Why Don't Banks Lend to Egypt's Private Sector?[1]

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Abstract

Bank credit to Egypt's private sector decreased over the last decade, despite a recapitalized banking system and high rates of economic growth. Recent macro-economic turmoil has reinforced the trend. This paper explains the decrease based on credit supply and demand considerations by 1) presenting stylized facts regarding the evolution of the banks' sources and fund use in 2005 to 2011, noting two different cycles of external capital flows, and 2) estimating private credit supply and demand equations using quarterly data from 1998 to 2011. The system of simultaneous equations is estimated both assuming continuous market clearing and allowing for transitory price rigidity entailing market disequilibrium. The main results are robust to the market clearing assumption. During the global financial crisis, a significant capital outflow stalled bank deposit growth, which in turn affected the private sector's credit supply. At the same time, the banking sector increased credit to the government. Both factors reduced the private sector's credit supply during the period under study. After the trough of the global crisis, capital flowed back into Egypt and deposit growth stopped being a drag on the supply side, but bank credit to the government continued to drive the decrease in the private sector's credit supply. Beginning in the final quarter of 2010, capital flows reversed in tandem with global capital markets, and in January 2011 the popular uprising that ousted President Hosni Mubarak added an Egypt-specific shock that accentuated the outflow. Lending capacity dragged again, accounting for 10 percent of the estimated fall in private credit. Credit to the government continued to drain resources, accounting for 70 - 80 percent of the estimated total decline. Reduced economic activity contributed around 15 percent of the total fall in credit. The relative importance of these factors contrasts with that of the preceding capital inflow period, when credit to the government accounted for 54 percent of the estimated fall, while demand factors accounted for a similar percentage.

Keywords: Private credit, Egypt, Supply and Demand System, Disequilibrium model.

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1. Introduction

Since 2000, banking credit to the private sector has declined in real terms and as a share of Egypt's GDP. During the past decade the banking system witnessed recapitalization of public banks and two different cycles of external capital flows. Capital flowed in until mid-2008 when the global financial crisis erupted, and flowed out until mid-2009. As global risk appetite recovered, capital flowed back in until the last quarter of 2010, when global capital markets tightened again and the January 2011 uprising accentuated the capital outflow.

Aside from the capital flows' stop-go cycles, public finance deficits and financing needs created an expansion-contraction-expansion cycle that affected bank credit to the private sector. Output fluctuations with episodes of high growth as well as output contractions affected the private sector's demand for credit. This paper describes how these factors interact to produce a decline in credit to the private sector.

The paper first examines the stylized facts of bank credit to the private sector in an international context, benchmarking the expected amount of private sector credit for a country with Egypt's characteristics (using FINSTAT, a benchmarking tool developed by the World Bank). It also explores the evolution of banking sector sources and uses, based on its aggregate balance sheet and similar exercises performed for Latin America and the MENA regions (Barajas et al., 2002; 2010).

The central objective of the paper is to estimate credit supply and demand equations in line with the abundant empirical literature on the topic. Some studies examine the issue assuming that prices are flexible enough to clear the market by equalizing supply and demand. Others assume that prices are not perfectly flexible and estimate demand and supply equations using the short-side rule (i.e. that observed credit quantities can occur on the demand or supply schedules, whichever is smallest, at a given interest rate). Assuming an excess supply or demand at a given point, the researcher infers the likelihood of the observed quantity being on the supply or demand regimes. Empirical studies based on aggregate time series data and applied to business loans include Laffont and Garcia (1977) for the Canadian market, Sealey (1979) and King (1986) for the US market. Pazarbasioglu (1997) and Kim (1999) investigate whether there was a credit crunch, respectively in Finland following the banking crisis of 1991-92, in Korea following the financial crisis in December 1997. In Latin America, Catao (1997) and Braun and Levy-Yeyati (2000) assessed credit contraction for Argentina, Berrospide and Dorich (2001) for Peru, Carrasquilla, Galindo and Vasquez (2000) and Barajas, Lopez and Oliveros (2001) for Colombia, Barajas and Steiner (2002) for Colombia, Peru and Mexico, and Hurlin and Kierzenkowski (2007) for Poland.

The rest of the paper is organized as follows. Section Two describes some stylized facts for the credit market in Egypt and compares the case with peer countries. It also discusses the evolution of the banking sector's main sources and uses of funds. Section Three describes the methodology of credit demand and supply estimation and presents the data sources. Section Four reports and interprets the empirical results within the macroeconomic context. Section Five concludes.

2. Stylized Facts

2.1 Banking Reform in Egypt

The Central Bank of Egypt in 2004 adopted a reform program that aims at building solid infrastructure and more efficient and sound banking sector. Although the global financial crisis led to many negative repercussions on several world economies, the Egyptian banking sector weathered the negative repercussions due to the successful reform program that have launched in 2004. Indeed, as it was mentioned by the World Bank (2009) "*the Egyptian financial sector is the most far reaching, substantive and comprehensive drive toward financial sector strengthening so far in Egypt - and indeed in any other country of the Middle East and North Africa region*".

This reform has been implemented in two phases. The first phase had three main pillars: first, strengthening the legal, regulatory and supervisory framework; second, consolidating the banking sector and increasing private participation within banking assets and finally the financial, operational and institutional restructuring of public-sector banks. Those reforms led to a robust, solid and well capitalized banks (see Table 1), as banks decreased from 57 to 39; assets increased by 88% to reach EGP 1.1 billion in 2008 up from EGP 0.57 billion in 2003; total deposits increased by 85% over the same period; capital adequacy ratio increased from 12.2% to reach 15.1%. In addition, the flow of new capital through mergers and acquisitions in the banking system reached EGP 24.24 billion in 2008. At the banking sector level, as it is shown in Table 2, the banking reform plan reduced the number of operating banks in Egypt from 61 banks to 39 while increasing the number of branches by 25% to reach 3502 branches (up from 2783). This was mainly due to the significant decrease in the number of private and foreign banks that ended their business. Furthermore, banking density has slightly decreased from 24.9 to 22.3 thanks to this increase in the total number of branches.

[Tables 1 and 2 about here]

Others aspects have also improved since the ratio of nonperforming loans to total gross loans has decreased from 26 percent in 2005 to 11 percent in 2011 and the interest rate spread declined from 5.9 percent to 4.8 percent. Finally, it is important to note that the bank liquid reserves to bank assets ratio has been increasing after the reform until 2007 to reach 45 percent up from 33.4 percent in 2005. However, the ration started to decrease due to the financial crisis in 2008/2009 reaching 34.2 percent. The deterioration has been more pronounced due to the popular uprising in January 2011 since the bank liquid reserves to bank assets ratio reached 16.3 percent as shown in Table 3. This means that the banking system liquidity has significantly decreased implying that adverse macroeconomic conditions should be more likely to lead to banking and financial crises.

[Table 3 about here]

The second phase of the banking sector reform program that started in 2009 aims at deepening the Egyptian banking sector and enhancing its efficiency and competitiveness through enhancing access to financial services, continuing the strengthening of the regulatory and supervisory framework through the implementation of Basel II/III and enhancing the implementation of Corporate Governance rules and regulations. Those reforms increased the loans-deposits ratio reaching 54%, average loans-GDP ratio reaching 49.4% and average deposits-GDP ratio reaching 90%. Those figures are much higher than the world average in 2008.

Having said that, the implications of the financial turmoil would have been much more severe on the banking sector and on the rate of credit to GDP haven't this reform have happened. Therefore, the impact of the banking sector reform program on the banks ability to extend credit cannot be missed.

2.2 Private Credit in Egypt in an International Context

In comparing Egypt to other countries, two trends emerge. First, while private credit to GDP declined continuously since 2000 in Egypt, it increased in Morocco, Tunisia, India and Turkey (see Figure 1). Second, in 2009, Egypt was performing below the MENA countries' average (40 percent), the middle income countries average (41.6 percent) and its peer group average (49.9 percent) (see Figure 2 and Table 4). It is quite alarming given that the private sector was the main source of investment (70% of total investments came from the private sector) and hence the driving force behind employment opportunities and economic growth.

[Figures 1 and 2 about here]

[Table 4 about here]

Having examined the international context for evolution of private credit in Egypt and expected levels based on this sample of countries, we turn now to the domestic context.

2.2 Sources and Uses of Funds of the Banking Sector

Total bank credit as a share of GDP has been falling since 2006, except in 2011, when credit to the government jumped by six percentage points of GDP (see Table 5).[5] The banking sector's claims on the government (Figure 3) and on the business sector (Figure 4) show divergent trends.

[Table 5 about here]

[5] This section and the remainder of the paper uses Central Bank of Egypt (CBE) data on credit aggregates. Section I used the FINSTATS database for all variables to ensure comparability across countries.

[Figures 3 and 4 about here]

To explain private sector lending we will examine the sources and uses of banking funds during this period using the methodology of an existing study of bank credit contraction in Latin America (IMF Staff papers Barajas-Steiner, 2002), to facilitate comparison.

The banking sector's fund sources are deposits (D_t); net foreign liabilities (NFL_t), and bank capital (K_t). Uses include lending to the private sector (CPS_t), lending to the government (GOV_t), changing its net credit position with the CBE (CB_t), and cash holdings or other assets (OTH_t). Hence, credit to private sector can be defined as follows:

$$CPS_t = D_t + NFL_t + K_t - GOV_t - CB_t - OTH_t$$

Private sector credit growth (and change) can be decomposed into changes in these other balance sheet items that either contribute to or offset the decline:

$$\Delta CPS_t/CPS_{t-1} = \Delta D_t/CPS_{t-1} + \Delta NFL_t/CPS_{t-1} + \Delta K_t/CPS_{t-1} - \Delta GOV_t/CPS_{t-1} - \Delta CB_t/CPS_{t-1} - \Delta OTH_t/CPS_{t-1}$$

Table 6 shows the changes in sources and uses of funds for the period 2005 to 2011. Real deposits are the main force behind the changes, exhibiting high growth rates during the boom years of 2007 and 2008, a time when real net foreign liabilities were falling. The 2009 data reflects the impact of the global crisis (data corresponds to fiscal years, ending in June), when the banking sector's net foreign liabilities increased, compensating the decrease in the deposits as a source of funding. The general trend in the uses of funds shows that the real credit position with the CBE was the main alternative use of funds until 2009 when real credit to the government began taking over as the main use of banking sector funds.

In 2011, against a background of political unrest, real credit to the private sector decreased by 8.5 percent, as a result of contraction of sources by 17 percent and of alternative uses by 8.5 percent. The banking sector's adjustment to capital outflow consisted of compensating the contraction of net foreign liabilities with a reduction in the net credit position with the CBE by a similar magnitude.

