Current account imbalances and financial fragility in the Eurozone: a stock-flow consistent approach

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Abstract: This paper builds a stock-flow consistent (SFC) macrodynamic model of the Eurozone that (i) can analyse simultaneously the role of credit and competitiveness in the widening of current account imbalances and (ii) can offer a comparative evaluation of wage, fiscal and macroprudential policies that have been suggested to address these imbalances. The model consists of a Northern and a Southern region. The Northern region is characterised by high export capacity and a large tradable sector while the Southern region has limited export capacity and a small tradable sector. Our preliminary simulation analysis shows that an increase in the credit inflows from the Northern region into the Southern region leads to a temporary increase in economic growth in the Southern region. However, this is accompanied by an increase in the leverage of firms and an increase in the current account deficit that ultimately lead to lower economic growth. Similar effects are found in the case in which there is a reduction in the interbank interest rate at which the Southern commercial banks borrow. Our model is also used to examine the effects of wage, fiscal and macroprudential policies on financial fragility and current account imbalances.

Keywords*:* Current account imbalances, financial fragility, industrial structure, Euro area

JEL Codes: C54, E5, E12, E32, F4

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1. Introduction

Ten years after the Eurozone crisis current account imbalances remain a key source of concern in the Eurozone. Although these imbalances have improved over the last years, this has primarily been achieved via policies that have significantly reduced economic growth. In addition, if the Eurozone economy expands more rapidly in the next years, these imbalances are very likely to increase again. This means that the understanding of the causes of these imbalances and the assessment of policies that can address these imbalances without causing recessions is crucial for the stability of the Eurozone.

So far, the academic literature has focused on two sets of explanations for the current account imbalances. The first one is linked with the role of competitiveness and its impact on trade deficits that can lead to external debt accumulation. The common argument concentrates on price competitiveness. The story is that if nominal wages rise faster than labour productivity, this leads to higher unit labour costs and real appreciation causing a deterioration of competitiveness and an increase in trade deficits (see e.g. Lapavitsas and Flassbeck, 2013; Stockhammer, 2016). Other studies have focused on the role of non-price competitiveness, pinpointing that trade deficits were basically driven by the structural features of the economies and the size of the non-tradable goods sector (see e.g. di Mauro and Forster, 2008; Giavazzi and Spaventa, 2011; Altomonte et al., 2013).

Another set of explanations focuses on the role of the banking sector and the financial markets. It has been argued that financial and market integration, the elimination of currency premium and interest rates convergence resulted in excessive capital inflows from the North, which financed bonds or equities that were issued by the Southern private sector. This deteriorated substantially the current account balance of the Southern countries. Lane (2012) has, amongst others, suggested that the key drivers of the credit expansion in the European South were the historically low lending interest rates due to the monetary policy implemented by ECB as well as financial integration, low transaction costs and the elimination of risks associated with exchange rate dynamics. In similar lines, Storm and Naastepad (2014, 2015a, 2015b, 2016) have argued that a credit boom contributed to high domestic demand growth in the Southern countries, pointing out that Northern banks increased their capital inflows to Southern banks and as a result Southern banks were able to finance

domestic demand growth (see also Lane and McQuade, 2014). These capital inflows were directed to non-tradable goods sectors such as construction, transportation, telecommunications and other services, causing property bubbles in several Southern economies and massive current account deficits. When financial markets revised their expectations regarding future growth and solvency of the European South, capital inflows to the South stopped, triggering the beginning of the crisis. The latter is in line with the literature on the interbank market, which suggests that riskier borrowers and borrowers from Southern countries faced a tightened access to interbank lending and capital markets once the crisis started (see e.g. Abbassi et al., 2014; Frutos et al., 2016).

The importance of imbalances has led the European Commission to develop the Macroeconomic Imbalance Procedure (MIP), which is a process through which the imbalances are monitored (see e.g. European Commission, 2016). Moreover, the European Systemic Risk Board (ESRB) has proposed a set of indicators that should be monitored in order for excessive imbalances to be prevented (see e.g. ESRB, 2016). However, the key challenge is to identify a set of policies that address these imbalances while avoiding recessionary effects. So far, emphasis has been placed on three policies: (i) structural reforms that focus on wage cost moderation; (ii) fiscal policies that aim to reduce the budget balance of the government and the debt-to-GDP; (iii) financial regulation policies that focus on countercyclical capital buffers in order to reduce the credit provision.

In the current literature a systematic comparative evaluation of these policies is missing. So far, few papers have concentrated on some of these policies. Toroj (2017) has developed a DSGE (Dynamic Stochastic General Equilibrium) model that investigates the effects of fiscal and monetary policies on current account imbalances. Vogel (2012) has also used a DSGE model in order to analyse the effects of wage cost moderation and fiscal consolidation on imbalances. Moreover, some other studies have analysed the effects of countercyclical capital buffers on imbalances via their effect on credit provision (see e.g. Lozej et al., 2018). However, these models analyse wage cost moderation, fiscal consolidation and countercyclical capital buffer policy separately and do not provide a systematic evaluation of these policies considering both their first-round and second-round effects.

This paper intends to contribute to the literature by developing a stock-flow consistent (SFC) macro model that (i) can analyse simultaneously the role of credit and competitiveness in the widening of current account imbalances and (ii) can offer a comparative evaluation of the policies that have been suggested to address the imbalances, focusing both on short-run and long-run effects. The model consists of two regions, the Southern and the Northern one. The Northern region is

characterised by high export capacity and a large tradable sector while the Southern region has limited export capacity and a small tradable sector. The structure of the model draws on Duwicquet and Mazier (2010) and Mazier and Valdecantos (2014). Our model differs from theirs because we have incorporated the interbank market, the simultaneous role of price and non-price competitiveness, the impact of banks financial performance on credit rationing and a corporate bond market with endogenous interest rates.

We use a SFC model for the following reasons. First, within such a model the role of credit and capital inflows can be easily incorporated via both the banking sector and the bond market. Second, in an SFC framework we are able to capture out of equilibrium processes in which financial fragility gradually builds up and contributes to imbalances. Third, in SFC models credit provision plays an important role in determining economic growth by affecting the demand-determined output. Credit provision can have positive effects on demand by increasing the amount of money that can be spent for consumption and investment, but it can also have negative effects since it might lead to high debt ratios and debt repayment problems. This dual role of credit is not clearly incorporated in conventional macro modelling.

The rest of the paper is organised as follows. In section 2 we present the structure of the model. In section 3 we show how a change in financial conditions about the credit availability in the Southern region affects financial fragility and current account imbalances. Section 4 focuses on the impact of wage, fiscal and macroprudential policies. Section 5 concludes.

2. Structure of the model

Our model is a demand-driven, open economy, growth model which consists of a Southern and a Northern region. Each region comprises five sectors: households, firms, banks, the government and the central bank. The two regions interact via the bond market, the interbank market and international trade. There are 8 classes of assets depicted in Table 1: tangible capital, high-powered money, deposits, corporate loans, corporate bonds, interbank loans, advances and government securities. Tangible capital is owned by firms and constitutes the net wealth of the system. High-powered money is held by banks. The corporate bonds issued by the firms of the two regions are internationally traded by households and government securities are internationally traded by both households and banks. Loans constitute an asset for domestic banks and it is assumed that firms

have only domestic lines of credit. Interbank loans are an asset for the banks that end up with excessive liquidity and a liability for those that end up demanding central banks advances. The transactions that take place in the model are shown in Table 2.

