	-.002
	(0.013)	(0.013)	(0.016)	(0.013)
Maximum historical inflation	-0.000			
	(0.000)			
Croatia	-32.391***	-30.240***	-23.396*	-30.669***
	(9.504)	(10.022)	(11.232)	(9.518)
Trend	2.558*	2.170	2.558*	2.213
	(1.426)	(1.467)	(1.376)	(1.466)
_cons	-7.446	21.701	16.402	23.436
	(14.833)	(16.489)	(15.249)	(16.877)
Obs.	129	132	109	132
Adjusted R-squared	0.676	0.695	0.733	0.694

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**
Instrumental variables in 2SLS: one-period lagged net foreign assets and external borrowing

Table 6b IV Regressions

Dependent Variable: Credit Dollarization (% of Total Bank Assets)

	(1)	(2)	(3)	(4)
Deposit dollarization	0.242	0.301**	0.355***	0.297**
(% of total bank assets)	(0.160)	(0.114)	(0.117)	(0.111)
Net foreign assets	-0.406***	-0.431***	-0.557***	-0.418***
(% of total bank assets)	(0.126)	(0.116)	(0.104)	(0.117)
Interest rate spread	-0.038	0.072	0.104*	0.069
(one period lagged)	(0.059)	(0.054)	(0.054)	(0.055)
Number of total banks		-0.564***	-0.470***	-0.604***
(per capita)		(0.124)	(0.095)	(0.126)
External borrowing	0.084	-0.040	-0.064	-0.075
(% of GDP)	(.097)	(0.069)	(0.125)	(0.075)
Trade	0.021	0.063**		
(% of GDP)	(0.029)	(0.025)		
Imports of intermediate goods			0.106	
(% of GDP)			(0.079)	
Exports				0.138**
(% of GDP)				(0.049)
Index of forex liberalization	-3.046	-3.311**	-3.977*	-2.788*
	(2.539)	(1.353)	(1.989)	(1.348)
Intermediate exchange rate regime	0.811	1.074	0.632	0.723
	(2.522)	(1.633)	(1.565)	(1.557)
Floating exchange rate regime	-2.461	-1.823	-1.225	-2.123
	(2.370)	(1.380)	(1.304)	(1.257)
Net foreign reserves	-0.316	-0.290*	-0.233	-0.338**
(% of GDP)	(0.189)	(0.147)	(0.154)	(0.145)
Domestic credit	0.002	-0.050	-0.035	-0.051
(% of GDP)	(0.090)	(0.070)	(0.059)	(0.066)
Inflation rate	0.011	-0.018	-0.023*	-0.018
	(0.012)	(0.011)	(0.012)	(0.011)
Maximum historical inflation	0.004***	0.003***	0.003**	0.003**
	(0.001)	(0.0017)	(0.001)	(0.001)
Croatia	-5.630	-4.166	-6.907**	-3.460
	(4.906)	(3.240)	(2.865)	(3.294)
Trend	0.573	0.275	0.272	0.341
	(0.364)	(0.237)	(0.292)	(0.231)
_cons	16.722	20.801***	24.022***	19.466
	(9.985)	(4.512)	(6.462)	(4.580)
Obs.	89	89	85	89
Adjusted R-squared	0.736	0.821	0.821	0.827

Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation)
***** Significant at 1%; ** significant at 5%; * significant at 10%**
Instrumental variables in 2SLS: one-period lagged net foreign assets and external borrowing

CHAPTER 3

REGULATION, FINANCIAL DEVELOPMENT, AND CAPITAL FLOWS

1. Introduction

Banks play an important role in any economy by channeling savings from consumers to producers. In emerging market and transition economies, bank credit is one of the main sources of external finance for domestic agents, due to underdeveloped capital markets. However, there is almost always higher demand than supply of funds, and thus insufficient bank credit.

Riess et al. (2002) show that the level of intermediation for ten transition economies, accession countries to the European Union (EU), is low when compared to developed economies and even to other countries with similar income per capita. These economies, however, have excess funds and seem unable to allocate them efficiently to domestic agents through the banking sector. Rather, since the mid-1990s, the banks have been net external creditors, as the increase in bank deposits has led to an increase in net assets with foreign banks. Thus, banks seem unwilling to take more risks by lending domestically and prefer to deposit the excess funds abroad.

Transition economies have different degrees of dollarization of bank deposits and loans.[1] When bank deposits are highly-dollarized and there are restrictions on domestic lending in dollars, banks might hold foreign assets rather than lend domestically (in domestic currency) as they want to keep matched foreign exchange positions. Could then restrictions on domestic dollar lending explain the low level of domestic intermediation? These regulatory effects have not been previously studied.

This chapter analyzes the effects of the liberalization of foreign exchange and capital account transactions on capital flows and the domestic level of financial development. Mainly, it disentangles the impact of controls on domestic foreign exchange operations (borrowing and lending in dollars) and on cross-border transfers, on banks' choice between domestic credit and foreign assets.

Dollarization of bank deposits and loans has been long seen as a source of economic instability, macroeconomic volatility, and potentially increased exposure to financial and currency crises. Consequently, regulators impose restrictions on dollar deposits and loans from domestic banks to residents in an attempt to discourage the use of foreign currencies. Restricting lending in dollars might cause banks to substitute dollar credit by cross-border deposits or loans, instead of substituting it by domestic currency credit. Consequently, capital outflows might increase and the overall level of credit in the economy might fall.

Honohan and Shi (2002) show, using data on fifty-eight emerging economies for the years 1990 – 2000, that around half of the domestic dollar deposits are exported through the banking sector. However, they do not take into account any regulation

[1] Dollarization of deposits and loans occurs when a significant share of deposits and loans from domestic banks to domestic agents are denominated in foreign currencies. I use the term "dollar" to denote any foreign currency in general.

effects. Moreover, restricting dollar deposits might reduce the total level of bank liabilities, as households choose to hold dollars (the "money under the mattress" phenomenon) or hold dollar deposits abroad. Garcia-Herrero (1997) argues that allowing for domestic dollar deposits helped stabilize the economy in Argentina and Paraguay during their banking crises, while the large offshore dollar deposits of residents destabilized the economy in Venezuela.

Ize and Levy Yeyati (2003) develop a general equilibrium minimum variance portfolio model and determine the benchmark level of dollarization as a function of inflation and the real exchange rate volatility. They consider then monetary policy induced deviations from benchmark dollarization. They theoretically show that capital flight and disintermediation can occur when a tax wedge is introduced, that is when financial intermediation in domestic and foreign currency is not taxed at the same rate.

To date, there are no empirical studies that explicitly consider the effects of foreign exchange and capital regulation on banks' choice between domestic credit and foreign assets. Moreover, there are no empirical studies that evaluate the effects of controls on foreign exchange operations separately from controls on current and capital account transactions.

This chapter draws on three literatures. First, it relates to the literature on the effects of capital account regulation on financial development and capital flows. There is a tendency in this literature to aggregate the exchange and capital controls (denoted below by capital controls), and hence not to differentiate between restrictions on domestic operations (between residents) and international operations (between residents

and non residents). However, this distinction is necessary if one were to study banks' portfolio allocation.

Previous studies have found mixed results for the effects of capital controls on financial development.[2] Chinn and Ito (2002) find a link between capital controls and financial development. However, this link depends on the measures used and the level of economic development. In a simple correlation analysis on a cross-country sample of forty-one countries, IMF (1999) finds that exchange and capital controls are associated with less domestic credit provided by banks.

Several studies evaluate the effectiveness of capital controls, thus the effects of controls on the volume and composition of capital inflows and outflows. Johnston and Ryan (1994) find mixed results for the effects of capital controls on capital outflows, while Montiel and Reinhart (1999) show that capital controls affect the structure but not the volume of capital inflows.

Second, this chapter relates to the literature on the effects of banking regulation on banks' portfolio allocation. Several studies evaluate the effects of banking regulation (such as the capital adequacy requirements) on banks' choices between alternative domestic assets (see, for example, Furfine (2001)). There are no studies, however, that evaluate the effects of controls on domestic banks' borrowing and lending in dollars on their portfolio allocation.[3] A good survey of prudential supervision of foreign exchange

[2] Regulatory measures on current and capital account transactions and their effects on the economy have been studied since the 1980s. There are studies on the effects of capital controls on economic growth and macroeconomic volatility (see, for example, Prasad et al. (2003)), on trade (see Stockman and Hernandez (1988) and IMF (1999)), on the international activities of banks (see Buch (2003)), as well as on the stability of the financial sector, inflation, real interest rate, consumption-smoothing behavior, and welfare.