[Table 6 about here]

During the capital inflow period 2006 to 2008, the Egyptian banking sector did not fund credit operations expanding its net foreign liabilities. In fact, during the capital inflow years the banking sector's liabilities with the rest of the world became instead a contractive factor. In 2009, when capital flowed out in response to the global crisis, banks used their external liabilities as a funding source, playing a counter-cyclical role. Only in 2011, during the capital outflow related to the January uprising, were the net foreign liabilities pro-cyclical (see Table 7).

[Table 7 about here]

The role of Egypt's central bank (CBE) helps explain this puzzling behavior. During the capital inflow period, the CBE intervened to prevent the domestic currency's appreciation. CBE's foreign currency assets increased from USD 23 billion in June 2006 to USD 48 billion in June 2008. To compensate for this expansion, the banks had to increase their net credit position with the CBE, especially in 2007 and 2008. During the capital outflow periods 2009 and 2011, the banking sector reduced its net credit position with the CBE.

Table 6 also shows a significant expansion of credit to government in FY2009 (30 percent), accompanied by a change in the banking sector's net credit position with the CBE. This may reflect a countercyclical monetary policy by the CBE who provided liquidity to the banking system to accommodate the government's higher demand for credit.

Figures 5 and 6 show the evolution of bank deposits. Until 2008 they grew at a significantly higher rate than the uses of funds. As of mid-2008 they stagnated and growth rates in Figure 6 show a close synchronicity with capital flows.

[Figures 5 and 6 about here]

From the demand for credit side, two factors typically affect credit expansion and/or contraction, i.e. the level of economic activity and the availability of alternative funding sources. Egypt's economic activity measured by the real industrial production index was clearly expanding, especially in the period 2002-2008, but then began contracting (see Figure 7).[6]

[Figure 7 about here]

The availability of alternative funding sources for firms (captured by the evolution of the stock market index, EGX 30) expanded significantly in the boom period 2004 to 2008. During the 2008 global crisis it fell precipitously, recovering again during the renewed capital inflow, and falling again in the recent macroeconomic turmoil (Figure 8).

[Figure 8 about here]

3 Methodology

Given the stylized facts regarding credit demand and supply determinants, we can verify the statistical validity of expected relationships and quantify the impact of different factors.

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[6] Quarterly GDP data is only available starting in 2002, while the industrial production index is available since 1998. The larger degrees of freedom for the econometric estimation explains the choice of this variable.

Following Laffont and Garcia (1977) and others, this section estimates aggregate demand and supply functions of bank credit to Egypt's private sector using two assumptions: an equilibrium approach and a disequilibrium one. The first assumes that prices are flexible and clear the market continuously, and estimates the system of simultaneous equations using traditional methods. The second method relaxes the market clearing assumption, allowing for transitory excess supply or demand situations, and estimates the system of equations using the Maddala and Nelson (1974) disequilibrium technique.

3.1 Equilibrium Hypothesis

In the specification of the supply and demand functions, the identification of the model requires that one or more variables included in one function be excluded from the other. Following Barajas and Steiner (2002), our identification variables in the demand equation capture the macroeconomic environment that affects credit demand: real industrial production (*RIP*) and the stock market index (*EGX30*). The former reflects the business environment and has a positive effect on credit demand; the latter represents an alternative form of financing for Egyptian firms, and should therefore have a negative impact on credit demand. Real lending rate (*RLEN*) is added to determine the impact of credit prices on credit demand.

The variables introduced in the supply function measure the banks' ability to supply loanable funds. We constructed an exogenous "lending capacity" (*LEND.CAP.*) variable which consists of real total deposits minus banks' real reserves. The higher the total deposits, the more the bank will supply credit. By contrast, the higher the reserves, the lower the available loanable funds. Therefore, we expect a positive effect of the lending capacity variable on credit to private sector.

To capture the trade-off that banks face when lending to the government, we introduced the real T-bill rates (*RTBILL*) in the supply function. This variable is mostly exogenous to the banking system but affect banks' willingness to lend to the government. The higher the T-bill rates, the more funds banks provide to government and hence the less they can lend to private firms. Therefore, it has a negative impact on credit supply to the private sector. Finally, lending rates (*RLEN*) were introduced to determine the impact of credit prices on credit supply[7]. Our dependent variable is real credit to the private sector (*RCRPV*).

The system of equations is:

Supply function:

$$ln(RCRPV)_t = \beta_0 + \beta_1\,(RLEN)_t + \beta_2\,ln(RTBILL)_t + \beta_3 ln(LEND.CAP)_{t-1} + \epsilon_t \qquad (1)$$

Demand function:

$$ln(RCRPV)_t = \alpha_0 + \alpha_1\,(RLEN)_t + \alpha_2\,ln(RIP)_{t-1} + \alpha_3\,ln(EGX30)_{t-1} + \varepsilon_t \qquad (2)$$

with ϵ_t and ε_t the respective disturbance terms.

We ran the regression using different techniques. First, using a seemingly unrelated regression, we estimated the supply and demand system assuming that the disturbances across

[7] Real rates were computed using the Fisher's relation (1+i) = (1+r)(1+π) where *i* is the nominal rate, *r* the real rate and π the inflation rate. Therefore, r = (1+i)/(1+π) – 1.

equations are contemporaneously correlated (Zellner, 1962). Next, we ran it using a multivariate regression. Finally, we used OLS and 2SLS regressions.

3.2 Disequilibrium Hypothesis

Since Fair and Jaffee (1972) extensive literature has adressed the econometric problems associated with estimating demand and supply schedules in disequilibrium markets. The main approach consists in using maximum likelihood (ML) methods. In a seminal paper, Maddala and Nelson (1974) derived the general likelihood function for different disequilibrium models and proposed the appropriate ML estimating procedures.

Their model is as follows:

$$d_t = x_{1,t}^{'}\beta_1 + \varepsilon_{1,t} \tag{3}$$

$$s_t = x_{2,t}^{'}\beta_2 + \varepsilon_{2,t} \tag{4}$$

$$q_t = \min(d_t, s_t) \tag{5}$$

where d_t denotes the unobservable quantity demanded during period t;

s_t the unobservable quantity supplied during period t;

$x_{1,t}^{'} = \left(x_{1,t}^{(1)} x_{2,t}^{(1)} \ldots x_{K_1,t}^{(1)}\right)$ is a vector of K_1 explanatory variables that influence d_t;

$x_{2,t}^{'} = \left(x_{1,t}^{(2)} x_{2,t}^{(2)} \ldots x_{K_2,t}^{(2)}\right)^{'}$ is a vector of K_2, explanatory variables that influence s_t;

β_1 and β_2 are respectively (K_1,1) and (K_2,1) vectors of parameters.

We assume that d_t and s_t are unobservable at date *t,* whereas $x_{1,t}$ and $x_{2,t}$ are observable. The variable q_t denotes the actual quantity observed at time *t*. The equation (5) is the crucial disequilibrium hypothesis, which allows for the possibility that the price of the exchanged good is not perfectly flexible and rationing occurs.

More generally, equation (5) indicates that any disequilibrium that occurs (i.e. any divergence between the quantity supplied and demanded) results from an incomplete price adjustment. Therefore, on the basis of voluntary exchange the 'short side' of the market prevails. With equation (5), the model indicates the probabilities of each observation belonging to either supplied or demanded quantities.

Next, we present the model's theoretical underpinnings. In a first version, following Maddala and Nelson (1974), we assume that both residuals $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are stationary processes, independently and normally distributed with variance σ^2_1 and σ^2_2 respectively. Under these regularity assumptions, the transformed variable $\varepsilon_{1,t} - \varepsilon_{2,t}$ is normally distributed with a variance equal to $\sigma^2 = \sigma^2_1+\sigma^2_2$.

Hence, the reduced variable $(\varepsilon_{1,t} - \varepsilon_{2,t})/\sigma$ follows a *N(0,1)*. The probability that the observation q_t belongs to the demand regime, denoted $\pi_t^{(d)}$, can then be computed as the corresponding *N(0,1)* fractile:

$$\pi_t^{(d)} = P(D_t < S_t) = \Phi(h_t) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{h_t} e^{-\frac{x^2}{2}} dx \qquad (6)$$

where $h_t = \left(x'_{2,t}\beta_2 - x'_{1,t}\beta_1\right)/\sigma$, and $\Phi(x)$ denotes the cumulative distribution function of the *N(0,1)*. Symmetrically, the probability of obtaining the supply regime, denoted $\pi_t^{(s)}$, is defined by $P(S_t < D_t) = 1 - \Phi(h_t)$[8]

3.3 Data

The quarterly dataset from 1998 to 2011 was compiled from different sources. Data regarding credit to private sector came from the banking survey published in CBE's monthly report. Total deposits, banks' reserves with the CBE (that were used to construct the lending capacity) and bank lending rates also come from the same source. Industrial production comes from the Central Agency for Public Mobilization and Statistics (CAPMAS) deflated by the CPI; and the stock market index (*EGX30*) as reported by the Egyptian Stock Market. EGX 30 Index is a market capitalization-weighted index. Finally, lending rates were taken from CBE reports while T-Bill rates were gathered from Ministry of Finance reports[9].

All nominal variables were deflated by the consumer price index. To partially control for endogeneity bias, the models use the lagged values for industrial production, bank deposits, bank reserves and the stock market index.

[8] For further details, see appendix 1-4

[9] To check whether our series are stationary or not, we ran the Augmented Dickey-Fuller test and found they all suffer from a unit root problem. After taking the first difference and running the ADF, we found our variables stationary. Finally, we conducted the Johansen's test to determine whether our series are co-integrated or not. We found that they form a co-integrated vector, allowing us to estimate the model in levels.

4 Empirical Results

4.1 Results of the Equilibrium Hypothesis

Table 8 presents the regression results using different techniques, all of which yield similar results. In the demand equation, real industrial production has the expected positive sign while the stock market index has a negative impact on the demand for credit, reflecting its role as a substitute for bank credit. The real lending rate turns out with an unexpected positive sign and statistically significant coefficient.

[Table 8 about here]

Concerning the supply function, we found lending capacity to be positively and statistically significant related to credit supply. The trade-off between government and private sector seems to be an important factor in explaining Egypt’s credit contraction. The more the banks provide loans to the government, the less they can lend to private firms. Consequently, the coefficient associated to the real T-bill interest rate is negative and statistically significant. Finally, in a supply function we expect a positive impact of credit prices on credit quantities. The real lending rate in fact has a positive and statistically significant impact on credit supply at 1 percent.

4.2 Results of the Disequilibrium Hypothesis

Table 9 summarizes the results using the disequilibrium model, with the same specifications as in the previous section. We use the two-step OLS parameters of the previous section as the initial values for the maximization process (see appendix for more details).