Table 1. *Balance sheet matrix*

	Households S	Firms S	Commercial banks S	Government S	Central bank S	Households N	Firms N	Commercial banks N	Government N	Central bank N	Total
Capital		$+K_S$					$+K_N$				$+K_S+K_N$
Deposits	$+D_S$		$-D_S$			$+D_N$		$-D_N$			0
Loans S		$-L_S$	$+L_S$								0
Loans N							$-L_N$	$+L_N$			0
Bonds S	$+p_S\,b_{S,H,S}$	$-p_S\,b_S$				$+p_S\,b_{S,H,N}$					0
Bonds N	$+p_N\,b_{N,H,S}$					$+p_N\,b_{N,H,N}$	$-p_N\,b_N$				0
Government securities S	$+SEC_{H,S}$		$+SEC_{S,B,S}$	$-SEC_S$	$+SEC_{CB,S}$			$+SEC_{S,B,N}$			0
Government securities N			$+SEC_{N,B,S}$			$+SEC_{H,N}$		$+SEC_{N,B,N}$	$-SEC_N$	$+SEC_{CB,N}$	0
HPM			$+HPM_S$		$-HPM_S$			$+HPM_N$		$-HPM_N$	0
Advances			$-A_S$		$+A_S$			$-A_N$		$+A_N$	0
Interbank loans			$-L_{INT}$					$+L_{INT}$			0
Total (net worth)	$+V_{H,S}$	$+V_{F,S}$	$+K_{B,S}$	$-SEC_S$	$+V_{CB,S}$	$+V_{H,N}$	$+V_{F,N}$	$+K_{B,N}$	$-SEC_N$	$+V_{CB,N}$	$+K_S+K_N$

The complete list of model equations is reported in Appendix A. The symbols of the variables and the parameters of the model can be found in Appendices B and C. In the next sub-sections the key equations of the model are described in three blocks. First, we describe how investment decisions are formed and the role of the bond market on firms financing decisions. Second, we focus on credit provision to firms and the role of the interbank market. Third, we describe how the two regions interact via international trade and how structural change takes place.

Regarding our notation for assets, the subscript denotes the sector that issues it. For instance, b_S denotes the bonds issued by the Southern region. When three subscripts are present, they denote from left to right, the region of the issuer, the sector that owns the asset followed by the region of the owner. The time subscript denotes the lag structure. For instance, $SEC_{S,B,N-1}$ denotes the government securities issued by the Southern region (*S*) and were held by the banks (*B*) of the Northern region (*N*) in the time period *t*-1.

Table 2. *Transactions flow matrix*

	Households S	Firms S		Commercial banks S		Government S	Central bank S		Households N	Firms N		Commercial banks N		Government N	Central bank N		Total
		Current	Capital	Current	Capital		Current	Capital		Current	Capital	Current	Capital		Current	Capital	
Consumption	$-C_S$	$+C_S$							$-C_N$	$-C_N$							0
Government expenditures		$+G_S$				$-G_S$								$-G_N$			
Investment		$+I_S$	$-I_S$							$+I_N$	$-I_N$						0
Trade		$-IM_S$								$+X_N$							0
		$+X_S$								$-IM_N$							0
Wages	$+w_S N_S$	$-w_S N_S$							$+w_N N_N$	$-w_N N_N$							0
Taxes	$-T_{H,S}$	$-T_{F,S}$				$+T_S$			$-T_{H,N}$	$-T_{F,N}$				$+T_N$			0
Profits	$+DP_S$	$-TP_S$	$+RP_S$						$+DP_N$	$-TP_N$	$+RP_N$						0
Interest on bonds S	$+coupon_S\, b_{S,H,S-1}$	$-coupon_S\, b_{S-1}$							$+coupon_S\, b_{S,H,N-1}$								0
Interest on bonds N	$+coupon_N\, b_{N,H,S-1}$								$+coupon_N\, b_{N,H,N-1}$	$-coupon_N\, b_{N-1}$							0
Interest on loans		$-int_{L,S}\, L_{S-1}$		$+int_{L,S}\, L_{S-1}$						$-int_{L,N}\, L_{N-1}$		$+int_{L,N}\, L_{N-1}$					0
Interest on deposits	$+int_{D,S}\, D_{S-1}$			$-int_{D,S}\, D_{S-1}$					$+int_{D,N}\, D_{N-1}$			$-int_{D,N}\, D_{N-1}$					0
Interest on advances				$-int_{A,S}\, A_{S-1}$			$+int_{A,S}\, A_{S-1}$					$-int_{A,N}\, A_{N-1}$			$+int_{A,N}\, A_{N-1}$		0
Interest on interbank loans				$-int_{int}\, L_{int-1}$								$+int_{int}\, L_{int-1}$					0
Interest on government securities S	$+int_{S,S}\, SEC_{H,S-1}$			$+int_{S,S}\, SEC_{S,B,S-1}$		$-int_{S,S}\, SEC_{S-1}$	$+int_{S,S}\, SEC_{CB,S-1}$					$+int_{S,N}\, SEC_{S,B,N-1}$					0
Interest on government securities N				$+int_{S,S}\, SEC_{N,B,S-1}$					$+int_{S,N}\, SEC_{H,N-1}$			$+int_{S,N}\, SEC_{N,B,N-1}$		$-int_{S,N}\, SEC_{N-1}$	$+int_{S,N}\, SEC_{CB,N-1}$		0
Commercial banks' profits	$+BP_{DS}$			$-BP_S$	$+BP_{US}$				$+BP_{DN}$			$-BP_N$	$+BP_{UN}$				0
Central bank's profits						$+CBP_S$	$-CBP_S$							$+CBP_N$	$-CBP_N$		0
Δloans			$+\Delta L_S$		$-\Delta L_S$						$+\Delta L_N$		$-\Delta L_N$				0
Δdeposits	$-\Delta D_S$				$+\Delta D_S$				$-\Delta D_N$				$+\Delta D_N$				0
Δadvances					$+\Delta A_S$			$-\Delta A_S$					$+\Delta A_N$			$-\Delta A_N$	0
Δhigh-powered money					$-\Delta HPM_S$			$+\Delta HPM_S$					$-\Delta HPM_N$			$+\Delta HPM_N$	0
Δbonds S	$-p_S\, \Delta b_{S,H,S}$		$+p_S\, \Delta b_S$						$-p_S\, \Delta b_{S,H,N}$								0
Δbonds N	$-p_S\, \Delta b_{N,H,S}$								$-p_N\, \Delta b_{N,H,N}$		$+p_N\, \Delta b_N$						0
Δinterbank loans					$+\Delta L_{int}$								$-\Delta L_{int}$				0
Δgovernment securities S	$-\Delta SEC_{H,S-1}$				$-\Delta SEC_{S,B,S-1}$	$+\Delta SEC_{S-1}$		$-\Delta SEC_{CB,S-1}$					$-\Delta SEC_{S,B,N-1}$				0
Δgovernment securities N					$-\Delta SEC_{N,B,S-1}$				$-\Delta SEC_{H,N-1}$				$-\Delta SEC_{N,B,N-1}$	$+\Delta SEC_{N-1}$			0
Total	0	0	0	0	0		0	0	0	0	0	0	0		0	0	0