[3] The only empirical study I could find on restrictions on the domestic use of domestic and foreign currencies is IMF (2003), which considers the restrictions' effects on nominal effective exchange rate, and finds no statistically significant effect.

operations in nineteen countries in 1996 and the methods used to manage foreign exchange risk in the banking sector is Abrams and Beato (1998).[4]

Third, there are several empirical studies that evaluate determinants of banks' international activities. Most work in this area focuses on foreign direct investment (FDI). Furthermore, papers that analyze determinants of banks' foreign assets refer mainly to banks from developed countries (mostly US, Germany, and Japan), and consider mainly factors from the host country. Regulation from the host country matters for banks' holdings of foreign assets, and so do demand conditions in the local markets, FDI in non banks, and relative returns (see Goldberg and Johnson (1990), Moshirian and Van der Laan (1998), Miller and Parkhe (1998), and Buch (2000), (2003)).

This chapter's contribution to the literature is twofold. First, it separates, theoretically and empirically, the effects of controls on foreign exchange operations and capital flows, on domestic credit and banks' foreign assets. It shows how these effects can vary, depending on the type of activity, domestic or international, that is restricted. Second, it examines the determinants of foreign assets for banks in transition economies, and contributes to the literature on determinants of banks' international activities. I find that for banks in transition economies, conditions from the home countries, as well as controls on foreign exchange and capital flows are important determinants of their decision to go abroad.

I derive a simple international portfolio choice model for a domestic bank (similar to Buch (2003) and Freixas and Rochet (1997, Chapter 8)). Each period the bank chooses its level of assets and liabilities to maximize expected profits while minimizing

[4] There is extensive literature on other aspects of banking regulation, such as supervision, regulatory monitoring, limits on activities that banks can engage in, loan classification, regulation of information disclosure, and their effects on bank stability and development, profitability, and foreign bank entrance.

overall portfolio risk. The assets are composed of domestic currency and dollar loans to residents, and foreign assets. Liabilities consist of domestic currency and dollar deposits from residents. There are several types of regulation costs the bank incurs: a cost per unit of dollar deposits taken, a cost per unit of dollar loans granted, and a cost per unit of foreign assets. The bank chooses between domestic credit and foreign assets based on expected relative returns and regulatory costs.

The empirical analysis uses a panel dataset for twenty-two transition economies. Measures of controls on foreign exchange operations include restrictions on domestic banks' lending in dollars domestically, restrictions on residents' accounts in dollars held domestically, and restrictions on banks' holdings of local securities denominated in dollars. The measures of controls on cross-border capital outflows include restrictions on residents' accounts in dollars held abroad and restrictions on financial credit between residents and nonresidents.

The main contribution of this chapter is to show that foreign exchange controls and capital flow controls have opposite effects on the level of domestic credit. I show that liberalization of foreign exchange operations increases the level of domestic credit, possibly because of keeping domestic capital in the economy, and discouraging capital flight, while the liberalization of capital flows reduces it. Thus the mixed effects of capital account controls on financial development found in previous studies might be due to the aggregation of both types of restrictions into one indicator. I also find that banks increase their holdings of foreign assets when capital outflows are liberalized. Furthermore, I find strong evidence that the liberalization of domestic lending in dollars increases banks' foreign assets. This last effect might be due to banks holding deposits

with correspondent foreign banks, which are just the dollar loans they granted to domestic firms, and the firms use them to make payments abroad through the banking sector.

The remainder of the chapter is organized as follows. Section 2 presents the theoretical framework. Section 3 outlines the econometric model and the estimation methods. Section 4 describes the data and the measures of regulation employed. I present the empirical results in Section 5, while in Section 6 I perform several robustness tests and discuss possible biases. Section 7 concludes.

2. A Simple International Portfolio Choice Model

I use a simple partial equilibrium, international portfolio choice model for a domestic bank, similar to Buch (2003) and Freixas and Rochet (1997, Chapter 8). The model is highly stylized, and it is intended to highlight the different impact of different restrictions on domestic and international operations on banks' portfolio choices.

Each period the domestic bank chooses its level of assets and liabilities. The bank assets are composed of domestic currency and dollar loans to residents, and foreign assets. Liabilities consist of deposits of residents in domestic currency or dollars

$$W + D + D^* = L + L^* + R^*, \tag{1}$$

where W denotes initial wealth, $D(D^*)$ denotes deposits of residents in domestic currency (dollars), $L(L^*)$ denotes loans granted to residents, denominated in domestic currency (dollars), and R^* is foreign assets. I assume that foreign liabilities are either zero, or supply-determined.

At the end of the period, the bank maximizes the following objective function:

$$(2) \qquad Max\, E(\tilde{\Pi}) - \frac{1}{2}\gamma\sigma^2(\tilde{\Pi}),$$

where $E(\tilde{\Pi})$ denotes expected profits, $\sigma^2(\tilde{\Pi})$ is the portfolio risk, and γ is the coefficient of risk aversion.

Banks are assumed to be small; they take the returns on assets and liabilities as given. The supply of deposits and the demand for loans in both domestic currency and dollars are assumed infinitely elastic. The gross interest rates paid on domestic currency and dollar deposits are $\tilde{r}_D$ and $\tilde{r}_{D^*}$,[5] and the gross returns for domestic currency and dollar loans are $\tilde{r}_L$ and $\tilde{r}_{L^*}$, respectively. The foreign asset is assumed to be risk-free, with a return of r^*. In addition, there are three types of regulation costs that the bank incurs: a cost per unit of dollar deposits taken (d_D), a cost per unit of dollar loans granted (d_L), and a cost per unit of foreign assets (a). Thus, domestic operations in dollars are taxed at rates d_D and d_L, while international operations (the majority of which are in dollars, for the case of emerging market and transition economies) are taxed at rate a.

Bank's profits are

$$(3) \qquad \tilde{\Pi} = \tilde{r}_L L + (\tilde{r}_{L^*} - d_L) L^* + (r^* - a) R^* - \tilde{r}_D D - (\tilde{r}_{D^*} + d_D) D^*,$$

Combine Eqs. (1) and (3) to obtain

[5] I use the symbol ~ to denote random variables, and the symbol – for the mean of a random variable. Hence, $E(\tilde{r}_D) = \bar{r}_D$, and similarly for the other interest costs/returns.

$$\tilde{\Pi} = (\tilde{r}_L - r^* + a)L + (\tilde{r}_{L^*} - d_L - r^* + a)L^* + (r^* - a)W - (\tilde{r}_D - r^* + a)D - (\tilde{r}_{D^*} + d_D - r^* + a)D^*, \tag{4}$$

Assume further that the variances of interest costs/returns on deposits/loans denominated in the same currency are equal, and that the variance for domestic currency returns is higher than that for dollar returns[6]

$$\sigma^2(r_D) = \sigma^2(r_L) = \alpha^2\sigma^2(r_{D^*}) = \alpha^2\sigma^2(r_{L^*}) = \alpha^2\sigma^2, \tag{5}$$

where $\alpha > 1$ is a parameter.

Also, assume that the correlation of returns denominated in the same currency is twice as large as that of returns in different currencies due to currency matching

$$corr(r_D, r_{D^*}) = corr(r_D, r_{L^*}) = corr(r_L, r_{D^*}) = corr(r_L, r_{L^*}) = \mu, \tag{6}$$

$$corr(r_D, r_L) = corr(r_{D^*}, r_{L^*}) = 2\mu, \tag{7}$$

where μ is a parameter and σ^2 denotes the variance of interest costs/returns on domestic currency deposits/loans.