We checked the results' robustness using various initial conditions for the algorithm of ML maximization and various methods to optimize the ML (i.e. by finding the zero of the gradient; by minimizing with or without condition on the parameter; with a numerical/analytical gradient, etc.). The results (available upon request) show that the ML estimated parameters are robust to these changes.

Figure 9 shows each regime's estimated probabilities for the best model in terms of the log-likelihood statistics and information criteria. It is conventional to assume an excess of supply (respectively demand) when the estimated probability of the supply regime (respectively demand) is higher than 0.5.

These estimated probabilities of supply and demand regimes clearly indicate that the probabilities of regimes are often larger than 0.8 or less than 0.2. We can identify two main periods: for 2001-2003, there was excess demand of credit that progressively decreased and switched to an excess of supply situation until 2011. After the global crisis (in 2008) both the demand and supply of credit to the private sector diminished, and while the fall in the supply is estimated to be greater, the excess supply still persists.

[Table 9 about here]

[Figure 9 about here]

The disequilibrium econometrics approach based on the short-side rule is consistent with the theory of equilibrium credit rationing derived from asymmetric information models.

Because of moral hazard and adverse selection problems, an excess demand in the loan market may exist, since a rise in the loan interest rate can reduce the banks' expected return.

If each bank attracts only the least profitable customers, each may have an excess supply of loanable funds, but none will accept to reduce its interest rate. Consequently, there may be an excess credit supply in the banking sector, without a fall in the interest rate to clear the loan market. This excess of supply can be observed in Figure 10, illustrating the estimated demand and supply for the private sector's real claims.

[Figures 10 and 11 about here]

4.3 Decomposing the Predicted Changes in Credit

The models presented in Tables 8 and 9 allow us to determine the relative importance of demand and supply factors in the evolution of credit to the private sector during five sub-periods. These are categorized based on external capital flows: inflow periods (July 2001-June 2004, July 2004-June 2008, July 2009-September 2010) or outflow periods (July 2008-June 2009, and October 2010-June 2011).

Predicted change is calculated by multiplying the coefficients obtained in the previous section by the change in the explanatory variable throughout a given sub-period. Changes brought about as a result of adjustments in interest rates show a movement along supply and demand curves. By contrast, changes in the other explanatory variables show the predicted shifts in the curves.

Tables 10 and 11 present the results for different sub-periods using the equilibrium and disequilibrium models respectively. The two models yield similar results even when the absolute numbers differ. The disequilibrium model offers more volatile predictions, given the greater elasticity of the credit supply to changes in the real T-bill rates (2.19 in the disequilibrium model versus 1.89 in the equilibrium model) and the larger elasticity of the demand for credit to changes in alternative funding sources (-.11 in the disequilibrium model versus -.08 in the equilibrium one).

General trends persist despite the differences. Until 2008, lending capacity growth is the single most important credit supply factor, whereas after 2009 it is credit to the government (captured by the real T-bill rate). From the demand perspective, both the level of activity and the alternative funding sources switch dominant roles.

During the period July 2004 to June 2008, from the demand side, the availability of substitute funding sources was partially dampened by the positive impact of economic expansion. From the bank credit supply side, moderate growth in credit to the government compensated the equally moderate lending capacity.

During the global crisis (July 2008 to June 2009) a significant capital outflow led to a negative impact of lending capacity, which in turn affected the private sector's credit supply. Additionally, the banking sector gave credit to the government. Both made the supply effect dominant during the period. From the demand side, the contraction of economic activity mitigated credit demand but the lack of alternative funding sources led to higher demand for credit from the banking sector.

After the June 2009 trough of the global crisis, capital flowed back into the country. Lending capacity growth stopped being a drag on the supply side, and availability of alternative funding sources released pressure from the demand side (Tables 10 and 11). Now credit to the government was behind the fall in credit to the private sector.

[Tables 10 and 11 about here]

From the last quarter of 2010 (October) capital started flowing out of Egypt, in tandem with global capital markets, and the January 2011 uprising added an Egypt-specific shock that accentuated the outflow. Capacity of lending declines dragged again and credit to the government continued to drain resources. During this period, credit to the government accounts for between 70 and 80 percent of the predicted total decline in credit, and the fall in deposits accounts for almost 10 percent of the predicted fall in private credit. The slowdown in economic activity accounts for about 15 percent of the predicted total fall in credit.

Table 12 summarizes these findings by presenting 1) how supply is higher or lower than demand shifts for each period 2) whether the shifts are in the same direction or operate in opposite ways, and 3) the main determinant of supply and demand shifts.

[Table 12 about here]

5 Conclusions

The paper explained the credit contraction to the private sector based on the banking sector's sources and uses of funds, as well as estimating econometrically a system of supply and demand for private credit. An analysis of the banking sector's sources and uses of funds reveals a close association of bank credit to the private sector with external capital flows but mostly through the deposit growth rate, which was the main determinant of the sources of funds. The banking sector's net external liabilities were countercyclical, i.e. they contracted during the capital inflow period and expanded during the capital outflow. In this sense, the sector played a stabilizing role. Only during the last cycle of capital outflow since the Revolution the net foreign liabilities have been pro-cyclical. The banks' net credit position with the CBE fell during the capital outflow episodes of 2009 and 2011 and increased during the capital inflow episodes, which may be interpreted as an effective countercyclical monetary policy.

The system of simultaneous equations was estimated both assuming continuous market clearing and allowing for transitory price rigidity entailing market disequilibrium. The main results are robust to the market clearing assumption. Up to the global financial crisis, the main elements driving bank credit were from the demand side, though in opposing directions: vigorous industrial activity implied growing demand for bank credit, but available alternative sources of financing implied lower demand for bank credit. After the global financial crisis, the banking sector's credit to the government played the dominant role from the supply side, while subdued economic activity operated in the same direction from the demand side.

Starting in the last quarter of 2010 capital flows reversed, in tandem with global capital markets, and the events of January 2011 accentuated the outflow. The slowdown in economic activity accounted for between 15 and 20 percent of the predicted total fall in credit, while the expansion of the credit to the government accounts for the remaining fall in the observed credit to the private sector. The relative importance of these factors contrasts with that of the preceding capital inflow period during which credit to the government accounted for about 50 percent of the estimated fall, while demand factors accounted for a similar amount.

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Tables

Table 1: Banking Aggregates before and after 2004 Reform

LE million (End of June)	2003	2008	% change
Total Assets (in EGP)	577,938	1,083,311	87.70%
Total Deposits (in EGP)	403,144	747,199	85.30%
Loans & Discounts (in EGP)	284,722	401,425	41.20%
Capital & Reserves (in EGP)	29,960	53,436	82.70%
Capital adequacy ratio	12.20%	15.10%	2.90%

Source: Central Bank of Egypt.

Table 2: Number of Banks and Banking Density

End of June	2004+	2005	2006	2007	2008	2009	2010
Total Number of Banks Operating in Egypt	**61**	**52****	**43*****	**41*****	**40*****	**39*****	**39**
Total Number of Branches	**2783**	**2841**	**2944**	**3056**	**3297**	**3443**	**3502**
Banking Density+	**24.9**	**24.8**	**24.5**	**24.2**	**22.9**	**22.3**	**22.3**
Number of Public Sector Banks	7	7	7	6	6	5	5
Number of Branches of Public Sector Banks	2153	2185	2222	2074	2089	2088	2080
Number of Private Sector Banks	35	34	29	28	27	27	27
Number of Branches of Private Sector Banks	571	607	674	930	1145	1270	1329
Number of Private and Joint venture (JV) Banks	19	11	7	7	7	7	7
Number of Branches of Private and JV Banks	59	49	48	52	63	85	93

*Population in thousand / Banking unit.

+ Egyptian banks abroad are not included , also two banks established under private laws and are not registered with CBE: the Arab International Bank, and Nasser Social Bank

*** The decrease was because seven branches of foreign banks ended their business.

Table 3: Financial and Banking Variables in Egypt

	2005	2006	2007	2008	2009	2010	2011
Bank capital to assets ratio (%)	6.1	4.9	4.8	5.6	5.5	6.2	6.3
Bank liquid reserves to bank assets ratio (%)	33.4	34.0	44.9	36.5	34.2	33.3	16.8
Bank nonperforming loans to total gross loans (%)	26.5	18.2	19.3	14.8	13.4	11.0	-
Deposit interest rate (%)	7.2	6.0	6.1	6.6	6.5	6.2	6.2
Lending interest rate (%)	13.1	12.6	12.5	12.3	12.0	11.0	11.0
Interest rate spread (lending minus deposit rate, %)	5.9	6.6	6.4	5.7	5.5	4.8	4.8

Source: Central Bank of Egypt.

Table 4: Private Credit/GDP (percent) Regional Comparison

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Egypt, Arab Rep.	52.0	54.9	54.7	53.9	54.0	51.2	49.3	45.5	42.8	36.2
MENA Average	37.7	38.0	37.0	36.1	36.3	37.1	38.1	39.5	39.5	40.3
MENA Median	34.4	28.4	26.2	25.6	27.7	28.2	30.9	34.3	31.2	33.8
LMC Average	29.5	29.2	29.1	29.7	31.1	33.5	35.0	38.1	39.9	41.6
LMC Median	27.1	23.9	21.1	24.4	25.5	27.3	29.1	30.3	32.2	33.6
HIC OECD Median	81.1	92.8	94.4	97.7	98.4	102.2	104.1	105.0	108.2	111.5
Peer Group Average	42.6	40.3	41.1	40.8	41.6	42.8	43.9	45.7	48.5	49.9
Expected median	19.0	19.2	19.4	21.1	22.8	23.8	25.7	28.3	31.1	31.6
Number of countries used for the regional and income group benchmarks (not the OECD benchmark)										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Regional benchmarks	11	11	11	11	11	11	11	11	11	11
Income group benchmarks	47	47	48	48	48	48	48	48	48	47

Source: Finstat (2011)

Table 5: Credit as Share of GDP

credit of banking sector in local currency (as % of GDP)						
	2006	2007	2008	2009	2010	2011
total credit	0.789	0.662	0.568	0.623	0.596	0.631
gov	0.387	0.309	0.249	0.325	0.322	0.382
pub bus	0.043	0.025	0.022	0.023	0.018	0.018
priv bus	0.278	0.254	0.219	0.200	0.182	0.161
household	0.081	0.074	0.078	0.076	0.075	0.070

Source: Central Bank of Egypt (CBE) monthly reports

Table 6: Change in sources and uses of funds of the banking sector (for fiscal years ending in June) as a ratio to real credit to the private sector

	2005	2006	2007	2008	2009	2010	2011
Change in credit to the private sector	***-0.044***	***0.009***	***-0.015***	***0.017***	***-0.078***	***-0.029***	***-0.085***
Change in sources	0.062	0.035	-0.026	0.116	-0.038	0.024	-0.170
Change in deposits	0.066	0.086	0.115	0.047	-0.171	-0.031	-0.044
Local currency	0.055	0.098	0.023	0.083	-0.072	0.030	-0.048
Foreign currency	-0.002	-0.013	0.030	-0.028	-0.053	-0.054	-0.020
Other	0.013	0.000	0.061	-0.008	-0.045	-0.008	0.024
Change in foreign liabilities	-0.010	-0.072	-0.121	0.046	0.146	0.060	-0.077
Change in capital	0.006	0.022	-0.019	0.023	-0.014	-0.005	-0.049
Change in alternative uses	0.106	0.026	-0.010	0.100	0.040	0.052	-0.085
Change in credit government	0.065	0.050	-0.108	0.013	0.210	0.072	0.044
Change in net credit to CBE	0.026	-0.020	0.066	0.074	-0.142	-0.025	-0.144
Change in other assets & cash	0.015	-0.004	0.033	0.013	-0.028	0.006	0.014

Source: Central Bank of Egypt
Note: Real figures of all aggregates were obtained by deflating nominal figures by the CPI index from CAPMAS.