2.1 Investment and the bond market

Desired investment (I_S^D), scaled by capital stock (K_S), is defined in equation (1). Investment depends positively on animal spirits $(\gamma_{0.S})$ and the rate of profit (r_S), while it depends negatively on firms' debt ratio $(lev_{F,S})$ and corporate bonds' yield $(yield_S)$.[1] Equation (1) resembles the investment functions that have been used in Minskyan models (see e.g. Lima and Meirelles, 2007; Charles, 2008; Nikolaidi and Stockhammer, 2017). This specification captures the positive effect of profitability and cash flows on investment as well as the negative effect of indebtedness and the cost of external finance.

$$I_S^D = \left(\gamma_{0,S} + \gamma_{1,S} r_{S-1} - \gamma_{2,S} lev_{F,S-1} - \gamma_{3,S} yield_{S-1}\right) K_{S-1} \quad (1)$$

We follow Dafermos et al. (2018) and we assume that firms issue bonds (b_S) at a proportion (x_S) of desired investment (see Equation 2); $\bar{p}_S$ is the par value of corporate bonds of the South. This proportion (x_S), defined in equation (3), depends negatively on the yield $(yield_S)$, defined in equation (4). The coupon $(coupon_S)$ is endogenously determined based on the yield of the previous period (see Equation 5). Firms react to the conditions of the bond market and are more willing to finance via bonds a larger proportion of investment if there exists strong demand for them, reflected in a high bond market price (p_S) and thus a low yield. Equations (6) and (7) define the demand for Southern corporate bonds; $B_{S,H,S}$ is the value of corporate bonds of Southern firms that are held by Southern households, $B_{S,H,N}$ is the value of corporate bonds of Southern firms that are held by Northern households. Southern households, follow a Tobin's portfolio allocation process and allocate their wealth $(V_{H,S})$ among the available assets; $yield_N$ is the yield on bonds issued by Northern countries; $int_{S,S}$ is the interest rate on securities issued by the Southern government, $int_{S,N}$ is the interest rate on securities issued by the Northern government, $int_{D,S}$ is the interest on deposits in Southern banks, $int_{D,N}$ is the interest on deposits in Northern banks, $Y_{H,S-1}$ is the disposable income of Southern households, $Y_{H,N-1}$ is the disposable income of Northern households. The portion of their wealth that is allocated to Southern bonds depends on the expected return of each asset (see Equation 6). Equation (7) extends the same process to

[1] In this preliminary version of the paper, the interest rate on loans is assumed to be constant.

households of the Northern region. Equation (8) defines the supply for Southern corporate bonds. The bond market is in equilibrium following an instantaneous price adjustment mechanism (9).

Overall, a higher demand for bonds has two effects on Southern firms' decisions. First, it increases the proportion of desired investment financed by new bonds, relaxing their budget constraint. Second, it has a positive effect on desired investment as firms take the price signal from the bond market and anticipate cheap funding conditions. The higher the sensitivity of investment on the yield the stronger the channel that links the bond market with domestic demand. Note that firms' reaction to demand for bonds has a stabilising feedback effect on the dynamics of the bonds market as the number of supplied bonds tends to decrease when demand is low and vice versa.

$$b_S = b_{S-1} + x_S \frac{I_S^D}{\bar{p}_S} \tag{2}$$

$$x_S = x_{0,S} - x_{1,S} yield_{S-1} \tag{3}$$

$$yield_S = \frac{coupon_S}{p_S} \tag{4}$$

$$coupon_S = yield_{S-1} \bar{p}_S \tag{5}$$

$$B_{S,H,S} = \Big(\lambda_{20,S} + \lambda_{21,S} int_{S,S} + \lambda_{22,S} yield_{S-1} + \lambda_{23,S} yield_{N-1} + \lambda_{24,S} int_{D,S} + \lambda_{25,S} \frac{Y_{H,S-1}}{V_{H,S-1}}\Big) V_{H,S-1} \tag{6}$$

$$B_{S,H,N} = \Big(\lambda_{30,N} + \lambda_{31,N} int_{S,N} + \lambda_{32,N} yield_{N-1} + \lambda_{33,N} yield_{S-1} + \lambda_{34,N} int_{D,N} + \lambda_{35,N} \frac{Y_{H,N-1}}{V_{H,N-1}}\Big) V_{H,N-1} \tag{7}$$

$$B_S = B_{S,H,S} + B_{S,H,N} \tag{8}$$

$$p_S = \frac{B_S}{b_S} \tag{9}$$

2.2 Investment and credit provision

Demand for new loans (NL_S^D), defined in equation (10), increases with desired investment and debt rollover ($repL_{S-1}$) and decreases by new bonds ($\bar{p}_S \Delta b_S$) and undistributed profits (RP_S); L_S is the amount of loans of Southern firms. Following the recent stream of literature on macrodynamics and banking (see e.g. Dafermos, 2012; Ryoo, 2013; Nikolaidi, 2014) we assume that banks provide

only a part of demanded loans to firms according to their perception of risk and their own targets. Credit rationing is captured by equation (11). The degree of credit rationing (CR_S) depends on firms' default risk proxied by firms' leverage ratio $(lev_{F,S})$, the difference between the actual and the minimum capital adequacy ratio $(CAR_{S-1} - CAR_S^T)$, the difference between the actual and the maximum bank leverage ratio $(lev_{B,S-1} - lev_B^{max})$, and other exogenous factors which could include the degree of securitisation and banks' animal spirits $(l_{0,S})$. The change in corporate loans (12) equals demand for new loans, mitigated by the amount credit rationed $\left(NL_{D,S}CR_S\right)$ and debt repayments $(repL_{S-1})$. It follows that actual investment is the residual in firms' budget constraint (see Equation 13).

$$NL_S^D = I_S^D - RP_S - \bar{p}_S \Delta b_S + repL_{S-1} \tag{10}$$

$$CR_S = l_{0,S} + l_{1,S} lev_{F,S-1} + l_{2,S}(CAR_{S-1} - CAR_S^T) - l_{3,S}\left(lev_{B,S-1} - lev_B^{max}\right) \tag{11}$$

$$L_S = L_{S-1} + (1 - CR_S)NL_S^D - repL_{S-1} \tag{12}$$

$$I_S = \Delta L_S + RP_S + \bar{p}_S \Delta b_S \tag{13}$$

In line with standard interbank market models, we assume that Southern banks seek to increase liquidity via interbank lending. Equation (14) defines interbank loans (L_{INT}). Banks borrow from the interbank market in order to raise their liquidity, when the asset side of their balance sheet tends to expand faster than their deposits; HPM_S is high-powered money of Southern banks, $SEC_{S,B,S}$ denotes government securities issued by the Southern region and held by the banks of the Southern region, $SEC_{N,B,S}$ denotes government securities issued by the Northern region and held by the banks of the Southern region, D_S is the deposits of the Southern banks. The overall residual in the budget constraint of banks is advances.