Using Eqs. (2) and (4) – (7), bank's maximization problem becomes

$$\underset{D, D^*, L, L^*}{Max} \{(\bar{r}_L - r^* + a)L + (\bar{r}_{L^*} - d_L\, r^* + a)L^* + (r^* - a)W - (\bar{r}_D - r^* + a)D - (\bar{r}_{D^*} + d_D - r^* + a)D^* - \frac{1}{2}\gamma\sigma^2 [\alpha^2 L^2 + L^{*2} + \alpha^2 D^2 + D^{*2} + 2\mu(-2\alpha^2 LD + \alpha LL^* - \alpha LD^* - \alpha DL^* + \alpha DD^* - 2D^*L^*)]\}, \tag{8}$$

[6] The assumption of higher uncertainty for domestic currency returns implicitly incorporates the uncertainty and lack of credibility of domestic policies. Notice, also, that the exchange rate volatility is not explicitly modeled, as the focus of the model is on regulation costs.

The optimal portfolio allocation of a domestic bank is given by the following set of first-order conditions[7]

(9) $$\bar{r}_L - r^* + a - \gamma\sigma^2[\alpha^2 L + \mu(\alpha L^* - 2\alpha^2 D - \alpha D^*)] = 0,$$

(10) $$\bar{r}_{L^*} - d_L - r^* + a - \gamma\sigma^2[L^* + \mu(\alpha L - \alpha D - 2D^*)] = 0,$$

(11) $$\bar{r}_D - r^* + a + \gamma\sigma^2[\alpha^2 D + \mu(-2\alpha^2 L - \alpha L^* + \alpha D^*)] = 0,$$

(12) $$\bar{r}_{D^*} + d_D - r^* + a + \gamma\sigma^2[D^* + \mu(-\alpha L - 2L^* + \alpha D)] = 0.$$

Eqs. (9) – (12) show that the equilibrium levels of banks' assets and liabilities depend on banks' degree of risk aversion (γ), the parameters and variances and covariances between risky assets (α, μ, and σ^2), expected excess returns ($\bar{r}_D - r^*$, $\bar{r}_{D^*} - r^*$, $\bar{r}_L - r^*$, and $\bar{r}_{L^*} - r^*$), and regulatory costs (d_D, d_L, and a). Next, I use the above equations to evaluate the effects of changes in the regulatory measures of foreign exchange and capital account operations on banks' portfolio allocation decisions.

Consider first a change in the regulatory cost of dollar loans (d_L) on the total level of domestic credit $(L + L^*)$ and the level of foreign assets R^*. It can be shown that

(13) $$\frac{\partial L^*}{\partial d_L} = -\frac{[(1+4\mu) + 2\mu^2(1-2\mu)}{\gamma\sigma^2(1+4\mu)(1-4\mu^2)} < 0,$$

(14) $$\frac{\partial L}{\partial d_L} = \frac{\mu}{\alpha\gamma\sigma^2(1+4\mu)} > 0,$$

[7] For the system to have a solution, I have to assume that $\mu < 0.5$.

$$\frac{\partial(L+L^*)}{\partial d_L} = -\frac{[(1-4\mu^2)\mu-(1+4\mu)\alpha-2\alpha\mu^2(1-2\mu)]}{\alpha\gamma\sigma^2(1+4\mu)(1-4\mu^2)} < 0. \tag{15}$$

Hence, the liberalization of foreign exchange lending (a decrease in d_L) increases the level of dollar loans and decreases domestic currency loans.[8] The level of credit in the economy increases. The direction of change in foreign assets depends on the variance and covariance parameters

$$\frac{\partial R^*}{\partial d_L} = -2\frac{\partial(L+L^*)}{\partial d_L} - \frac{1}{\gamma\sigma^2(1-2\mu)}. \tag{16}$$

Holdings of foreign assets are more likely to decrease when the correlation between interest costs and returns for deposits and loans denominated in the same currency (μ) is small. Then, an increase in dollar loans as a result of foreign exchange liberalization will trigger a smaller change in dollar deposits. Thus, there will be more substitution of foreign assets by dollar loans.[9]

Second, consider a change in the regulatory cost of cross-border flows (a). The effects on banks' assets are the following

$$\frac{\partial L}{\partial a} = -\frac{\partial D}{\partial a} = \frac{1}{\gamma\sigma^2\alpha^2(1+4\mu)}(1+2\mu-2\mu\alpha), \tag{17}$$

$$\frac{\partial L^*}{\partial a} = -\frac{\partial D^*}{\partial a} = \frac{1}{\gamma\sigma^2\alpha(1+4\mu)}[\alpha(1+2\mu)-2\mu)] > 0, \tag{18}$$

[8] I abstract from any changes in the default risk, and the effects the regulatory measures might have on the variance of returns on loans.

[9] If I instead assume that the cost of dollar instruments is the same, $d_L = d_D$, then the liberalization of foreign exchange operations will still increase domestic credit (by rising the level of dollar loans), while leaving the level of foreign assets unchanged.

$$\frac{\partial(L+L^*)}{\partial a} = \frac{1}{\gamma\sigma^2\alpha^2(1+4\mu)}[(1+\alpha^2)(1+2\mu)-2\mu\alpha)] > 0. \quad (19)$$

The liberalization of capital flows (a decrease in a) will lead to a decrease in dollar loans and the overall level of domestic credit. The total level of deposits increases; hence, foreign assets have to increase, in order for banks to maintain a balanced portfolio

$$\frac{\partial R^*}{\partial a} < 0. \quad (20)$$

To summarize, the two sets of restrictions have opposite effects on domestic credit. The liberalization of domestic foreign exchange operations increases domestic credit, while the liberalization of international operations (capital outflows) decreases it. Foreign asset holdings increase when capital outflows are liberalized, while the effect of foreign exchange liberalization depends on model parameters.

3. Empirical Model and Estimation Methods

In order to assess the effects of foreign exchange and capital account regulation on financial development and capital flows, I estimate the following two equations

$$\textit{Domestic Credit}_{it} = \alpha_1' \textit{ Forex Regulation}_{it} + \beta_1' \textit{ Cross-border Flows Regulation}_{it} + \gamma_1' \textit{ Controls}_{it} + \varepsilon_{it}, \quad (21)$$

$$\textit{Foreign Assets}_{it} = \alpha_2' \textit{ Forex Regulation}_{it} + \beta_2' \textit{ Cross-border Flows Regulation}_{it} + \gamma_2' \textit{ Controls}_{it} + \zeta_{it}. \quad (22)$$

The two equations are specified under the assumption that direct intervention on the foreign exchange market and capital account has a short-run effect (similar to Montiel

and Reinhart (1999)) as banks make a one-time adjustment of their portfolio to the policy change. However, I also test for persistence effects.

Eq. (21) captures the effect of regulatory measures on the level of domestic credit, while Eq. (22) measures the effects of regulation on bank foreign assets. *Forex Regulation* measures the effect of the liberalization of domestic foreign exchange operations (mainly of dollar deposits and loans from domestic banks). *Cross-border Flows Regulation* denotes the measures of liberalization of capital flows, referring mainly to bank lending and/or holding deposits abroad. *Controls* denote all other factors that might affect banks' decision to lend domestically vs. hold foreign assets, including relative returns, as they are further described in this section and Section 4. Finally, ε and ζ are disturbance terms.

I estimate each equation separately, using pooled OLS (POLS) as the benchmark. In order to control for unobserved heterogeneity, I use then the fixed effects (FE), random effects (RE), and first difference (FD) estimators, and compare the results. Since domestic credit and foreign assets are measured as stock variables and show a high level of persistence, I expect the first difference estimator to provide the most reliable results.

There are several issues that have to be addressed when measuring regulatory effects: 1) if and how regulation affects foreign banks that operate domestically; 2) which banks can perform foreign exchange operations; 3) how to separate the regulation effects from all other possible effects (the identification problem); and 4) the possible endogeneity of regulatory measures. I discuss each of these issues separately.

First, our measures of financial development and bank foreign assets refer to all domestic depository institutions, and thus include foreign banks that operate locally.

Since the presence of foreign banks in many transition economies is large[10] and rapidly growing over time, one question that arises when studying regulation effects is if and how domestic regulatory measures affect foreign banks. Mainly, do regulatory measures affect both domestic and foreign banks in the same way? According to IIB (2002)[11] and the banking laws in different countries, foreign banks operating domestically are mostly under local supervision and their activities are regulated by domestic legislation. Thus, the effects of regulations should affect banks in the same way regardless of their country of origin.