Table 7 – Change in CBE foreign currency assets (in Billion US$)

		Int. Res. & For. Assets[1]	Change in CBE IR & FA[2]	Current Account[3]	Capital Account[4]
2005	Mar	17.6	2.6	1.0	1.6
	Jun	19.2	1.6	0.1	1.5
	Sept	22.0	2.8	0.2	2.6
	Dec	23.4	1.4	0.8	0.6
2006	Mar	23.7	0.3	0.9	-0.6
	Jun	23.2	-0.5	-0.1	-0.4
	Sept	25.9	2.7	1.3	1.4
	Dec	32.0	6.1	0.4	5.7
2007	Mar	36.4	4.4	1.1	3.3
	Jun	38.5	2.1	-0.6	2.7
	Sept	38.9	0.4	-0.1	0.5
	Dec	43.2	4.3	-0.2	4.5
2008	Mar	47.5	4.3	0.7	3.6
	Jun	48.5	1.0	0.5	0.5
	Sept	41.9	-6.6	-1.0	-5.6
	Dec	34.9	-7.0	-1.5	-5.5
2009	Mar	32.1	-2.8	-0.9	-1.9
	Jun	31.7	-0.4	-1.0	0.6
	Sept	35.6	3.9	-0.5	4.4
	Dec	36.0	0.4	-0.8	1.2
2010	Mar	39.3	3.3	-1.3	4.6
	Jun	40.7	1.4	-1.7	3.1
	Sept	45.7	5.0	-0.8	5.8
	Dec	43.5	-2.2	-0.6	-1.6
2011	Mar	30.5	-13.0	-1.0	-12.0
	Jun	26.5	-4.0	-0.4	-3.6
	Sept	24.5	-2.0	-2.2	0.2
	Dec	18.5	-6.0	-1.8	-4.2

Source: Authors' calculations based on CBE monthly reports.
Notes: 1. International reserves + foreign assets of the CBE.
2. Change in (1)
3. Current account from the CBE monthly reports
4. (2) – (3)

Table 8: Demand and Supply of Private Credit (Equilibrium Estimation)

	SURE		MVREG	
	Ln(Claim. Priv.)		Ln(Claim. Priv.)	
	Supply	Demand	Supply	Demand
Real Lending Rate	1.721***	0.892***	1.721***	0.892***
	(0.327)	(0.212)	(0.343)	(0.222)
Real T-bill Rate	-0.958***		-0.958***	
	(0.335)		(0.351)	
Ln(Lagged Lending Cap.)	0.198***		0.198***	
	(0.0584)		(0.0612)	
Ln(Lagged Industrial Prod.)		0.249***		0.249***
		(0.0523)		(0.0548)
Ln(Lagged EGX 30)		-0.0397***		-0.0397***
		(0.0121)		(0.0126)
Constant	6.165***	6.566***	6.165***	6.566***
	(0.497)	(0.285)	(0.521)	(0.299)
Observations	45	45	45	45
R-squared	0.458	0.491	0.458	0.491

	OLS		2SLS	
	Ln(Claim. Priv.)		Ln(Claim. Priv.)	
	Supply	Demand	Supply	Demand
Real Lending Rate	2.509***	0.788***	2.509***	0.788***
	(0.391)	(0.235)	(0.391)	(0.235)
Real T-bill Rate	-1.892***		-1.892***	
	(0.431)		(0.431)	
Ln(Lagged Lending Cap.)	0.241***		0.241***	
	(0.0658)		(0.0658)	
Ln(Lagged Industrial Prod.)		0.378***		0.378***
		(0.0622)		(0.0622)
Ln(Lagged EGX 30)		-0.0785***		-0.0785***
		(0.0155)		(0.0155)
Constant	5.776***	6.044***	5.776***	6.044***
	(0.560)	(0.328)	(0.560)	(0.328)
Observations	45	45	45	45
R-squared	0.517	0.560	0.517	0.560

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Demand and Supply of Private Credit (Disequilibrium estimation)

Equations	Estimates
Supply equation	
Constant	6.6444***
	(7.2737)
Real lending rate	2.7062***
	(4.5826)
Real T-bill rates	-2.1912***
	(-3.8632)
Ln(Lagged lending capacity)	0.1387*
	(1.2887)
Variance of residuals	0.0564***
	(48.308)
Demand equation	
Constant	4.7733***
	(9.5659)
Real lending rate	0.7455
	(1.1246)
Ln(Lagged real industrial production)	0.6378***
	(9.7747)
Ln(Lagged stock market index)	-0.1127***
	(-8.4481)
Variance of residuals	0.0066***
	(187.20)
Log-likelihood	-84.0863
Adjusted R^2	0.4750
Frequency of supply regimes (FS)	22.22%
Frequency of demand regimes (FD)	77.78%
Akaïke Information criteria	-252.41
Schwarz Information Criteria	-234.34

Notes: 1) Asymptotic t-statistics are in parentheses.
2) FD (FS) denotes the frequency of demand (supply) regimes given that a period or regime occurs when the corresponding probability is higher than 0.5.

Table 10: Decomposition of Predicted Change in Real Credit (Equilibrium Hypothesis)

Supply

	Coeff	Growth					Multiplication				
		Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11	Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11
Real Lending rate	2.509	-1.5%	-1.1%	-4.1%	2.1%	0.6%	-3.76%	-2.66%	-10.35%	5.18%	1.50%
Real Tbill rate	-1.892	-1.3%	-0.8%	-4.2%	2.9%	3.6%	2.40%	1.43%	7.99%	-5.56%	-6.78%
Ln(Lend. Cap.)	0.241	11.5%	5.3%	-5.9%	-1.6%	-2.6%	2.78%	1.27%	-1.42%	-0.39%	-0.63%
Shifts in the curve[1]							**5.18%**	**2.70%**	**6.56%**	**-5.95%**	**-7.41%**
Total changes in Supply[2]							**1.42%**	**0.04%**	**-3.79%**	**-0.78%**	**-5.91%**

Demand

	Coeff	Growth					Multiplication				
		Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11	Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11
Real Lending rate	0.788	-1.5%	-1.1%	-4.1%	2.1%	0.6%	-1.18%	-0.84%	-3.25%	1.63%	0.47%
Ln(Industrial Prod.)	0.378	12.9%	10.1%	-4.2%	-7.0%	-3.2%	4.86%	3.81%	-1.60%	-2.64%	-1.21%
Ln(EGX 30)	-0.079	21.5%	81.3%	-40%	21.7%	-7.5%	-1.69%	-6.38%	3.13%	-1.71%	0.59%
Shifts in the curve[3]							**3.18%**	**-2.57%**	**1.53%**	**-4.35%**	**-0.62%**
Total changes in Demand[4]							**1.99%**	**-3.41%**	**-1.72%**	**-2.72%**	**-0.15%**
Estimated Total shifts in Supply and Demand[5]							**8.35%**	**0.13%**	**8.10%**	**-10.30%**	**-8.03%**
Estimated Total changes Private credit[6]							**3.41%**	**-3.37%**	**-5.51%**	**-3.50%**	**-6.06%**
Observed Total changes Private credit[7]							**4.16%**	**-0.29%**	**-5.70%**	**-6.13%**	**-7.13%**

Source: Constructed by the authors using the regressions results.

Notes:

1= change in real T-bill rates + change in lending capacity.

2= 1 + change in lending rate

3= change in industrial production and stock market index

4= 3+ change in lending rate + change in T-bill rate

5=1+3

6= 2+4

7= observed change in claims on private sector.

Table 11: Decomposition of Predicted Change in Real Credit (Disequilibrium Hypothesis)

Supply

	Coeff	Growth					Multiplication				
		Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11	Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10-Jun.11
Real Lending rate	2.706	-1.5%	-1.1%	-4.1%	2.1%	0.6%	-4.06%	-2.87%	-11.16%	5.58%	1.62%
Real T-bill rate	-2.191	-1.3%	-0.8%	-4.2%	2.9%	3.6%	2.78%	1.65%	9.25%	-6.44%	-7.85%
Ln(Lend. Cap.)	0.139	11.5%	5.3%	-5.9%	-1.6%	-2.6%	1.60%	0.73%	-0.82%	-0.22%	-0.36%
Shifts in the curve							**4.38%**	**2.39%**	**8.43%**	**-6.67%**	**-8.22%**
Total changes in Supply							**0.32%**	**-0.48%**	**-2.74%**	**-1.09%**	**-6.60%**

Demand

	Coeff	Growth					Multiplication				
		Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10 Jun.11	Jul.01-Jun.04	Jul.04-Jun.08	Jul.08-Jun.09	Jul.09-Sep.10	Oct.10 Jun.11
Real Lending rate	0.746	-1.5%	-1.1%	-4.1%	2.1%	0.6%	-1.12%	-0.79%	-3.08%	1.54%	0.45%
Ln(Industrial Prod.)	0.638	12.9%	10.1%	-4.2%	-7.0%	-3.2%	8.21%	6.42%	-2.70%	-4.46%	-2.04%
Ln(EGX 30)	-0.113	21.5%	81.3%	-39.9%	21.7%	-7.5%	-2.42%	-9.16%	4.50%	-2.45%	0.85%
Shifts in the curve							**5.78%**	**-2.74%**	**1.80%**	**-6.91%**	**-1.19%**
Total changes in Demand							**4.67%**	**-3.53%**	**-1.27%**	**-5.37%**	**-0.75%**
Estimated Total shifts in Supply and Demand							**10.2%**	**-0.35%**	**10.23%**	**-13.57%**	**-9.41%**
Estimated Total changes Private credit							**4.98%**	**-4.01%**	**-4.01%**	**-6.45%**	**-7.34%**
Observed Total changes Private credit							**4.16%**	**-0.29%**	**-5.70%**	**-6.13%**	**-7.13%**

Source: Constructed by the authors using the regressions results.