The European Central Bank targets the interbank interest rate via the Corridor System. Banks with excess reserves compare the interbank rate with the deposit facility (int_{DF}) (remuneration) rate and decide whether to lend at the interbank market or deposit their reserves to the central bank. Banks that demand more reserves, compare the main refinancing operations (int_{MRO}) (lending) rate with the interbank rate and decide whether they will borrow from the central bank or the interbank market (see also Schasfoort et al., 2017). The actual rate fluctuates around this corridor between the

deposit facility and main refinancing operations rates. We provide a simplified account of this process with a focus on the dynamics of the interbank interest rate. We use a generalised logistic function as the simplest way to guarantee that the interbank rate (int_{INT}) is bounded from above by the lending rate (int_{MRO}) and from below by the deposit facility rate (int_{DF}). We assume that the interbank rate depends positively on Southern banks' leverage. The parameter values β_1 and β_2 determine the steepness (sensitivity) of the curve and the level of the leverage at the sigmoid's midpoint respectively and in conjunction they capture the tolerance of the financial market to bank's liquidity and solvency. This tolerance of the financial market depends on many factors such as the availability and cost of information regarding Southern banks' quality of assets, the perception of risk, the performance of Southern banks to European Banking Authority's stress tests, the expectations formation mechanism regarding banks' margins of safety, the centralisation of the banking sector and so on. In our setting, these are assumed to be exogenous. Equation (15) implies that when Southern banks increase their leverage ratio, the interbank interest rate increases and vice versa.

$$L_{INT} = L_{INT-1} + \zeta_1\left(\Delta L_S + \Delta HPM_S + \Delta SEC_{S,B,S} + \Delta SEC_{N,B,S} - \Delta D_S\right) \tag{14}$$

$$int_{INT} = int_{DF} + \frac{int_{MRO} - int_{DF}}{1+e^{-\beta_1(lev_{B,S}-\beta_2)}} \tag{15}$$

Equations (16) and (17) define the Capital Adequacy Ratio (CAR_S) and banks' leverage ratio $(lev_{B,S})$ as measured by Basel III (see BCBS, 2017). Capital Adequacy Ratio is defined as the ratio of banks' own funds $(K_{B,S})$ to the weighted sum of its assets and leverage ratio is defined as the ratio of assets to the banks' own funds. The risk weight on securities is denoted by w_S and the weight on loans is denoted by w_L.

$$CAR_S = \frac{K_{B,S}}{w_S(SEC_{S,B,S}+SEC_{N,B,S})+w_L L_S} \tag{16}$$

$$lev_{B,S} = \frac{SEC_{S,B,S}+SEC_{N,B,S}+ HPM_S+L_S}{K_{B,S}} \tag{17}$$

2.3 International trade and industrial structure

The third block analyses international trade, competitiveness and technical change. Equation (18) defines the time path of exports (X_S) and equation (19) defines the growth rate of exports $(g_{X,S})$. Based on Boggio and Barbieri (2017), exports depend on three factors. First, they depend on price competitiveness through the growth rate of the unit labour cost $(g_{ULC,S-1})$. Second, there is a demand effect which is captured by the growth rate of the foreign income $(g_{Y,N-1})$. Third, we capture non-price factors (such as the quality, differentiation or degree of complexity of exports, market size, technological leadership and institutional characteristics) via the growth rate of capital stock $(g_{K,S-1})$ (see e.g. Athanasoglou and Bardaka, 2010). In addition, we take into account the size of the tradable sector. Giavazzi and Spaventa (2011) suggest that the larger the tradable sector, the more relaxed is the intertemporal budget constraint. Since we examine how current account deficits are linked to financial fragility, we capture the positive effect of the tradable sector on the intertemporal constraint by scaling the effect of domestic capital stock growth by the size of the tradable goods sector. The size of the relative size of the tradable-goods sector depends on many factors, such as sectoral rate of profit differentials, market liberalisation, access to credit for each sector, the Baumol's effect (i.e. the relative price increase of services (non-tradable) to manufacturing (tradable) due to differential sectoral productivity growths) and the degree of monopolisation. In our setting, we assume that the size of the tradable goods sector (β_S) is exogenous.

$$X_S = X_{S-1}(1 + g_{X,S}) \tag{18}$$

$$g_{X,S} = \chi_{0,S} - \chi_{1,S} g_{ULC,S-1} + \chi_{2,S} g_{Y,N-1} + \beta_S \chi_{3,S} g_{K,S-1} \tag{19}$$

We connect technical change and competitiveness with industrial structure. Equation (20) defines the time path of labour productivity (λ_s). We assume that technical change takes place via Harrod-neutral technical progress. Labour productivity growth $(g_{\lambda,S})$ depends on the Kaldor-Verdoorn effect; $g_{Y,S}$ is the growth rate of the Southern region (see Equation 21). The assumption of a cumulative causation between labour-saving technical progress and capital accumulation is in accordance with the stylised facts of long-run positive productivity growth rates and relatively stable capital to output ratios (see e.g. Kim and Lavoie, 2016). Moreover, we capture this positive effect

of the tradable goods sector on productivity growth by scaling the Kaldor-Verdoorn effect by the relative size of the tradable sector $(\beta_S \sigma_{1,S})$. Note that there is no need to define an explicit imports function as Southern imports equal Northern exports (see Equation 22).

$$\lambda_S = \lambda_{S-1}(1 + g_{\lambda,S}) \tag{20}$$

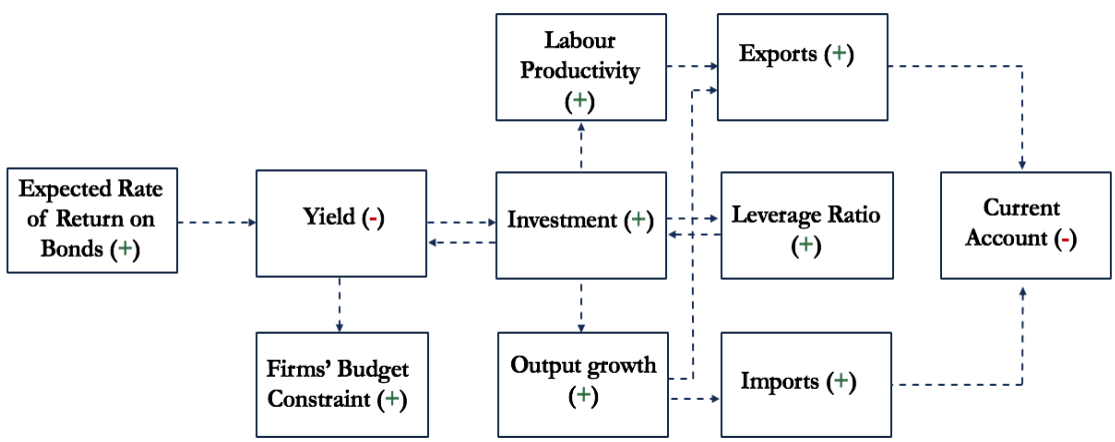
$$g_{\lambda,S} = \sigma_{0,S} + \beta_S \sigma_{1,S} g_{Y,S-1} \tag{21}$$

$$IM_S = X_N \tag{22}$$

3. Effects of financial conditions on the current account balance and financial fragility

In this section we analyse how a change in financial conditions, linked with the availability of credit for the Southern countries, affects the current account balance and the financial fragility in these countries. Our analysis relies on some preliminary simulations that we have conducted using our model. The key channels are shown in Fig. 1 and Fig. 2.