Second, not all banks are allowed to perform operations in foreign currencies, and thus take dollar deposits and extend dollar loans. In some countries, a permit or a license is required for a bank to engage in foreign exchange or international operations. Abrams and Beato (1998) survey the prudential regulation and management of foreign exchange rate risk, and show that seven out of the nineteen countries considered have licensing requirements for banks in order to perform general foreign exchange operations. Ideally, one would use measures of domestic credit and foreign assets for only the banks that can engage in foreign exchange and international operations, in order to capture the foreign exchange regulation effects. However, due to data constraints, I use aggregate data for

[10] There is a large diversity of patterns for foreign banks' presence in transition economies. While the Croatian banking sector is almost entirely foreign-controlled, foreign banks play only a marginal role in other countries, e.g. Slovenia and Russia. For example, according to BIS (2002), the share of foreign banks' local claims in domestic bank credit in 2001 is 68 percent in the Czech Republic, 52 percent in Poland, 40 percent in Hungary, and only 2 percent in Russia.

[11] According to IIB (2002), foreign banks in the Czech Republic, Estonia, Latvia, and Poland are under the host country supervision standards. Foreign banks' subsidiaries and even foreign banks' branches comply with the regime applied to domestic banks. Romania, on the other hand, relies on the global supervision by home country for branches of non-domestic banks. However, in practice, these foreign branches are still subject to the rules imposed by the National Bank of Romania.

the banking sector, and thus implicitly assume that foreign exchange and capital restrictions affect all banks.[12]

Third, in order to identify the effect of regulation, I control for other factors that might affect the level of domestic credit and foreign assets, and might be correlated with the foreign exchange and capital restrictions: (1) demand for credit, (2) banking crises, (3) the "follow the customer" strategy, and (4) the overall environment in which banks operate.

Several papers (see, for example, Riess et al. (2002), Hájková et al. (2002), Várhegyi (2002), and Hristov and Zaimov (2003)) attribute the low level of credit in transition economies to banks' inability to identify profitable investment projects or the high competition for "good borrowers" from foreign investors/lenders, as well as existent shortcomings in risk-appraisal and the legal environment. I include several proxies for the riskiness of domestic lending, firms' external borrowing, and enterprise reform and competition policy.

Banking crises are usually followed by the tightening of the institutional framework, and thus changes in regulation. I also include an indicator of banking crisis, to control for the drop in lending due to severe banking distress or bank runs, when all or most of bank capital has been exhausted. Also, banks can substitute domestic credit by

[12] I expect that the banks that are licensed to perform foreign exchange and international operations are the large banks. Since I use aggregate and not bank-level data, I capture the effects coming from the large banks anyway. Also, there is evidence that most banks in transition economies are licensed for foreign exchange operations. In Bulgaria, in 2002, all banks have a foreign exchange license. In Kazakhstan, in 2002, only one out of 42 banks is restricted to operations in domestic currency only. In Macedonia, in 2001, 18 out of 22 banks have a license for international operations. In Russia, in 2000, 764 banks out of 1311 can conduct operations in foreign exchange, while in Ukraine in 1993 and 1999, 115 out of 228, and 153 out of 203, respectively, are licensed for foreign exchange operations. In Yugoslavia, all banks can perform foreign exchange operations.

domestic securities, in addition to foreign assets. Hence, I include a measure of the relative cost of domestic credit to domestic securities.

Foreign assets of banks from transition economies are mostly composed of deposits with foreign banks and foreign securities. Thus I can assume a perfectly elastic supply, which is consistent with the fact that banks in developing economies are small relative to the other participants on the international financial markets. There is also the possibility that banks' international activities are determined by the "follow the customer" strategy. Thus, I include a measure of the outstanding stock of FDI abroad as a potential determinant of foreign assets.

4. Data

I use aggregate annual data on twenty-two transition economies from Central and Eastern Europe and Central Asia. Data for some countries start as early as 1990. However, for most countries the dataset covers the second half of the 90s (see Table 1).

4.1. Regulatory Measures

In 1997, the IMF introduced three measures for controls on exchange, current, and capital account operations, based on data from the AREAER (Annual Reports on Exchange Arrangements and Exchange Restrictions): the index of controls on current payments and transfers, the index of capital controls, and the index of exchange and capital controls, which is a combination of the first two. These indices include 142 individual types of exchange and capital controls. However, these measures do not differentiate among restrictions on operations in dollars between residents and operations

in dollars between residents and nonresidents. Hence, they cannot be used to estimate the regulatory effects on banks' portfolio allocations.

Currently, the most commonly used restrictions on capital account operations are controls on transactions by commercial banks. For the period 1998 - 2000, 85 percent of the IMF members had some form of limits on bank cross-border borrowing or lending, bank holdings of external accounts, and dollar borrowing and lending domestically. To date, few studies examine the effects of these foreign exchange and capital restrictions on banks' portfolio allocation.

Restrictions on dollar lending in emerging economies can take different forms (see Delgado et al. (2002) and the AREAER). The highly-dollarized economies tend to have no restrictions (for example, Armenia, Latvia, or the Kyrgyz Republic); the prohibition of dollar lending, as the other extreme, is very rare (Macedonia, in 1996 - 2000, and Slovenia, in 1991). The requirement that dollar lending has to be approved by officials is most commonly used as a controlling mechanism. Alternative restrictions involve access to dollar credit limited to firms with dollar returns and/or dollar payments, the use of dollar credit to finance critical imports only, and credit ceilings on individual banks' outstanding dollar debt.

I use data from the AREAER, as well as from the central banks' publications and banking and foreign exchange legislation, to define an index of foreign exchange lending (IXFXLEND), which takes the value 0 if lending in dollars is prohibited, 1 if there are any restrictions on banks' lending and firms' borrowing in dollars, or if there are approval requirements, and 2 if there are no restrictions, or if only registration of the loan is required. Alternatively, I define a dummy variable (DFXLEND) that takes the value 1

if there are no restrictions on domestic banks' dollar lending, zero otherwise (see Tables 2a and 2b for the description and summary statistics of the variables).

Residents can hold dollar accounts domestically, subject to different restrictions, such as: approval required for depositing into them, only individuals/enterprises can maintain them, and only one account per person can be opened. I define an index of foreign exchange accounts held domestically (IXRDACC), which takes the value 0 if dollar accounts are prohibited, 1 if there are any restrictions on the opening of dollar accounts, or if there are approval requirements, 2 if there are no restrictions, or only registration of the account is required. Alternatively, I define a dummy variable (DRDACC) that takes the value 1 if there are no restrictions on residents' dollar accounts, zero otherwise.

Banks might be substituting dollar loans by dollar securities issued domestically. I use as a control an index of the liberalization of banks' holdings of local securities denominated in dollars (IXFXSEC), which takes the value 0 if these holdings are prohibited, 1 if there are any restrictions or approval requirements, and 2 if there are no restrictions. Alternatively, I use a dummy variable (DFXSEC), which takes the value 1 if there are no controls, and zero if there are controls on holdings of domestic dollar securities.

Similarly, I define measures of restrictions on capital outflows: the index of foreign exchange accounts held abroad (IXRAACC), which takes the value 0 if these accounts are prohibited, 1 if there are any restrictions or approval requirements, and 2 if they are liberalized (or only registration is required) and a dummy variable (DRAACC), which is 1 if there are no restrictions, and zero if there are restrictions. In addition, I

construct a dummy variable for capital outflows liberalization (DKOUTFLOW), which takes the value 1 if either residents' deposits abroad are restricted, or financial credit from residents to nonresidents is limited, zero if neither is restricted.

Table 3a presents the correlations among the regulatory measures employed in the analysis. Based on the theoretical model, I expect the liberalization of dollar lending (IXFXLEND or DFXLEND) to have a positive effect on the overall level of domestic credit, while the effect on foreign assets is ambiguous. In addition, the liberalization of capital outflows (IXRAACC, DRAACC, or DKOUTFLOW) should decrease domestic credit and raise foreign assets.