Notes:

1= change in real T-bill rates + change in lending capacity.

2= 1 + change in lending rate

3= change in industrial production and stock market index

4= 3+ change in lending rate + change in T-bill rate

5=1+3

6= 2+4

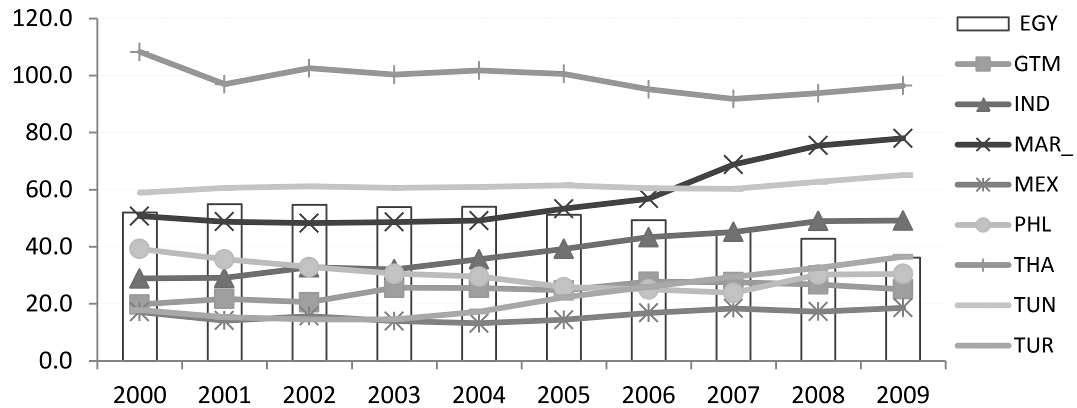
7= observed change in claims on private sector.

Table 12: Summary of the Decomposition Results

	Equilibrium				Disequilibrium			
	Shifts	Direction	Determinants		Shifts	Direction	Determinants	
			Supply	Demand			Supply	Demand
Jul.01-Jun.04	S<D	Same	Lend. Cap.	Industry	S<D	Same	T-Bill rate	Industry
Jul.04-Jun.08	S<D	Opposite	T-Bill rate	Alternative Fin.	S<D	Same	T-Bill rate	Alternative Fin.
Jul.08-Jun.09	S>D	Same	T-Bill rate	Alternative Fin.	S>D	Same	T-Bill rate	Alternative Fin.
Jul.09-Sep.10	S<D	Same	T-Bill rate	Industry	S<D	Same	T-Bill rate	Industry
Oct.10-Jun.11	S>D	Same	T-Bill rate.	Industry	S>D	Same	T-Bill rate	Industry

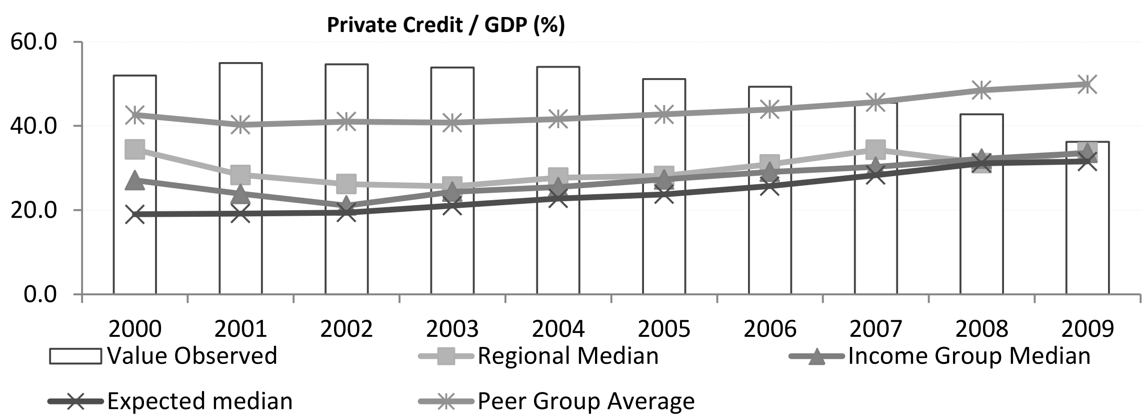
Figures

Figure 1: Private Credit/GDP (percent) in Selected Peer Economies



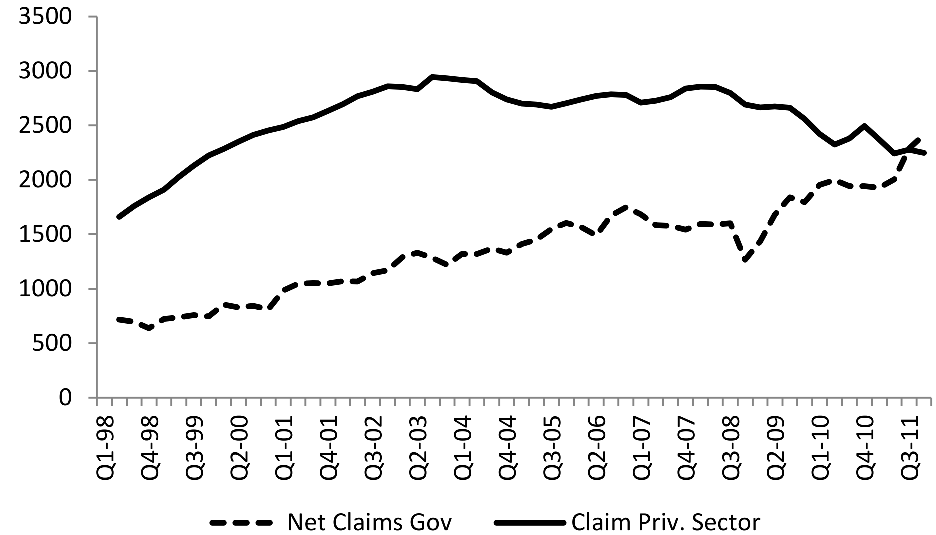
Source: Finstat (2011)

Figure 2: Private Credit/GDP (percent) - Regional Comparison



Source: Finstat (2011)

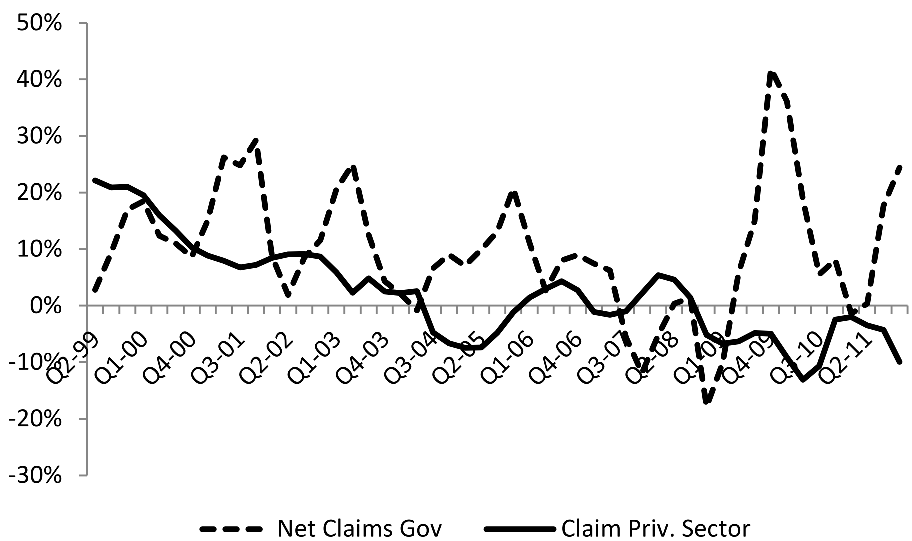
Figure 3: Real Claims on Government vs. Private Sector



Source: The Central Bank of Egypt

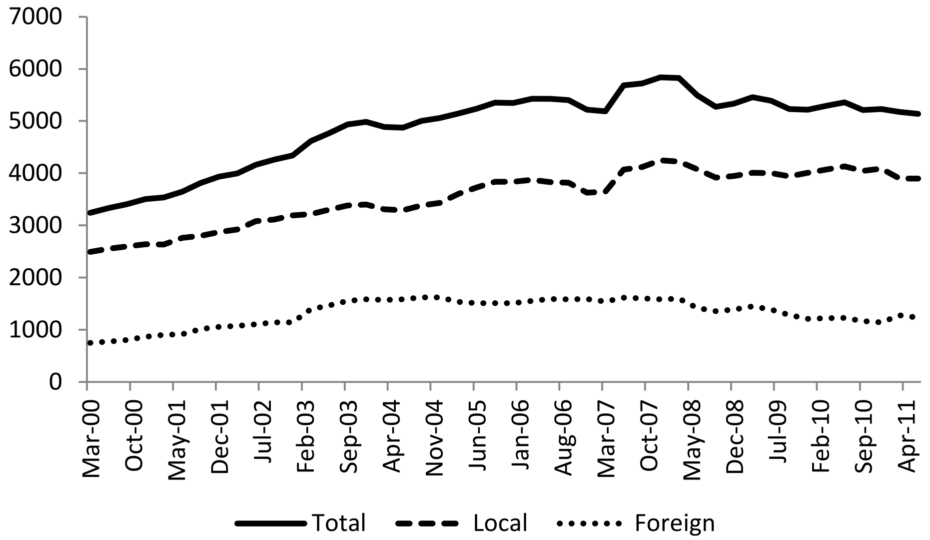
Note: Real figures of claims on government and private sector were obtained by deflating nominal figures by the CPI index