Fig. 1: Transmission channels of an increase in the demand for Southern corporate bonds



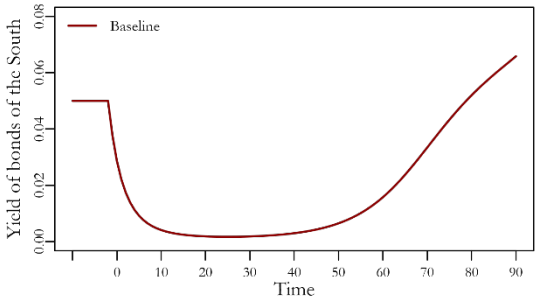
Suppose that there is a positive expectations shock regarding the rate of return on Southern bonds which leads to increased international demand for them, i.e. a shock to liquidity preference of

households. This rise in demand increases Southern bonds' price and reduces their yield (Fig. 2a). A lower yield has in turn two distinct effects. First, it has a positive effect on desired investment since the cost of borrowing is lower. Second, a decrease in the bond yield leads to a relaxation of Southern firms' budget constraint as they increase the number of new bonds issued. Both effects lead to an increase in the actual investment-to-output ratio and the growth rate of output (Figs. 2b and 2d). The higher desired investment results in a higher demand for bank loans. In the first years, banks provide part of these loans since firms' leverage ratio (see Fig. 2c) and bank's leverage ratio are relatively low. This further contributes to higher actual investment and output. This increase in output affects both imports and exports. In our simulations the increase in imports is higher than the increase in exports since the Southern countries have a small tradable sector and a high propensity of imports with respect to income. As a result, the trade balance and the current account balance gradually deteriorate (Figs. 2e and 2f).

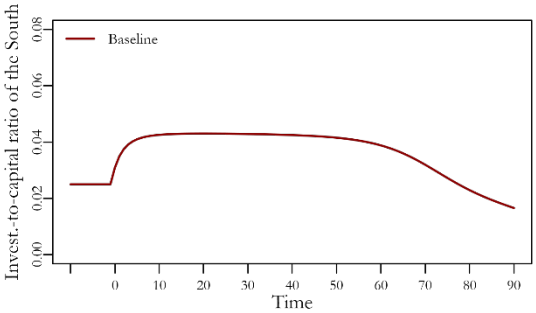
However, credit expansion leads to an increase in firms' leverage ratio (Fig. 2c) and reduces the capital adequacy ratio of banks. As a result, there is a gradual decrease in desired investment and provision of loans. This in turn, has a negative impact on actual investment and economic activity.

Fig. 2: Effects of the implementation of a rise in the demand for Southern private bonds

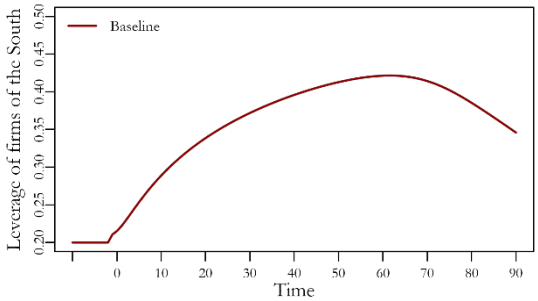
(a) Yield of bonds of the South



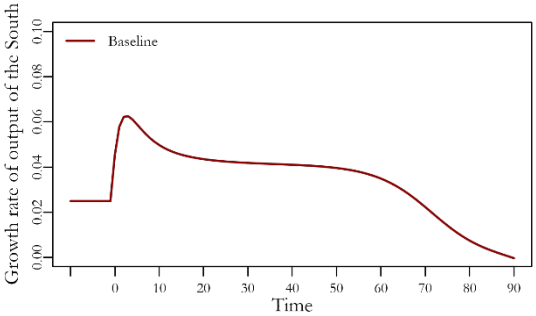
(b) Investment-to-capital ratio of the South



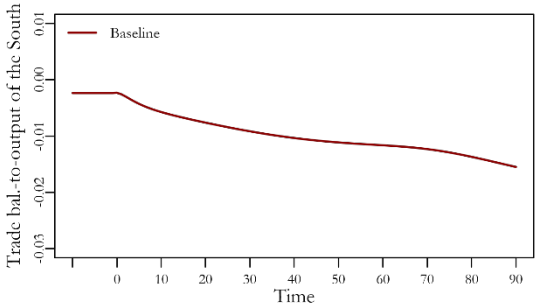
(c) Leverage ratio of firms of the South



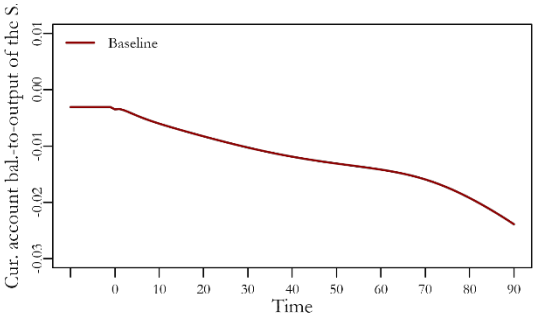
(d) Growth rate of output of the South



(e) Trade balance-to-output of the South

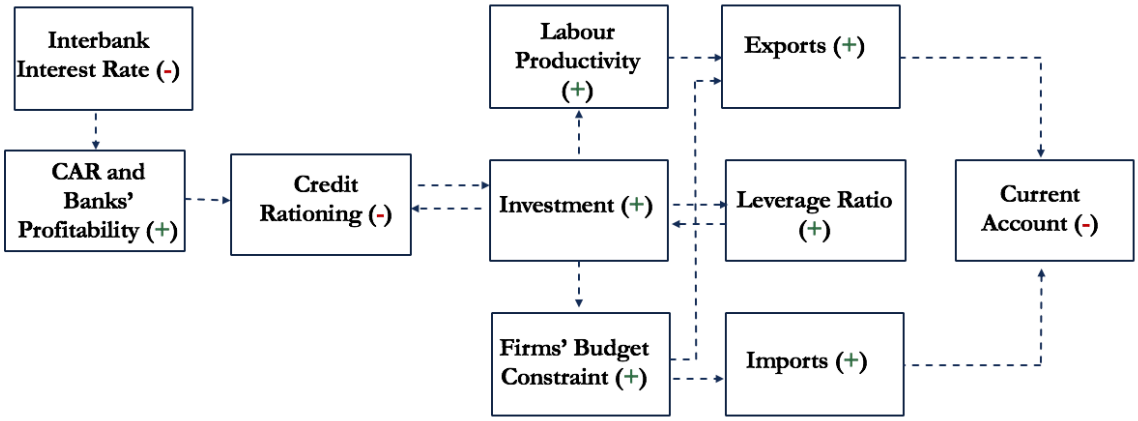


(f) Capital account balance-to-output of the South



Suppose now that there is a positive expectations shock regarding the interest rate in the interbank market which leads to a lower interbank interest rate (see Fig. 3 for the key channels). This increases Southern banks' profitability and capital adequacy ratio, reducing credit rationing. As a result, actual investment increases. This has two effects. First, there is an increase in output. Since the Southern countries have a small tradable sector and a high propensity of imports with respect to income, imports increase more than exports causing a deterioration in the current account imbalance. Second, higher investment leads to an increase in total debt and a gradual increase in the financial fragility of firms and banks.