There are several caveats of the regulation measures that have to be at least mentioned. First, these measures capture the intensity of the controls up to a very limited point. Second, they are all "de jure" measures, and do not take into account the enforcement of controls. The regulation effects on credit and foreign assets might be biased upward for countries with weak enforcement or low circumvention cost. I discuss possible biases in Section 6. Third, the prohibition of domestic accounts in foreign exchange seems to be one of the most controversial and poor measure from all the 142 measures used by the IMF, according to the IMF specialists (see IMF (2003)). Last, it is possible that countries do not report changes in regulations right away, and thus there might be a lag in reporting. Also, there is an improvement in countries reporting changes in regulation and a greater coverage of regulation towards the end of the 90s.

4.2. Financial Intermediation and Capital Flows

I use three alternative measures for domestic credit: the ratio of domestic credit to enterprises to GDP (LTGDP), the ratio of domestic credit to the private sector (including both enterprises and households) to GDP (DCPR),[13] and the ratio of domestic credit to enterprises to total bank assets (LTTBA). Similarly, I use the ratios of banks' foreign assets to GDP and banks' foreign assets to total bank assets, denoted by FORASSGDP and FORASSTBA, respectively.[14]

4.3. Controls

Several controls are used, in addition to the relative returns for bank assets, to account for changes in domestic credit and foreign assets that are not caused by restrictions on foreign exchange operations or capital flows. These controls are presented below. Also, the correlations among the measures employed are presented in Table 3b.

Relative Returns

The relative cost of domestic lending to foreign assets is measured by the external interest rate spread (ESPREAD), defined as the spread between the average domestic lending rate and the LIBOR rate. I also use a domestic spread (DSPREAD), measured as the average lending rate minus the domestic risk-free rate (the three-month Treasury-bill

[13] The first measure includes credit to state enterprises, and is an imperfect measure of financial intermediation and depth in an economy. The second measure includes only credit to private enterprises. The drawback of this measure is that an increase might simply capture the privatization of large state enterprises, rather than the issuance of new loans. Thus, I use both measures and compare the results.

[14] I use the gross measure for foreign assets, rather than net foreign assets. Buch (2003) argues that gross measures are more appropriate when studying the effect of regulatory measures, as effects might cancel out with the net measures.

rate, or if this is not available, the money market rate, discount rate, or refinancing rate), which captures the cost of domestic lending relative to other domestic investment opportunities.

Demand for Domestic Credit

Changes in the riskiness of domestic lending might cause banks to reallocate their resources among different investment opportunities. I use the EBRD index of enterprise reform (IXENTPR), which takes values from 1 (little progress) to 4.3 (substantial progress; standards and performance of enterprises typical of advanced industrial countries), to measure the overall development of enterprises. Alternative measures are: the EBRD index of competition policy (IXCOMPET), similarly defined,[15] a dummy variable DBANKRUPTL, which takes the value 1 if a bankruptcy law was adopted, zero otherwise, and a measure of the country risk (MOODYS), which is an index based on Moody's long-term foreign currency sovereign rating and takes values from 1 (lowest country risk) to 21 (highest country risk).

To measure an increase in firms' demand for finance, I use INVESTGDP, which is the ratio of reinvestment to GDP. I also use the ratio of external credit (credit from foreign investors) to GDP (NONBGDP), as a measure of firms' access to alternative sources of finance.

[15] The indices of enterprise reform and competition policy build on the judgment of the EBRD's Office of the Chief Economist. The index of enterprise reform includes information on the existence of soft budget constrains, credit and subsidy policy, enforcement of bankruptcy legislation, competition and corporate governance, and enterprise investment. The index of competition policy refers to competition legislation, enforcement and institutions, actions to reduce abuse of market power, and elimination of entry restrictions.

Banking Crises

Following Caprio and Klingebiel (2003), I include a dummy variable DBCRISIS, which takes the value 1 in the years when there is a banking crisis, either systemic or borderline, zero otherwise. A systemic banking crisis is defined as a situation when an economy faces large-scale financial and corporate distress within a short period, and much or all bank capital is exhausted. A borderline crisis is a non-systemic crisis, such as bank runs of individual banks.[16]

"Follow the Customer" Hypothesis

One reason banks might go abroad is to follow their customers. I include the ratio of total outstanding stock of FDI abroad to GDP (FDIOUTSGDP) to control for this effect.

Overall Environment in which Banks Operate

Due to the specifics of the transition economies, the EBRD index of initial conditions (IXIC) is used to control for the state of the economy at the beginning of the transition process. This includes the initial level of development, trade dependence on CMEA (Council for Mutual Economic Assistance), macroeconomic disequilibria, distance to the EU, natural resource endowments, and state capacity. The index takes values from 1 to 4.3, a higher value denoting a more favorable starting position.

Following Barth et al. (2002) and Demirgüç-Kunt and Huizinga (1999), I use the following controls for the macroeconomic conditions that might influence banks'

[16] Data on banking crises in Kazakhstan and Moldova have been added from Tang et al. (1998). According to their definition, a banking crisis is a severe banking distress (large share of non performing loans) and/or bank runs.

activities: the rate of devaluation of the exchange rate (DEVRATE) and alternatively the inflation rate (ICPI), the ratio of banks assets owned by the government to total bank assets (STATBANK),[17] and the growth rate of GDP per capita (GGDPUSD).

5. Empirical Analysis

Table 3b reports the correlations among the variables employed in the main specification. Notice first the high correlation (0.530) between the rate of devaluation of the exchange rate (DEVRATE) and the interest rate spread (ESPREAD). The spread is calculated using nominal interest rates, thus it includes the depreciation of the exchange rate. However, I separately include the rate of devaluation, to capture additional valuation effects (changes in stock variables due to changes in the exchange rates).

Second, two other independent variables, the index of enterprise reform (IXENTPR) and the ratio of state-owned bank assets (STATBANK) are highly correlated with other explanatory variables. As one would expect, the index of enterprise reform is highly correlated with the index of initial conditions (0.456) and trend (0.520). It is also correlated with the interest rate spread (-0.458), the rate of devaluation (-0.344), and the state ownership of banks (-0.355). The state ownership of banks decreases over time as more banks are privatized (the correlation of STATBANK and TREND is -0.429).

First, I estimate Eqs. (21) and (22) using pooled OLS (POLS). However, since there are country effects that are probably missing from the specification, I also estimate the two equations using FE, RE, and FD. I choose to present the results for all estimators

[17] This variable is also used by Riess et al. (2002), and described as an indicator of low profitability and high concentration of the banking sector. Buch (2003) uses it to measure limits on foreign bank entrance.

for comparison reasons, and since each has advantages and drawbacks (see Wooldridge (2002)).

Since I use stock measures, there is persistence in the dependent variables.[18] Furthermore, I find that the autoregressive coefficients for the changes in the errors, $\Delta\varepsilon_i$ and $\Delta\zeta_{it}$, are 0.240, 0.216, and -0.086 for the credit measures, and 0.000 and -0.105 for the bank asset measures. This suggests there is serial correlation in the initial errors. Hence, the first difference (FD) estimator provides the most reliable results. However, it also reduces the sample size, and it eliminates the effect of factors that do not vary over time.[19] The fixed effects (FE) estimator uses all the observations in the sample. It tends to provide large economic effects, but smaller statistical effects. The random effects (RE) estimator tends to work better than the FE estimator when there is not too much variation in the explanatory variables. However, it assumes that the independent variables are not correlated with the errors (the missing country-specific effect), and this tends to be false with aggregate data.[20]

5.1. Effects on Financial Intermediation

Tables 4a – 4c present the effects of the regulatory measures on domestic financial intermediation, using all four specifications (POLS, FE, RE, and FD). In Table 4a, financial intermediation is measured as the ratio of domestic credit to enterprises to

[18] The autoregressive coefficients for LTGDP, DCPR, LTTBA, FORASSGDP, and FORASSTBA are 0.86, 0.84, 0.79, 0.99, and 0.90, respectively.

[19] There is more variation across countries than over time in the regulation measures. There are only 6 changes in foreign exchange restrictions over time, and 12 in capital outflows restrictions.

[20] I perform the Hausman tests for the appropriateness of the RE estimator. For all three measures of domestic financial intermediation, I reject the null hypothesis that the random effects and the regressors are uncorrelated, while for the two measures of foreign assets, I cannot reject the null hypothesis. Thus, the RE estimation seems to be appropriate for measuring the regulatory effects on foreign assets, but not on domestic credit.