Figure 4: Growth Rates of Claims on Gov. and Private Sector



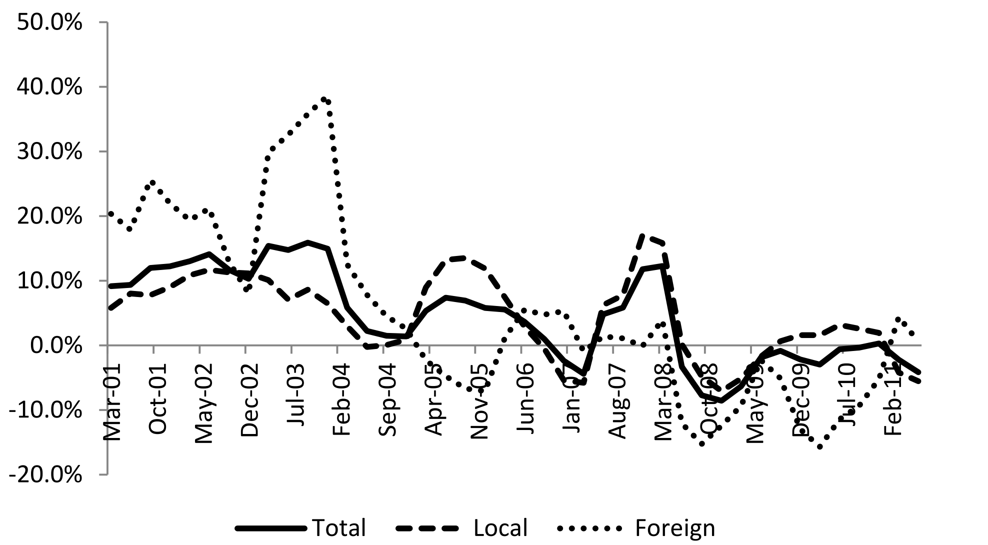
Source: Central Bank of Egypt

Figure 5 Real Deposits in Local and Foreign Currency (in constant EGP)



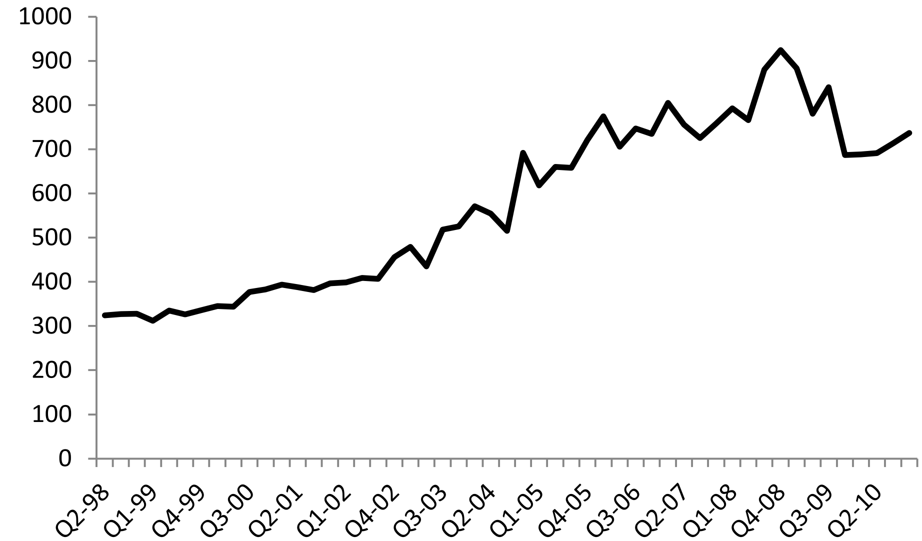
Source: Central Bank of Egypt

Figure 6: Real Deposits in Local and Foreign Currency (growth rates in percent)



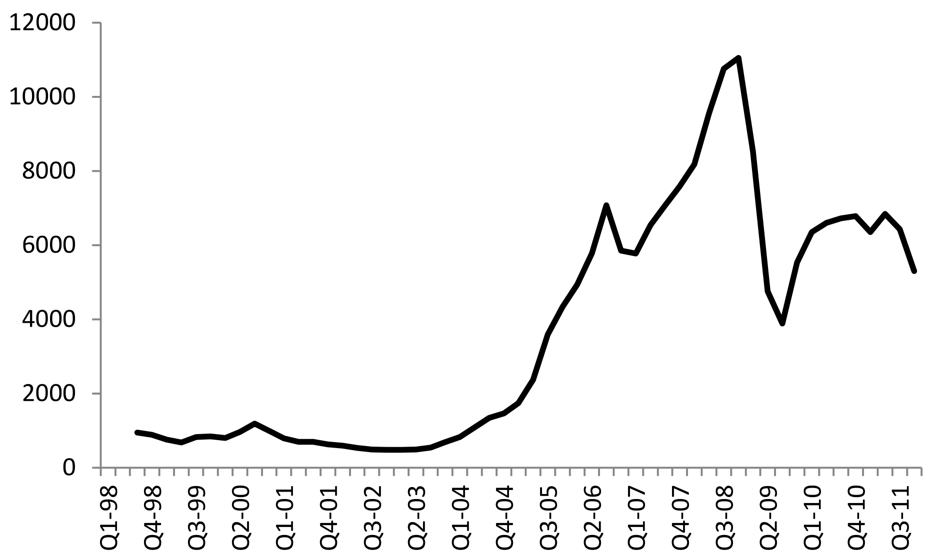
Source: Central Bank of Egypt

Figure 7: Real Industrial Production



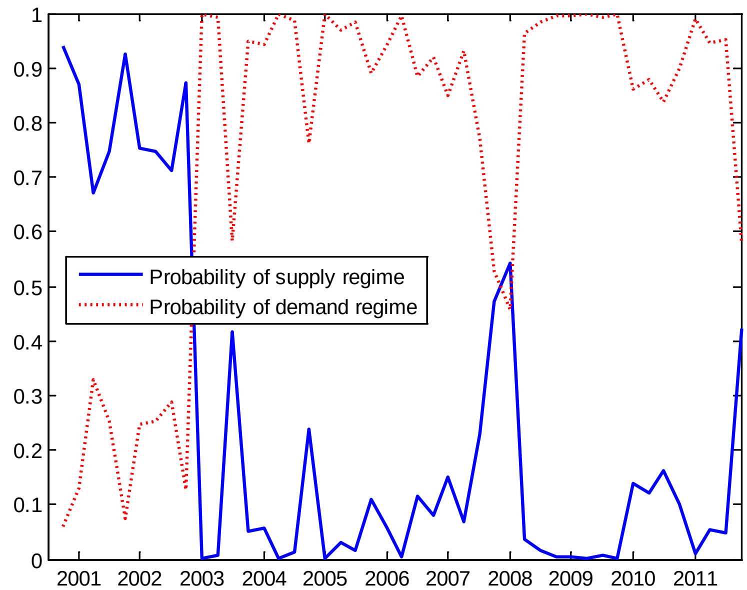
Source: CAPMAS. Note: Real industrial production obtained by deflating nominal figures by the CPI index.

Figure 8: Stock Market Index - EGX30



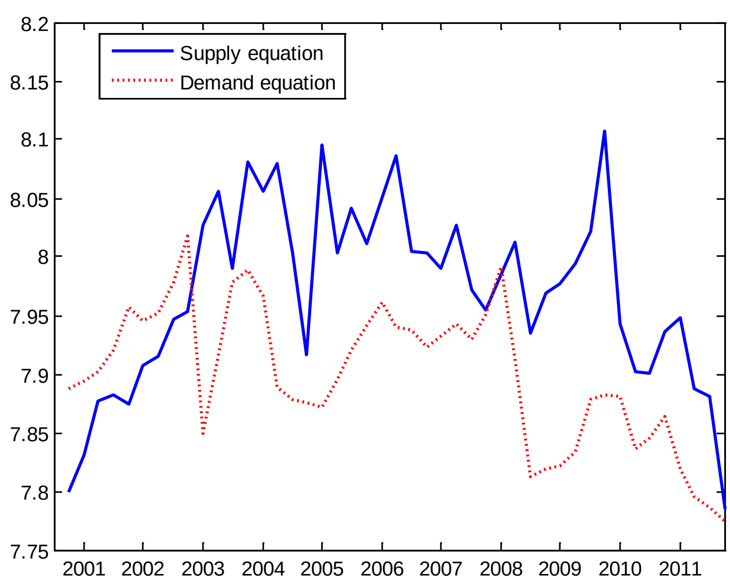
Source: The Egyptian Stock Market.

Figure 9: Unconditional Probability of the Regime S or D



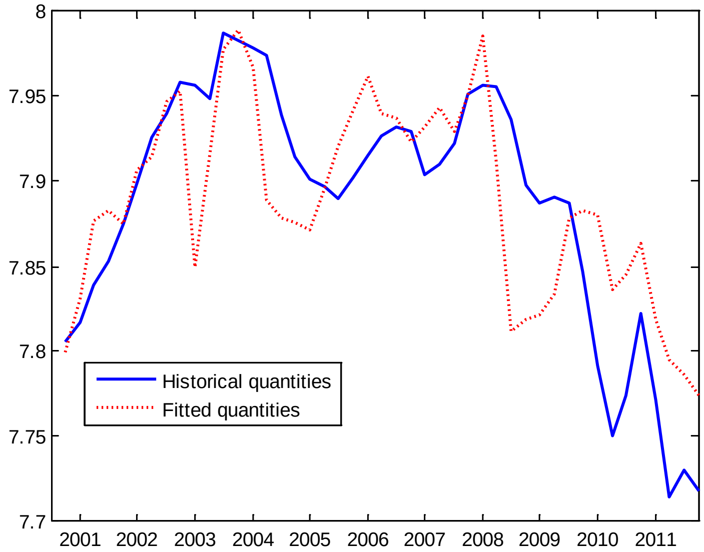
Source: Constructed by the authors.

Figure 10: Estimated Demand and Supply



Source: Constructed by the authors.

Figure 11: Adjustment on quantities



Source: Constructed by the authors.

Appendix 1: The log-likelihood function

Let θ denote the vector of structural parameters $\theta = (\beta_1 \beta_2 \sigma_1 \sigma_2)'$. To compute the marginal density, $f_{Q_t}(q_t)$, of the observable variable q_t, we consider the joint density of d_t and s_t, denoted $g_{D_t,S_t}(d_t, s_t)$. Given the definition of the disequilibrium, we know that:

$$f_{Q_t}(q_t) = f_{Q_t|D_t<S_t}(q_t) + f_{Q_t|S_t<D_t}(q_t) \tag{A.1}$$

Next, we obtain the corresponding marginal density of q_t on the two subsets (cf. Appendix 2):

$$f_{Q_t|D_t<S_t}(q_t) = \int_{q_t=d_t}^{\infty} g_{D_t,S_t}(d_t, z)dz \tag{A.2}$$

$$f_{Q_t|S_t<D_t}(q_t) = \int_{q_t=s_t}^{\infty} g_{D_t,S_t}(z, s_t)dz \tag{A.3}$$

Finally, we obtain the unconditional density function of Q_t:

$$f_{Q_t}(q_t) = f_{Q_t}(q_t, \theta) = \int_{q_t}^{\infty} g_{D_t,S_t}(q_t, z)dz + \int_{q_t}^{\infty} g_{D_t,S_t}(z, q_t)dz \tag{A.4}$$

Conditional to a structural parameters set θ and a sample of observable variables $q_t, x_{1,t}$ and $x_{2,t}$ observed on T periods, the log-likelihood function of the model is then defined by:

$$L(\theta) = \sum_{t=1}^{T} \log\left[f_{Q_t}(q_t, \theta)\right] \tag{A.5}$$

If we assume that both residuals ε_1 and ε_2 are independent, the unconditional density function of Q_t can be expressed as follows:

$$f_{Q_t}(q_t) = \frac{1}{\sigma_1}\phi\left(\frac{x_{1,t}'\beta_1 - q_t}{\sigma_1}\right)\Phi\left(\frac{x_{2,t}'\beta_2 - q_t}{\sigma_2}\right) + \frac{1}{\sigma_2}\phi\left(\frac{x_{2,t}'\beta_2 - q_t}{\sigma_2}\right)\Phi\left(\frac{x_{1,t}'\beta_1 - q_t}{\sigma_1}\right) \tag{A.6}$$

where ϕ(.) denotes the normal N(0,1) density function.