Fig. 3: Transmission channels of a decline in the interbank interest rate



At some point in time the gradual increase in the leverage of banks causes an increase in the interbank rate. This gives rise to a destabilising mechanism of increasing debt and increasing funding costs. As banking leverage increases and banking profits decrease, credit rationing increases. Note that in the model, interest rates are exogenous and therefore there is no transition mechanism between the interbank rate and domestic rates. However, this does not change the qualitative behaviour of the above-mentioned mechanism as endogenous lending and deposit rates would only amplify the effects.

4. Analysing the impact of wage, fiscal and macroprudential policies on current account imbalances and financial fragility

[In progress]

5. Conclusion

In this paper, we have used an open-economy SFC model to assess the links between external and internal imbalances and to evaluate the most common policy prescriptions that aim to reduce current account imbalances. Our preliminary simulation analysis shows that an increase in the credit inflows from the Northern region into the Southern region leads to a temporary increase in economic growth in the Southern region. However, this is accompanied by an increase in the leverage of firms and an increase in the current account deficit that ultimately lead to lower economic growth. Similar effects are found in the case in which there is a reduction in the interbank interest rate at which the Southern commercial banks borrow.

The model can be extended in many ways. First, household debt and housing prices could be introduced to capture housing bubbles and household financial fragility. This would be an important extension since the household market has played a key role in the emergence of imbalances. Second, the wage share could be endogenised to reflect the links between economic growth and income distribution. Third, the introduction of a heterogenous productions sector would allow us to make a more explicit distinction between the tradable and the non-tradable sector.

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Appendix A: List of equations

A.1 Southern countries

A.1.1 Firms

$$Y_S = C_S + I_S + G_S + X_S - IM_S \quad \text{(A1)}$$

$$TP_{G,S} = Y_S - w_S N_S - int_{L,S} L_{S-1} - coupon_S b_{S-1} \quad \text{(A2)}$$

$$TP_S = TP_{G,S} - T_{FS} \quad \text{(A3)}$$

$$RP_S = s_{F,S} TP_{S-1} \quad \text{(A4)}$$

$$DP_S = TP_S - RP_S \quad \text{(A5)}$$

$$r_S = \frac{TP_S}{K_S} \quad \text{(A6)}$$

$$lev_{F,S} = \frac{L_S + p_S b_S}{K_S} \quad \text{(A7)}$$

$$I_S^D = \left(\gamma_{0,S} + \gamma_{1,S} r_{S-1} - \gamma_{2,S} lev_{F,S-1} - \gamma_{3,S} yield_{S-1}\right) K_{S-1} \quad \text{(A8)}$$

$$NL_S^D = I_S^D - RP_S - \bar{p}_S \Delta b_S + repL_{S-1} \quad \text{(A9)}$$

$$I_S = \Delta L_S + RP_S + \bar{p}_S \Delta b_S \quad \text{(A10)}$$

$$K_S = K_{S-1} + I_S \quad \text{(A11)}$$

$$\lambda_S = \lambda_{S-1}(1 + g_{\lambda,S}) \quad \text{(A12)}$$

$$g_{\lambda,S} = \sigma_{0,S} + \beta_S \sigma_{1,S} g_{Y,S-1} \quad \text{(A13)}$$

$$w_S = s_{W,S} \lambda_S h_S \quad \text{(A14)}$$

$$N_S = \frac{Y_S}{h_S \lambda_S} \quad \text{(A15)}$$

$$re_S = \frac{Y_S}{\lambda_S h_S LF_S} \quad \text{(A16)}$$

$$ur_S = 1 - re_S \quad \text{(A17)}$$

$$LF_S = LF_{S-1}(1 + g_{LF,S}) \quad \text{(A18)}$$

$$ULC_S = \frac{w_S}{\lambda_S} \quad \text{(A19)}$$

$$X_S = X_{S-1}(1 + g_{X,S}) \quad \text{(A20)}$$

$$g_{X,S} = \chi_{0,S} - \chi_{1,S} g_{ULC,S-1} + \chi_{2,S} g_{Y,N-1} + \beta_S \chi_{3,S} g_{K,S-1} \quad \text{(A21)}$$

$$IM_S = X_N \quad \text{(A22)}$$

$$b_S = b_{S-1} + x_S \frac{I_S^D}{\bar{p}_S} \quad \text{(A23)}$$

$$x_S = x_{0,S} - x_{1,S} yield_{S-1} \quad \text{(A24)}$$

$$yield_S = \frac{coupon_S}{p_S} \tag{A25}$$

$$coupon_S = yield_{S-1}\bar{p}_S \tag{A26}$$

$$p_S = \frac{B_S}{b_S} \tag{A27}$$

$$B_S = B_{S,H,S} + B_{S,H,N} \tag{A28}$$

A.1.2 Households

$$Y_{HG,S} = w_S N_S + DP_S + BP_S + int_{D,S} D_{S-1} + int_{S,S} SEC_{H,S-1} + coupon_S b_{S,H,S-1} + coupon_S b_{N,H,S-1} \tag{A29}$$

$$Y_{H,S} = Y_{HG,S} - T_{H,S} \tag{A30}$$

$$C_S = c_{1,S} Y_{HG,S-1} + c_{2,S} V_{H,S-1} \tag{A31}$$

$$V_{H,S} = V_{H,S-1} + Y_{HS} - C_S + b_{S,H,S-1}\Delta p_S + b_{N,H,S-1}\,\Delta p_N \tag{A32}$$

$$SEC_{H,S} = \left(\lambda_{10,S} + \lambda_{11,S} int_{S,S} + \lambda_{12,S} yield_{S-1} + \lambda_{13,S} yield_{N-1} + \lambda_{14,S} int_{D,S} + \lambda_{15,S} \frac{Y_{H,S-1}}{V_{H,S-1}}\right) V_{H,S-1} \tag{A33}$$

$$B_{S,H,S} = \left(\lambda_{20,S} + \lambda_{21,S} int_{S,S} + \lambda_{22,S} yield_{S-1} + \lambda_{23,S} yield_{N-1} + \lambda_{24,S} int_{D,S} + \lambda_{25,S} \frac{Y_{H,S-1}}{V_{H,S-1}}\right) V_{H,S-1} \tag{A34}$$

$$B_{N,H,S} = \left(\lambda_{30,S} + \lambda_{31,S} int_{S,S} + \lambda_{32,S} yield_{S-1} + \lambda_{33,S} yield_{N-1} + \lambda_{34,S} int_{D,S} + \lambda_{35,S} \frac{Y_{H,S-1}}{V_{H,S-1}}\right) V_{H,S-1} \tag{A35}$$

$$D_{S,N} = \left(\lambda_{40,S} + \lambda_{41,S} int_{S,S} + \lambda_{42,S} yield_{S-1} + \lambda_{43,S} yield_{N-1} + \lambda_{44,S} int_{D,S} + \lambda_{45,S} \frac{Y_{H,S-1}}{V_{H,S-1}}\right) V_{H,S-1} \tag{A36a}$$