GDP. Table 4b presents the results for the domestic credit to private sector to GDP. These two measures capture mostly the magnitude effect (increase or decrease in credit). I also use the ratio of domestic credit to enterprises to total bank assets, to capture the substitution of credit with other types of assets effect. These results are presented in Table 4c.

The liberalization of foreign exchange operations (dollar lending domestically) has a positive and (mostly) significant effect on the level of domestic credit. It increases the total level of credit by around 2.5 – 6 percentage points and the level of credit to the private sector by 1 – 5 percentage points (see Tables 4a and 4b). There is a substitution effect, of other bank assets with domestic credit when dollar lending is liberalized, but the effect is not statistically significant (see Table 4c).

The liberalization of capital flows has a negative, but mostly insignificant effect on domestic lending. Notice the very large effect with the POLS estimator in Tables 4a and 4c, which probably captures missing country effects, since it disappears when I control for these effects.[21]

The other variables have the following effects. The spread has a positive and significant effect, as higher return for domestic lending relative to foreign assets will induce banks to lend more. A 10 percentage points increase in the spread will increase domestic lending by around 0.1 - 0.4 percentage points, thus the economic effect is relatively small. The rate of devaluation of the exchange rate has mixed effects, which vary with the measure and the specification used. It has a negative and significant effect

[21] I obtain very similar results if I use IXRAACC instead of DKOUTFLOW. In Table 4a, the effect becomes statistically significant in the RE estimation.

on the ratio of credit to total bank assets, which might capture either the substitution effect, or a valuation effect.

The index of initial conditions matters for the magnitude of domestic credit (see Tables 4a and 4b). As one would expect, the level of credit in transition economies still depends on economic conditions when they embarked on the transition path.[22] The banking crisis indicator has a counterintuitive positive effect in the POLS estimation, while with the FE, RE, and FD estimators it has a negative and sometimes significant effect. The index of enterprise reform, which I use to proxy for the demand for credit, is positive and highly significant with the POLS, and mostly negative with the other estimators. Since the FE, RE, and FD effects are most likely more consistent than the POLS effects, then banks seem to lend less domestically as the enterprises become more competitive. It might be the case that the index is a poor measure of demand conditions, or that it captures some other effects (see the high correlations with other explanatory variables, and possibly with missing variables). I present alternative proxies for the demand conditions in Section 6.

5.2. Effects on Capital Outflows

Tables 5a and 5b present the effects of regulatory measures on capital outflows. I present the results for bank foreign assets measured as a ratio to GDP, in Table 5a, and as a ratio to total bank assets, in Table 5b. Similarly to the domestic credit case, the first measure captures the magnitude, while the second measure captures substitution of foreign assets by other assets on the bank's balance sheet.

[22] Around 37 percent of the variance in LTGDP and DCPR is explained by IXIC alone.

The effect of domestic liberalization of dollar lending is surprisingly positive and very significant. Allowing banks to lend in dollars increases the level of domestic credit, as I show in Section 5.1, but it also increases banks' holdings of foreign assets. The ratio of foreign assets to GDP increases by 4 – 5 percentage points (see Table 5a), while the ratio of foreign assets to total bank assets increases by 4 – 8 percentage points (see Table 5b). A possible explanation for this finding is that after the liberalization of foreign exchange operations, banks grant dollar loans to domestic firms that use them to make payments abroad. Firms make these payments through the domestic banks, which increase their deposits with foreign correspondent banks, in anticipation of the future payments. The fact that a high percent of foreign assets are deposits with foreign banks seems to confirm this hypothesis. Thus, both domestic credit and foreign asset increases when dollar lending is liberalized.

The liberalization of capital outflows reduces banks' cost of holding foreign assets. Hence, holdings of foreign assets increase by around 2 – 4 percentage points (see Tables 5a and 5b).

The interest rate spread decreases foreign asset holdings, as a higher return for domestic loans relative to foreign assets cause banks to lend more domestically. However, the economic effect is pretty small: a 10 percentage point increase in the spread decreases the foreign assets ratio (to GDP and total bank assets, respectively) by 0.2 – 0.5 percentage points.

The index of initial conditions is again significant and has a positive effect; more developed economies seem to have banks with higher holdings of foreign assets.[23] Surprisingly, the indicator of banking crisis has no effect on holdings of foreign assets,

[23] The index alone explains some 35 percent of total variation in the foreign asset ratios.

regardless of the measure employed. The share of state-owned assets and the index of enterprise reform have mixed effects. The trend has a large positive effect on the measure of magnitude, but no effect on the substitution measure.

6. Alternative Measures and Possible Biases

In this section, I discuss the results obtained using alternative specifications and measures for the regulatory indicators and the controls, in order to assess the robustness of my findings. I also discuss the issue of endogeneity of the regulatory measures and possible biases in the estimated effects.[24]

When using a dummy (DFXLEND) instead of the index of foreign exchange liberalization (IXFXLEND), results do not change.[25] To test for persistence in the regulatory measures (the measures have a gradual effect), I estimate a regression with all variables but the regulatory dummies in first differences, and find no evidence of persistence in either the domestic credit or the foreign assets. It seems to be the case that regulations of foreign exchange operations and capital flows have a one-time effect on banks' assets.

The index of dollar lending IXFXLEND might be capturing the effect of dollar deposits liberalization. If this is the case, the positive effect on foreign assets can be simply explained by banks' matching of assets and liabilities by currency. I control for the liberalization of dollar deposits, the level of dollar deposits and the level of dollar liabilities using the following measures: the index of liberalization of domestic dollar

[24] These results are not presented here, but are available upon request.

[25] I try using an alternative measure of restrictions on foreign exchange operations, a dummy variable, which takes the value 1 if there is a tax imposed on foreign exchange operations (and thus, a higher cost of dollar instruments), and zero otherwise. This has no significant effects on banks' assets.

accounts (IXRDACC), the ratio of dollar deposits to total bank assets, and the ratio of dollar bank liabilities to total bank assets, respectively. The positive effect of IXFXLEND on domestic credit and foreign assets does not change. In addition, to check if the dollar lending regulation effect is not coming from the trade liberalization in general, I also include the ratios of exports, imports, and total trade (imports plus exports) to GDP. Although these measures have a positive and significant effect on foreign assets, the regulatory effects of interest remain the same.

I estimate the model replacing the index of enterprise reform by other controls for the demand for credit. These controls are: the proxy for the country risk (MOODYS), the measure of the existence of a bankruptcy law (DBANKRUPTL), the index of competitiveness (IXCOMPET), firms' external borrowing (NONBGDP), and the reinvestment ratio (INVESTGDP). I find that a higher country risk will reduce the domestic lending, while having no significant effect on foreign assets.[26] Higher demand for credit by firms, measured by a higher reinvestment rate, increases the level of domestic credit and has no effect on foreign assets. However, this variable is most likely endogenous. Domestic firms' credit from foreigners seems to be a complement, and not a substitute for domestic credit. It also increases the level of foreign assets, since it probably captures some of the liberalization of capital account operations. However, this variable is also most likely endogenous. The bankruptcy law and the index of competitiveness have no significant effect on banks' assets. In all these alternative specifications, the regulatory effects do not change.

I perform the following additional sensitivity tests:

[26] The sample size drops by 30 observations when using MOODYS.

- Using the outstanding stock of FDI abroad (FDIOUTSGDP) as a determinant of foreign assets, to capture the "follow the customer" effect. This variable has mixed effects, which might be due to endogeneity issues (as it measures the total stock of FDI, including banks and non banks).
- Using the inflation rate (ICPI) instead of the rate of devaluation of the exchange rate (DEVRATE).
- Using the growth rate of GDP (GGDPUSD) to control for the overall environment in which banks operate.
- Using year dummies for the time effects, instead of the time trend.
- Controlling for the substitution of domestic credit with other domestic assets. I use the domestic spread instead/in addition to the external spread. I also use the index of liberalization of the domestic issue of dollar securities (IXFXSEC), as well as other regulatory measures that might cause substitution between alternative domestic assets, such as the adoption of a capital adequacy ratio requirement.
- Using dummy variables for the countries that have signed an association or partnership agreement with the EU.