Appendix 2 provides the proof. In this case, the first and second order derivatives of *L(ϑ)* can be computed analytically (Maddala and Nelson, 1974) or numerically. We can use an iterative procedure such as the Newton-Raphson to obtain the *ML* estimates of the structural parameters *ϑ*. Given the parameters' estimated values, we can assess the probability that the observation q_t belongs either to the demand or the supply regime, $\hat{\pi}_t^{(d)}$ and $\hat{\pi}_t^{(s)}$.

Appendix 2: Marginal densities of Q_t in a stable disequilibrium model

Let $g_{D_t,S_t}(d_t,s_t)$ denote the joint density of D_t and S_t. We know that the corresponding marginal densities of the unobservable variables D_t and S_t are defined by:

$$f_{D_t}(d_t)=\int_{-\infty}^{\infty} g_{D_t,S_t}(d_t,z)dz \qquad f_{S_t}(s_t)=\int_{-\infty}^{\infty} g_{D_t,S_t}(z,s_t)dz \tag{A.7}$$

We compute the marginal density of Q_t on the two subset $Q_t = D_t$, with $D_t < S_t$ and $Q_t = S_t$, with $S_t < D_t$.

When $D_t < S_t$, for a given realization d_t of D_t, the marginal density of Q_t, is given by the area defined by the joint density $g_{D_t,S_t}(d_t,z)$, for values z of S_t superior to d_t.

Assuming that $D_t < S_t$, the marginal density of Q_t is then given by:

$$f_{Q_t|D_t<S_t}(q_t)=\int_{q_t=d_t}^{\infty} g_{D_t,S_t}(d_t,z)dz \tag{A.8}$$

Symmetrically, we obtain the marginal density of Q_t when $S_t < D_t$.

$$f_{Q_t|S_t<D_t}(q_t)=\int_{q_t=s_t}^{\infty} g_{D_t,S_t}(z,s_t)dz \tag{A.9}$$

In general, we know that the marginal density of Q_t is given by:

$$f_{Q_t}(q_t)=\int_{q_t}^{\infty} g_{D_t,S_t}(q_t,z)dz+\int_{q_t}^{\infty} g_{D_t,S_t}(z,q_t)dz \tag{A.10}$$

Let us assume that residuals ε_1 and ε_2 are independent ($\sigma_{12}=0$). In this case, the joint density can be expressed as follows:

$$g_{D_t,S_t}(d_t,s_t)=\frac{1}{2\pi\sigma_1\sigma_2}\exp\left\{-\frac{1}{2}\left[\left(\frac{d_t-x_{1,t}^{'}\beta_1}{\sigma_1}\right)^2+\left(\frac{s_t-x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right]\right\} \tag{A.11}$$

$$=\frac{1}{2\pi\sigma_1\sigma_2}\exp\left[-\frac{1}{2}\left(\frac{d_t-x_{1,t}^{'}\beta_1}{\sigma_1}\right)^2\right]\times\exp\left[-\frac{1}{2}\left(\frac{s_t-x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right]$$

Now, consider the first member of the marginal density of Q_t (equation A.4):

$$\int_{q_t}^{\infty} g_{D_t,S_t}(q_t,z)dz=\frac{1}{2\pi\sigma_1\sigma_2}\int_{q_t}^{\infty}\left\{\exp\left[-\frac{1}{2}\left(\frac{q_t-x_{1,t}^{'}\beta_1}{\sigma_1}\right)^2\right]\times\exp\left[-\frac{1}{2}\left(\frac{z-x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right]\right\}dz$$

$$= \frac{1}{\sqrt{2\pi}\sigma_1} \exp\left[-\frac{1}{2}\left(\frac{q_t - x_{1,t}^{'}\beta_1}{\sigma_1}\right)^2\right] \times \frac{1}{\sqrt{2\pi}\sigma_2} \int_{q_t}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{z - x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right] dz$$

In the first term of this expression, we recognize the value of the $N(0,1)$ density function at the particular point $\left(q_t - x_{1,t}^{'}\beta_1\right)/\sigma_1$. Indeed:

$$\frac{1}{\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{q_t - x_{1,t}^{'}\beta_1}{\sigma_1}\right)^2\right] = \phi\left(\frac{q_t - x_{1,t}^{'}\beta_1}{\sigma_1}\right) \quad \text{(A.12)}$$

where $\phi(.)$ denotes the $N(0,1)$ density function. Since this function is symmetric the first member of the marginal density of Q_t can be expressed as:

$$\int_{q_t}^{\infty} g_{D_t,S_t}(q_t, z)dz = \frac{1}{\sigma_1}\phi\left(\frac{x_{1,t}^{'}\beta_1 - q_t}{\sigma_1}\right) \times \frac{1}{\sqrt{2\pi}\sigma_2} \int_{q_t}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{z - x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right] dz \quad \text{(A.13)}$$

The second term can be transformed in order to introduce the $N(0,1)$ cumulative distribution function, denoted $\Phi(.)$. Consider the following change in variable $\tilde{z} = \left(z - x_{2,t}^{'}\beta_2\right)/\sigma_2$, with $dz = d\tilde{z}\sigma_2$. Then, we have:

$$\frac{1}{\sqrt{2\pi}\sigma_2} \int_{q_t}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{z - x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right] dz = \frac{1}{\sqrt{2\pi}\sigma_2} \int_{\tilde{q}_t}^{\infty} \exp\left(-\frac{\tilde{z}^2}{2}\right) d\tilde{z}\sigma_2 \quad \text{(A.14)}$$

$$= \frac{1}{\sqrt{2\pi}} \int_{\tilde{q}_t}^{\infty} \exp\left(-\frac{\tilde{z}^2}{2}\right) d\tilde{z}$$

with $\tilde{q}_t = \left(q_t - x_{2,t}^{'}\beta_2\right)/\sigma_2$. This integral can then be expressed as a function $\Phi(.)$.

$$\frac{1}{\sqrt{2\pi}\sigma_2} \int_{q_t}^{\infty} \exp\left[-\frac{1}{2}\left(\frac{z - x_{2,t}^{'}\beta_2}{\sigma_2}\right)^2\right] dz = 1 - \Phi\left(\tilde{q}_t\right) = \Phi\left(-\tilde{q}_t\right) \quad \text{(A.15)}$$

Finally, we obtain:

$$\int_{q_t}^{\infty} g_{D_t,S_t}(q_t, z)dz = \frac{1}{\sigma_1}\phi\left(\frac{x'_{1,t}\beta_1 - q_t}{\sigma_1}\right)\Phi\left(\frac{x'_{2,t}\beta_2 - q_t}{\sigma_2}\right) \quad \text{(A.16)}$$

Symmetrically, we can compute the second term of the marginal density of Q_t (equation A.10) as:

$$\int_{q_t}^{\infty} g_{D_t,S_t}(z, q_t)dz = \frac{1}{\sigma_2}\phi\left(\frac{x'_{2,t}\beta_2 - q_t}{\sigma_2}\right)\Phi\left(\frac{x'_{1,t}\beta_1 - q_t}{\sigma_1}\right) \quad \text{(A.17)}$$

The marginal density of Q_t is then defined by equation A.6:

$$f_{Q_t}(q_t) = \frac{1}{\sigma_1}\phi\left(\frac{x'_{1,t}\beta_1 - q_t}{\sigma_1}\right)\Phi\left(\frac{x'_{2,t}\beta_2 - q_t}{\sigma_2}\right) + \frac{1}{\sigma_2}\phi\left(\frac{x'_{2,t}\beta_2 - q_t}{\sigma_2}\right)\Phi\left(\frac{x'_{1,t}\beta_1 - q_t}{\sigma_1}\right)$$

Appendix 3: The choice of initial conditions in the *ML* optimization procedure

There are various methods to obtain the initial conditions on structural parameters θ in the ML iteration. Here, we use a two-step OLS procedure. First, we consider the linear regressions of the observation q_t on the exogenous variables sets in both functions: $q_t = x'_{i,t}\hat{\gamma}_i + \mu_{i,t}$, with $i = 1,2$. Given the realizations of $\hat{\gamma}_1$ and $\hat{\gamma}_2$, we compute a first approximation of demand and supply, as $\tilde{d}_t = x'_{1,t}\hat{\gamma}_1$ and $\tilde{s}_t = x'_{2,t}\hat{\gamma}_2$. Even if we know that $\hat{\gamma}_1$ and $\hat{\gamma}_2$, are not convergent estimators of β_1 and β_2, we build two subgroups of observations.