$$D_S = D_{S-1} + Y_{H,S} - C_S - \bar{p}_S \Delta b_{S,H,S} - \bar{p}_N \Delta b_{N,H,S} - \Delta SEC_{H,S} \tag{A36}$$

$$b_{S,H,S} = \frac{B_{S,H,S}}{p_S} \tag{A37}$$

$$b_{N,H,S} = \frac{B_{N,H,S}}{p_N} \tag{A38}$$

A.1.3 Commercial banks

$$BP_S = int_{L,S}L_{S-1} + int_{S,S}SEC_{S,B,S-1} + int_{S,N}SEC_{N,B,S-1} - int_{D,S}D_{S-1} - int_A A_{S-1} - int_{INT}L_{INT-1} \quad \text{(A39)}$$

$$K_{B,S} = K_{B,S-1} + BP_{U,S} \quad \text{(A40)}$$

$$BP_{U,S} = s_{B,S}BP_{S-1} \quad \text{(A41)}$$

$$BP_{D,S} = BP_S - BP_{U,S} \quad \text{(A42)}$$

$$HPM_S = h_{1,S}D_S \quad \text{(A43)}$$

$$SEC_{S,B,S} = h_{2,S}D_S \quad \text{(A44)}$$

$$SEC_{N,B,S} = SEC_N - SEC_{H,N} - SEC_{N,B,N} - SEC_{CB,N} \quad \text{(A45)}$$

$$A_S = A_{S-1} + \Delta L_S + \Delta HPM_S + \Delta SEC_{S,B,S} + \Delta SEC_{N,B,S} - \Delta D_S - BP_{U,S} - \Delta L_{INT} \quad \text{(A46)}$$

$$CR_S = l_{0,S} + l_{1,S}lev_{F,S-1} - l_{2,S}(CAR_{S-1} - CAR_S^T) + l_{3,S}\left(lev_{B,S-1} - lev_B^{max}\right) \quad \text{(A47)}$$

$$L_S = L_{S-1} + (1 - CR_S)NL_S^D - repL_{S-1} \quad \text{(A48)}$$

$$L_{INT} = L_{INT-1} + \zeta_1\left(\Delta L_S + \Delta HPM_S + \Delta SEC_{S,B,S} + \Delta SEC_{N,B,S} - \Delta D_S\right) \quad \text{(A49)}$$

$$int_{MRO} = int_{DF} + \psi_A \quad \text{(A50)}$$

$$int_{INT} = int_{DF} + \frac{int_{MRO} - int_{DF}}{1 + e^{-\beta_1(lev_{B,S} - \beta_2)}} \quad \text{(A51)}$$

$$CAR_S = \frac{K_{BS}}{w_S(SEC_{S,B,S} + SEC_{N,B,S}) + w_L L_S} \quad \text{(A52)}$$

$$lev_{B,S} = \frac{SEC_{S,B,S} + SEC_{N,B,S} + HPM_S + L_S}{K_{BS}} \quad \text{(A53)}$$

$$CAR_S^T = \begin{cases} CAR^{min}, & \text{if } g_S < J \\ CAR^{min} + \frac{(g_S - J)}{H - J}0.025, & \text{if } J \leq g_S \leq H \\ CAR^{min} + 0.025, & \text{if } g_S > H \end{cases} \quad \text{(A54)}$$

A.1.4 Government sector

$$SEC_S = SEC_{S-1} + G_S - T_S + int_{S,S}SEC_{S-1} - CBP_S \quad \text{(A55)}$$

$$G_S = gov_S Y_{S-1} \quad \text{(A56)}$$

$$T_{H,S} = \tau_{H,S}Y_{HG,S-1} \quad \text{(A57)}$$

$$T_{F,S} = \tau_{F,S}TP_{G,S-1} \quad \text{(A58)}$$

$$T_S = T_{H,S} + T_{F,S} \quad \text{(A59)}$$

A.1.5 Central bank

$$CBP_S = int_A A_{S-1} + int_{S,S}SEC_{S,CB-1} \quad \text{(A60)}$$

$$SEC_{CB,S} = SEC_S - SEC_{H,S} - SEC_{S,B,S} - SEC_{S,B,N} \quad \text{(A61)}$$

$$SEC_{CB,S} = SEC_{CB,S-1} + \Delta HPM_S - \Delta A_S \quad \text{(A62-red)}$$

A.1.6 Current Account

$$CAB_S = X_S - IM_S + coupon_N b_{N,H,S-1} - coupon_S b_{S,H,N-1} + int_{S,N} SEC_{N,B,S-1} - int_{S,S} SEC_{S,B,N-1} - int_{INT} L_{INT-1} \quad \text{(A63)}$$

$$KAB_S = -p_N \Delta b_{N,H,S} + p_S \Delta b_{S,H,N} - \Delta SEC_{N,B,S} + \Delta SEC_{S,B,N} + \Delta L_{INT} \quad \text{(A64)}$$

A.2 Northern countries

The equations for the Northern countries are similar to the equations for the Southern countries. These equations are listed below.

A.2.1 Firms

$$Y_N = C_N + I_N + G_N + X_N - IM_N \quad \text{(A65)}$$

$$TP_{G,N} = Y_N - w_N N_N - int_{L,N} L_{N-1} - coupon_N b_{N-1} \quad \text{(A66)}$$

$$TP_N = TP_{G,N} - T_{F,N} \quad \text{(A67)}$$

$$RP_N = s_{F,N} TP_{N-1} \quad \text{(A68)}$$

$$DP_N = TP_N - RP_N \quad \text{(A69)}$$

$$r_N = \frac{TP_N}{K_N} \quad \text{(A70)}$$

$$lev_{F,N} = \frac{L_N + p_N b_N}{K_N} \quad \text{(A71)}$$

$$I_N^D = \left(\gamma_{0,N} + \gamma_{1,N} r_{N-1} - \gamma_{2,N} lev_{F,N-1} - \gamma_{3,S} yield_{N-1}\right) K_{N-1} \quad \text{(A72)}$$

$$NL_N^D = I_N^D - RP_N - \bar{p}_N \Delta b_N + repL_{N-1} \quad \text{(A73)}$$

$$I_N = \Delta L_N + RP_N + \bar{p}_N \Delta b_N \quad \text{(A74)}$$

$$K_N = K_{N-1} + I_N \quad \text{(A75)}$$

$$\lambda_N = \lambda_{N-1}(1 + g_{\lambda,N}) \quad \text{(A76)}$$

$$g_{\lambda,N} = \sigma_{0,N} + \beta_N \sigma_{1,S} g_{Y,N-1} \quad \text{(A77)}$$

$$w_N = s_{W,N} \lambda_N h_N \quad \text{(A78)}$$

$$N_N = \frac{Y_N}{h_N \lambda_N} \quad \text{(A79)}$$

$$re_N = \frac{Y_N}{\lambda_N h_N LF_N} \tag{A80}$$

$$ur_N = 1 - re_N \tag{A81}$$

$$LF_N = LF_{N-1}(1 + g_{LF,N}) \tag{A82}$$

$$ULC_N = \frac{w_N}{\lambda_N} \tag{A83}$$

$$X_N = X_{N-1}(1 + g_{X,N}) \tag{A84}$$

$$g_{X,N} = \chi_{0,N} - \chi_{1,N} g_{ULC,N-1} + \chi_{2,N} g_{Y,S-1} + \beta_N \chi_{3,N} g_{K,N-1} \tag{A85}$$