None of these sensitivity tests changes the main results.

Several potential caveats of the regulatory measures deserve some discussion. First, as I have already mentioned in Section 4, these are "de jure" measures, and they might be upward biased for countries with weak enforcement or low circumvention cost. The real regulatory effect for these countries might be smaller than the estimated effect. Second, these measures might be upward biased towards the end of the sample. Third,

there might be a lag in reporting. However, with one-period leads instead of the current values, the regulation measures are not significant anymore. Fourth, I use an unbalanced panel and there are missing observations for most countries. As long as the reason some data are missing is not related to the error term, the results will be unbiased. I expect countries to report changes in regulations, and missing data might indicate that for a given period there were no changes in regulation. If this is the case, my estimates do not suffer from a missing data bias.

7. Conclusions

How does liberalization of foreign exchange and capital account transactions influence capital flows and the domestic level of financial intermediation? Using data on twenty-two transition economies, I show that the liberalization of foreign exchange operations increases the level of domestic credit, possibly because of keeping domestic capital in the economy, and discouraging capital flight, while the liberalization of capital outflows reduces it. I also find that banks increase their holdings of foreign assets when capital outflows are liberalized. Surprisingly, the liberalization of domestic lending in dollars also increases banks' foreign assets.

Is a dollarized financial system better than none? This chapter suggests there is a disintermediation cost associated with restrictions on domestic dollar lending. However, the question deserves further examination. Policy makers might have to weigh the costs of financial dollarization, such as higher complexity of monetary policy, limited availability of policy instruments, and possibly higher exposure to financial and currency

crises, against the benefits of higher financial intermediation, and decide if they prefer a dollarized financial system to none.

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Table 1 Country and Regulatory Measures Coverage

Albania	1989 - 1990
Armenia	1996
Azerbaijan	1997 - 2001
Bulgaria	1994 - 2001
Croatia	1998 - 2001
Czech Republic	1996 - 2001
Estonia	1992 - 2001
Georgia	1997 – 1998
Hungary	1996, 2001
Kazakhstan	1996 - 2001
Kyrgyz Republic	1998 - 2001
Latvia	2001
Lithuania	1993 - 2001
Macedonia	1996 - 2001
Moldova	1996 - 2001
Poland	1998 - 2001
Romania	1996 - 2001
Russia	1996 - 2000
Slovak Republic	1996 - 2001
Slovenia	1991 – 1992, 1996 - 2001
Ukraine	1997 - 2001
Yugoslavia	2001

Table 2a Coding and Data Sources

Code	Description	Data Sources
Regulatory Measures		
IXFXLEND	Index of liberalization of foreign exchange lending	AREAER
DFXLEND	Dummy for the liberalization of foreign exchange lending	AREAER
IXRDACC	Index of liberalization of residents' foreign exchange accounts held domestically	AREAER
DRDACC	Dummy for the liberalization of residents' foreign exchange accounts held domestically	AREAER
IXFXSEC	Index of liberalization of banks' holdings of local securities denominated in dollars	AREAER
DFXSEC	Dummy for the liberalization of banks' holdings of local securities denominated in dollars	AREAER
IXRAACC	Index of liberalization of residents' foreign exchange accounts held abroad	AREAER
DRAACC	Dummy for the liberalization of residents' foreign exchange accounts held abroad	AREAER
DKOUTFLOW	Dummy for the liberalization of capital outflows	AREAER
Financial Intermediation and Capital Flows		
LTGDP	Domestic credit to enterprises to GDP, %	Central Banks' publications
DCPR	Domestic credit to the private sector to GDP, %	EBRD
LTTBA	Domestic credit to enterprises to total bank assets, %	Central Banks' publications
FORASSGDP	Banks' foreign assets to GDP, %	IFS
FORASSTBA	Banks' foreign assets to total bank assets, %	IFS

Table 2a Coding and Data Sources (cont'd)

Code	Description	Data Sources
Controls		
ESPREAD	Spread between average domestic lending rate and LIBOR rate	EBRD, Economagic
DSPREAD	Spread between average lending rate and domestic risk-free rate	EBRD, IFS
IXENTPR	Index of enterprise reform	EBRD
IXCOMPET	Index of competition policy	EBRD
DBANKRUPTL	Dummy if there is a bankruptcy law	EBRD
MOODYS	Index of Moody's long-term foreign currency sovereign rating	Moody's
INVESTGDP	Reinvestment to GDP, %	EBRD
NONBGDP	External borrowing by firms to GDP, %	BIS
DBCRISIS	Dummy if there is a banking crisis	Caprio& Klingebiel
FDIOUTSGDP	Total outstanding stock of FDI abroad to GDP, %	UNCTAD
IXIC	Index of initial conditions	EBRD
DEVRATE	Rate of devaluation of the exchange rate	IFS
ICPI	Rate of inflation	IFS
STATBANK	Banks assets owned by government to total bank assets, %	EBRD
GGDPUSD	Growth rate of GDP per capita	IFS

Table 2b Summary Statistics

Variable	LTGDP	LTTBA	DCPR	FORASSGDP	FORASSTBA
Mean	19.850	34.422	16.295	7.454	18.477
Median	14.548	33.009	11.9	5.774	15.799
Std. Dev.	15.816	12.332	12.610	6.158	10.387
Minimum	2.080	4.026	0.600	0.086	3.834
Maximum	64.456	63.69	59.300	29.997	51.500
No. obs.	156	110	198	207	118

Variable	IXFXLEND	IXRDACC	IXFXSEC	IXRAACC	DKOUTFLOW
Mean	1.407	1.716	1.063	1.161	0.166
Median	1	2	1	1	0
Std. Dev.	0.592	0.488	0.704	0.450	0.373
No. obs.	113	236	79	211	229

Table 3a Correlations among Alternative Regulatory Measures

Indicator	IXFXLEND	DFXLEND	IXRDACC	DRDACC	IXFXSEC	DFXLEND	IXRAACC	DRAACC
DFXLEND	0.929							
	(113, 0.000)							
IXRDACC	0.069	0.094						
	(113, 0.469)	(113, 0.324)						
DRDACC	0.150	0.185	0.966					
	(113, 0.113)	(113, 0.050)	(236, 0.000)					
IXFXSEC	0.339	0.339	0.048	0.093				
	(72, 0.004)	(72, 0.004)	(79, 0.675)	(79, 0.414)				
DFXSEC	0.660	0.660	0.221	0.283	0.832			
	(72, 0.000)	(72, 0.000)	(79, 0.050)	(79, 0.011)	(79, 0.000)			
IXRAACC	0.311	0.278	0.228	0.242	0.203	0.377		
	(107, 0.001)	(107, 0.004)	(210, 0.001)	(210, 0.000)	(79, 0.073)	(211, 0.001)		
DRAACC	0.306	0.306	0.225	0.232	0.203	0.377	0.918	
	(107, 0.001)	(107, 0.001)	(210, 0.001)	(210, 0.001)	(79, 0.072)	(79, 0.001)	(211, 0.000)	
DKOUTFLOW	0.306	0.310	0.261	0.270	0.173	0.362	0.876	0.954
	(107, 0.001)	(107, 0.001)	(228, 0.000)	(228, 0.000)	(79, 0.128)	(79, 0.001)	(211, 0.000)	(211, 0.000)

Number of observations and P-values in parenthesis.