In the first subgroup, denoted by index d, we consider only the observations on Q_t, $X_{1,t}$ and $X_{2,t}$ for which we have $\tilde{d}_t \le \tilde{s}_t$. In the second subgroup, we consider the observations for which we have $\tilde{s}_t \le \tilde{d}_t$. The second step of the procedure consists in applying the OLS on both subgroups:

$$q_t^{(d)} = x_{1,t}^{(d)'}\tilde{\beta}_1 + \tilde{\mu}_{1,t} \text{ and } q_t^{(s)} = x_{2,t}^{(s)'}\tilde{\beta}_2 + \tilde{\mu}_{2,t} \quad \text{(A.18)}$$

Then, we use the OLS estimates $\tilde{\beta}_i$ as starting values for β_i in the ML iteration. For the parameters σ_1 and σ_2, we adopt the following starting values:

$$\tilde{\sigma}_i = \frac{1}{n_i}\sum_{j=1}^{n_i}\tilde{\mu}_{i,j} \quad i = 1,2 \tag{A.19}$$

where n_1 denotes the size of the "demand" subgroup of observations for which we have $\tilde{d}_t \leq \tilde{s}_t$, and n_2 denotes the size of the corresponding "supply" subgroup.[10]

Appendix 4: Test for Disequilibrium

Quandt (1988) proposed different approaches to test for disequilibrium. First, let us rewrite the model to distinguish between the price variable p_t (here the lending rate) and the other explanatory variables in each regime, denoted $\tilde{x}_{1,t}$ and $\tilde{x}_{2,t}$ (including the constant).

$$d_t = \alpha_1 p_t + \tilde{x}_{1,t}^{'}\beta_1 + \varepsilon_{1t} \tag{A.20}$$

$$s_t = \alpha_2 p_t + x_{2,t}^{'}\beta_2 + \varepsilon_{2t} \tag{A.21}$$

$$q_t = \min(d_t, s_t) \tag{A.22}$$

These tests are based on the reduced form from the *equilibrium* version of the model given by:

$$\begin{pmatrix} q_t \\ p_t \end{pmatrix} = \left(ll - \alpha_2\beta_1/(\alpha_1-\alpha_2)\alpha_1\beta_2/(\alpha_1-\alpha_2) - \beta_1/(\alpha_1-\alpha_2)\beta_2/(\alpha_1-\alpha_2)\right)\begin{pmatrix} \tilde{x}_{1,t} \\ \tilde{x}_{2,t} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} \tag{A.23}$$

Let $\varepsilon_t = (\varepsilon_{1t}\varepsilon_{2t})^{'} : N(0,\Sigma)$ and let Γ denote the coefficients of the endogenous variables in the structural equation (A.20). Let $v_t = (v_{1t}v_{2t})^{'} : N(0,\Omega)$ with $\Omega = \|\omega_{ij}\| = \Gamma^{-1}\Sigma\Gamma^{-1}$.

Using the reduced form and the properties of v_t, it can be shown that the *equilibrium quantity* may be expressed as follows:

$$q_t = \frac{\omega_{12}}{\omega_{22}}p_t + \left(\frac{\omega_{12}}{\omega_{22}} - \alpha_2\right)\frac{\beta_1}{(\alpha_1-\alpha_2)}\tilde{x}_{1,t} + \left(\alpha_1 - \frac{\omega_{12}}{\omega_{22}}\right)\frac{\beta_2}{(\alpha_1-\alpha_2)}\tilde{x}_{2,t} + \mu_t \tag{A.24}$$

[10] Monte Carlo simulations of the procedure's accuracy are available upon request.

This equation is a hybrid between structural and reduced form equations and has the following properties (1) all variables other than q_t appear on the right hand side 2) its error term is uncorrelated with any of the right hand variables and may be consistently estimated by OLS 3) its coefficients are complicated but *constant* functions of the original structural parameters.

If the disequilibrium model is appropriate, we can write :

$$q_t = \delta_t d_t + (1-\delta_t)s_t \tag{A.25}$$

where $\delta_t = 1$ if $d_t < s_t$ and 0 otherwise. So, if the *disequilibrium model is appropriate*, we have :

$$q_t = [\delta_t \alpha_1 + (1-\delta_t)\alpha_2]p_t + \delta_t \beta_1 \tilde{x}_{1,t} + (1-\delta_t)\beta_2 \tilde{x}_{2,t} + w_t \tag{A.26}$$

which is similar to A.24 except that the *parameters are time varying*. A simple test of the disequilibrium assumption consists in testing the parameters' time stability in a regression similar to equation A.24.

Quandt (1988) proposed to consider an equation of the general form:

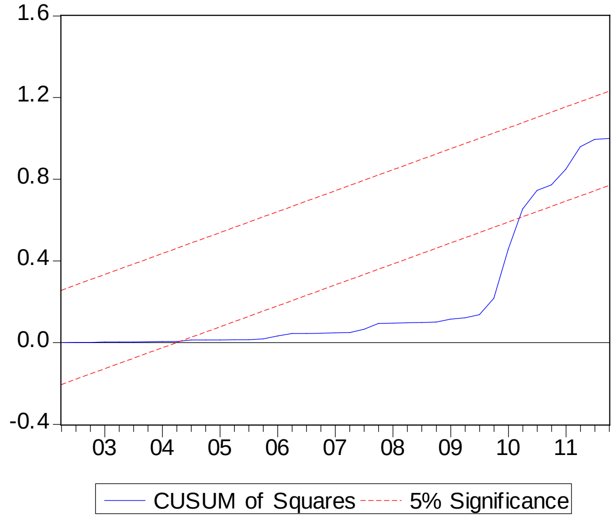
$$q_t = \theta_0 p_t + \theta_1 \tilde{x}_{1,t} + \theta_2 \tilde{x}_{2,t} + \varepsilon_t \tag{A.27}$$

and to compute the simple recursive residuals. The cusum and cusum of squares test can then be used to test the null hypothesis that the regression coefficient is constant, i.e. the equilibrium hypothesis.

Figure 12 displays the cusum and cusum-square statistic and the confidence interval for the null of equilibrium, based on the regression model (18) where q_t denotes the real claims, p_t denotes the real lending rate, $\tilde{x}_{1,t}$ includes the lagged real total deposits, the lagged real banks deposit with the central bank and the lagged real net claims on government, $\tilde{x}_{1,t}$ includes the real T-bill rate, the lagged stock market index and the lagged real industrial production.

The cusum of squares statistic is larger than the interval confidence since 2005, so the parameters' null of constancy and hence the equilibrium assumption are rejected. The cusum test gives a different result: the null of equilibrium is not rejected. But, this result is not robust since the recursive estimates of the parameters (Figure 13) show that not all the coeffcients are constant over time.

Figure 12: CUSUM Tests



Source: Constructed by the authors.

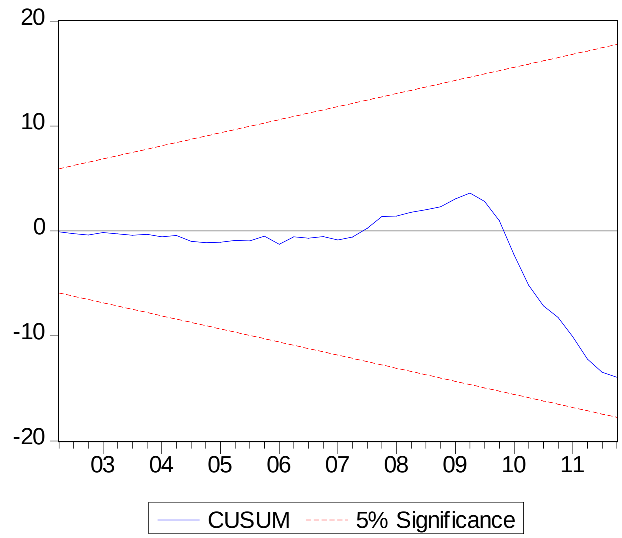
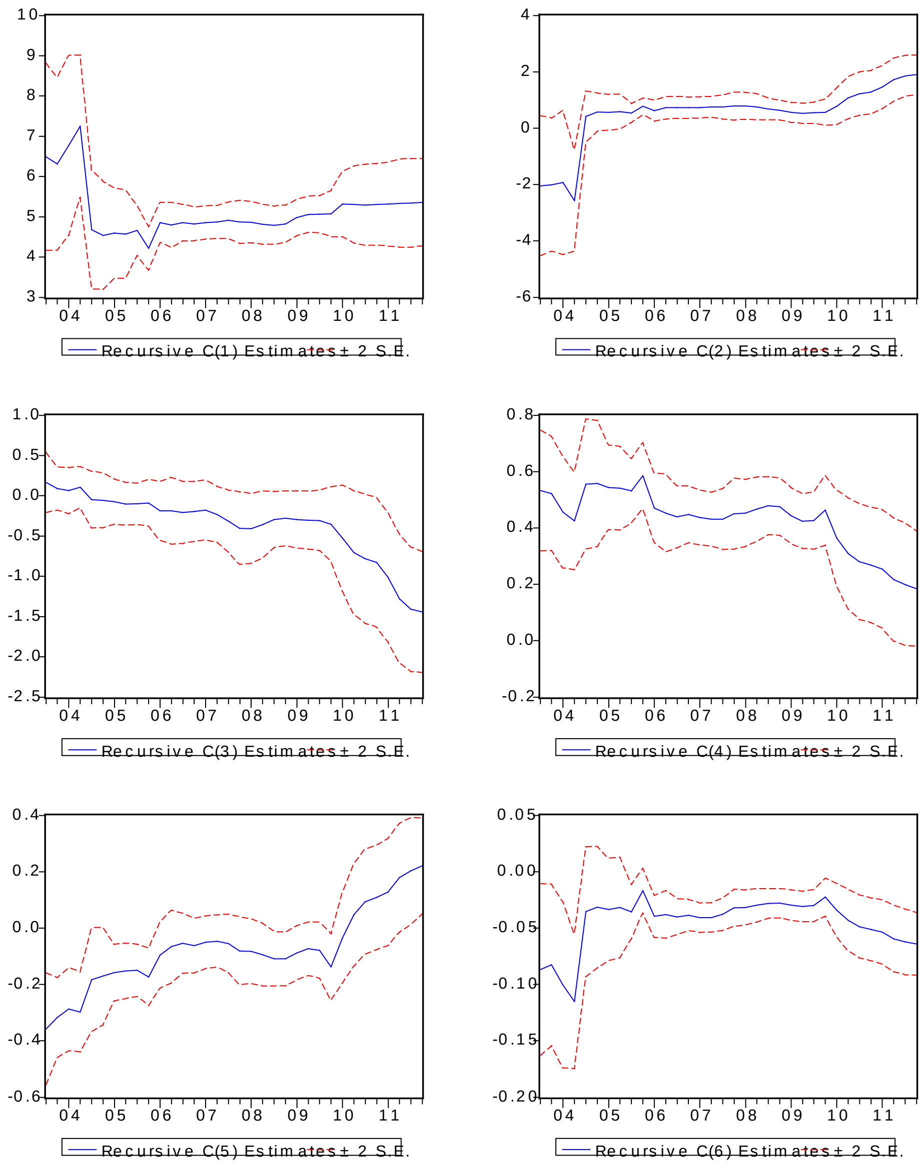


Figure 13: Recursive Parameter Estimates


Recursive C(1) Estimates ± 2 S.E.
Recursive C(2) Estimates ± 2 S.E.
Recursive C(3) Estimates ± 2 S.E.
Recursive C(4) Estimates ± 2 S.E.
Recursive C(5) Estimates ± 2 S.E.
Recursive C(6) Estimates ± 2 S.E.