Table 3b Correlations among Main Independent Variables

Indicator	IXFXLEND	DKOUTFLOW	IXIC	ESPREAD	DEVRATE	DBCRISIS	STATBANK	IXENTPR
DKOUTFLOW	0.306							
	(107, 0.001)							
IXIC	-0.081	-0.257						
	(112, 0.396)	(226, 0.000)						
ESPREAD	-0.110	-0.119	-0.052					
	(110, 0.251)	(186, 0.104)	(190, 0.467)					
DEVRATE	0.119	-0.094	-0.169	0.530				
	(108, 0.218)	(195, 0.190)	(197, 0.017)	(189, 0.000)				
DBCRISIS	-0.036	0.055	0.011	-0.016	-0.129			
	(112, 0.709)	(226, 0.409)	(273, 0.850)	(190, 0.825)	(273, 0.070)			
STATBANK	0.086	-0.330	0.099	0.285	0.162	0.295		
	(96, 0.403)	(167, 0.000)	(166, 0.203)	(161, 0.000)	(164, 0.038)	(166, 0.000)		
IXENTPR	0.111	0.173	0.456	-0.458	-0.344	0.126	-0.355	
	(112, 0.244)	(225, 0.009)	(231, 0.000)	(192, 0.000)	(201, 0.000)	(231, 0.056)	(174, 0.000)	
TREND	-0.148	0.158	0.000	-0.366	-0.202	0.178	-0.429	0.520
	(113, 0.117)	(229, 0.016)	(273, 1.000)	(196, 0.000)	(204, 0.004)	(273, 0.003)	(174, 0.000)	(241, 0.000)

Number of observations and P-values in parenthesis.

Table 4a
Dependent Variable: Domestic Credit (% of GDP)

	POLS	FE	RE	FD
IXFXLEND	3.515	5.923**	4.606*	2.410
	(2.420)	(2.848)	(2.461)	(1.645)
DKOUTFLOW	-11.050**	-3.187	-4.138	-2.038
	(4.361)	(2.926)	(2.927)	(3.066)
IXIC	2.832**		3.298***	
	(1.144)		(1.005)	
ESPREAD	0.044*	.015	.031	.037***
	(0.025)	(.021)	(.024)	(.006)
DEVRATE	-0.027	.001	-.009	-.019*
	(0.016)	(.017)	(.018)	(.010)
DBCRISIS	7.400**	-3.804**	-1.126	-.603
	(3.080)	(2.039)	(2.073)	(.713)
STATBANK	-0.157*	.096	-.013	.064
	(0.077)	(.061)	(.055)	(.065)
IXENTPR	13.179***	-6.565	4.030	-1.108
	(4.622)	(4.338)	(3.682)	(1.903)
TREND	0.298	.398	-.093	-.141
	(0.725)	(.476)	(.428)	(.288)
_cons	-21.937*	21.142	1.303	1.572
	(11.827)	(10.242)	(9.307)	(3.197)
Obs.	89	89	89	68
R-squared	0.639	0.116	0.457	0.243

Adjusted R-squared for POLS and FD. Overall R-squared for FE and RE.
Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation for POLS and FD)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 4b
Dependent Variable: Domestic Credit to the Private Sector (% of GDP)

	POLS	FE	RE	FD
IXFXLEND	1.282	4.897*	4.210*	3.331**
	(2.748)	(2.885)	(2.376)	(1.573)
DKOUTFLOW	-2.791	-3.326	-1.053	-3.682
	(4.451)	(2.959)	(2.898)	(2.617)
IXIC	3.125***		4.176***	
	(1.054)		(.971)	
ESPREAD	.019	.011	.024	.038***
	(.037)	(.021)	(.023)	(.006)
DEVRATE	.015	.027	.022	.011
	(.019)	(.016)	(.018)	(.007)
DBCRISIS	1.672	-2.960	-2.217	-1.228*
	(2.816)	(2.065)	(2.053)	(.627)
STATBANK	-.122	.031	-.071	.031
	(.080)	(.058)	(.051)	(.058)
IXENTPR	10.603*	-15.239***	-.637	-5.631
	(5.103)	(4.375)	(3.621)	(3.280)
TREND	-.246	.800*	-.093	-.215
	(.741)	(.461)	(.417)	(.254)
_cons	-6.711	41.312***	13.791	2.906
	(13.498)	(10.317)	(9.110)	(2.749)
Obs.	91	91	91	68
R-squared	0.618	0.262	0.462	0.428

Adjusted R-squared for POLS and FD. Overall R-squared for FE and RE.
Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation for POLS and FD)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 4c
Dependent Variable: Domestic Credit (% of Total Bank Assets)

	POLS	FE	RE	FD
IXFXLEND	3.833	3.694	4.164	.489
	(2.375)	(2.931)	(2.807)	(1.215)
DKOUTFLOW	-14.649**	.385	-.004	-1.888
	(6.004)	(3.002)	(3.110)	(2.433)
IXIC	-2.338		-1.381	
	(1.782)		(1.957)	
ESPREAD	.054**	.042*	.045*	.033**
	(.020)	(.025)	(.026)	(.012)
DEVRATE	-.046*	-.050**	-.046**	-.034
	(.025)	(.020)	(.021)	(.020)
DBCRISIS	2.324	-1.102	-1.537	-.346
	(3.043)	(2.385)	(2.451)	(1.798)
STATBANK	-.082	.137**	.059	.078
	(.132)	(.067)	(.065)	(.095)
IXENTPR	7.073	-12.794***	-6.071	-3.398
	(5.970)	(4.563)	(4.166)	(2.119)
TREND	-.631	-.537	-1.132**	.037
	(.888)	(.519)	(.489)	(.332)
_cons	25.599	64.686***	57.365	-1.144
	(20.383)	(11.140)	(11.143)	(3.513)
Obs.	71	71	71	56
R-squared	0.283	0.000	0.043	0.150

Adjusted R-squared for POLS and FD. Overall R-squared for FE and RE.
Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation for POLS and FD)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 5a
Dependent Variable: Banks' Foreign Assets (% of GDP)

	POLS	FE	RE	FD
IXFXLEND	.686	4.901***	3.921***	4.439***
	(1.353)	(1.453)	(1.244)	(.570)
DKOUTFLOW	2.756	3.035**	3.130**	2.575***
	(1.737)	(1.492)	(1.377)	(.864)
IXIC	1.894***		1.850***	
	(.514)		(.656)	
ESPREAD	-.012	-.005	-.004	-.008**
	(.009)	(.011)	(.010)	(.003)
DEVRATE	.011	.006	.005	.006
	(.008)	(.008)	(.008)	(.003)
DBCRISIS	1.481	-.796	-.263	-.503
	(1.551)	(1.022)	(.957)	(.495)
STATBANK	-.012	.031	.026	.017
	(.032)	(.029)	(.025)	(.015)
IXENTPR	1.610	.868	.596	-.249
	(2.803)	(2.166)	(1.859)	(3.350)
TREND	.887***	.710***	.794***	.208
	(.313)	(.230)	(.201)	(.143)
_cons	-7.990	-9.147*	-9.124**	-1.427
	(6.736)	(5.114)	(4.570)	(1.664)
Obs.	95	95	95	73
R-squared	0.577	0.058	0.464	0.185

Adjusted R-squared for POLS and FD. Overall R-squared for FE and RE.
Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation for POLS and FD)
***** Significant at 1%; ** significant at 5%; * significant at 10%**

Table 5b
Dependent Variable: Banks' Foreign Assets (% of Total Bank Assets)

	POLS	FE	RE	FD
IXFXLEND	4.825	5.303**	4.230*	8.413***
	(3.191)	(2.499)	(2.205)	(1.413)
DKOUTFLOW	10.270***	3.072	3.899	4.505***
	(2.659)	(2.559)	(2.551)	(1.407)
IXIC	1.616*		-.603	
	(.903)		(1.277)	
ESPREAD	-.094***	-.029	-.041*	-.054***
	(.013)	(.021)	(.022)	(.012)
DEVRATE	.061***	-.009	.000	.017
	(.013)	(.017)	(.018)	(.018)
DBCRISIS	-.187	1.302	1.702	-.904
	(2.736)	(2.033)	(1.994)	(.819)
STATBANK	-.052	.020	.025	.086*
	(.041)	(.057)	(.052)	(.042)
IXENTPR	-10.898**	7.437*	.724	3.230
	(4.460)	(3.891)	(3.235)	(6.014)
TREND	.712	.187	.616	.451
	(.645)	(.442)	(.387)	(.278)
_cons	29.834**	-11.800	3.804	-3.998
	(10.426)	(9.499)	(8.616)	(3.343)
Obs.	71	71	71	56
R-squared	0.429	0.017	0.086	0.436

Adjusted R-squared for POLS and FD. Overall R-squared for FE and RE.
Standard errors in parentheses (adjusted for heteroskedasticity and serial correlation for POLS and FD)
***** Significant at 1%; ** significant at 5%; * significant at 10%**