$$IM_N = X_S \tag{A86}$$

$$b_N = b_{N-1} + x_N \frac{I_N^D}{\bar{p}_N} \tag{A87}$$

$$x_N = x_{0,N} - x_{1,N} yield_{N-1} \tag{A88}$$

$$yield_N = \frac{coupon_N}{p_N} \tag{A89}$$

$$coupon_N = yield_{N-1} \bar{p}_N \tag{A90}$$

$$p_N = \frac{B_N}{b_N} \tag{A91}$$

$$B_N = B_{N,H,N} + B_{N,H,S} \tag{A92}$$

A.2.2 Households

$$Y_{HG,N} = w_N N_N + DP_N + BP_N + int_{D,N} D_{N-1} + int_{S,N} SEC_{H,N-1} + coupon_S b_{S,H,N-1} + coupon_N b_{N,H,N-1} \tag{A93}$$

$$Y_{H,N} = Y_{HG,N} - T_{H,N} \tag{A94}$$

$$C_N = c_{1,N} Y_{H,N-1} + c_{2,N} V_{H,N-1} \tag{A95}$$

$$V_{H,N} = V_{H,N-1} + Y_{H,N} - C_N + b_{S,H,N-1} \Delta p_S + b_{N,H,N-1} \Delta p_N \tag{A96}$$

$$SEC_{H,N} = \left(\lambda_{10,N} + \lambda_{11,N} int_{S,N} + \lambda_{12,N} yield_{N-1} + \lambda_{13,N} yield_{S-1} + \lambda_{14,N} int_{D,N} + \lambda_{15,N} \frac{Y_{H,N-1}}{V_{H,N-1}}\right) V_{H,N-1} \tag{A97}$$

$$B_{N,H,N} = \left(\lambda_{20,N} + \lambda_{21,N} int_{S,N} + \lambda_{22,N} yield_{N-1} + \lambda_{23,N} yield_{S-1} + \lambda_{24,N} int_{D,N} + \lambda_{25,N} \frac{Y_{H,N-1}}{V_{H,N-1}}\right) V_{H,N-1} \tag{A98}$$

$$B_{S,H,N} = \left(\lambda_{30,N} + \lambda_{31,N} int_{S,N} + \lambda_{32,N} yield_{N-1} + \lambda_{33,N} yield_{S-1} + \lambda_{34,N} int_{D,N} + \lambda_{35,N} \frac{Y_{H,N-1}}{V_{H,N-1}}\right) V_{H,N-1} \tag{A99}$$

$$D_{N,N} = \Big(\lambda_{40,N} + \lambda_{41,N} int_{S,N} + \lambda_{42,N} yield_{N-1} + \lambda_{43,N} yield_{S-1} + \lambda_{41,N} int_{D,N} + \lambda_{45,N} \frac{Y_{H,N-1}}{V_{H,N-1}}\Big) V_{H,N-1} \quad \text{(A100a)}$$

$$D_N = D_{N-1} + Y_{H,N} - C_N - \bar{p}_S \Delta b_{S,H,N} - \bar{p}_N \Delta b_{N,H,N} - \Delta SEC_{H,N} \quad \text{(A100)}$$

$$b_{S,H,N} = \frac{B_{S,H,N}}{p_S} \quad \text{(A101)}$$

$$b_{N,H,N} = \frac{B_{N,H,N}}{p_N} \quad \text{(A102)}$$

A.2.3 Commercial banks

$$BP_N = int_{L,N} L_{N-1} + int_{S,N} SEC_{S,B,N-1} + int_{S,N} SEC_{N,B,N-1} - int_{D,N} D_{N-1} - int_{N,A} A_{N-1} + int_{INT} L_{INT-1} \quad \text{(A103)}$$

$$K_{B,N} = K_{B,N-1} + BP_{U,N} \quad \text{(A104)}$$

$$BP_{U,N} = s_{B,N} BP_{N-1} \quad \text{(A105)}$$

$$BP_{D,N} = BP_N - BP_{U,N} \quad \text{(A106)}$$

$$HPM_N = h_{1,N} D_N \quad \text{(A107)}$$

$$SEC_{S,B,N} = h_{2,N} D_N \quad \text{(A108)}$$

$$SEC_{N,B,N} = h_{3,N} D_N \quad \text{(A109)}$$

$$A_N = A_{N-1} + \Delta L_N + \Delta HPM_N + \Delta SEC_{S,B,N} + \Delta SEC_{N,B,N} - \Delta D_N - BP_{U,N} + \Delta L_{INT} \quad \text{(A110)}$$

$$CR_N = l_{0,N} + l_{1,N} lev_{F,N-1} - l_{2,N}(CAR_{N-1} - CAR_N^T) + l_{3,N}\big(lev_{B,N-1} - lev_B^{max}\big) \quad \text{(A111)}$$

$$L_N = L_{N-1} + (1 - CR_N) NL_N^D - repL_{N-1} \quad \text{(A112)}$$

$$CAR_N = \frac{K_{BN}}{w_S(SEC_{S,B,N} + SEC_{N,B,N}) + w_L L_S + w_{INT} L_{INT}} \quad \text{(A113)}$$

$$lev_{B,N} = \frac{SEC_{S,B,N} + SEC_{N,B,N} + HPM_N + L_N + L_{INT}}{K_{BN}} \quad \text{(A114)}$$

$$CAR_N^T = \begin{cases} CAR^{min}, & \text{if } g_N < J \\ CAR^{min} + \frac{(g_N - J)}{H - J} 0.025, & \text{if } J \le g_N \le H \\ CAR^{min} + 0.025, & \text{if } g_N > H \end{cases} \quad \text{(A115)}$$

A.2.4 Government Sector

$$SEC_N = SEC_{N-1} + G_N - T_N + int_{S,N} SEC_{N-1} - CBP_N \quad \text{(A116)}$$

$$G_N = gov_N Y_{N-1} \quad \text{(A117)}$$

$$T_{H,N} = \tau_{H,N} Y_{HG,N-1} \quad \text{(A118)}$$

$$T_{F,N} = \tau_{F,N} TP_{G,N-1} \quad \text{(A119)}$$

$$T_N = T_{H,N} + T_{F,N} \quad \text{(A120)}$$

A.2.5 Central bank

$$CBP_N = int_{A,N} A_{N-1} + int_{S,N} SEC_{N,CB-1} \quad \text{(A121)}$$

$$SEC_{CB,N} = SEC_N - SEC_{H,N} - SEC_{N,B,S} - SEC_{N,B,N} \quad \text{(A122)}$$

$$SEC_{CB,N} = SEC_{CB,N-1} + \Delta HPM_N - \Delta A_N \quad \text{(A123)}$$

A.2.6 Current Account

$$CAB_N = (X_N - IM_N) + coupon_S b_{S,H,N-1} - coupon_N b_{N,H,S-1} + int_{S,S} SEC_{S,B,N-1} - int_{S,N} SEC_{N,B,S-1} + int_{INT} L_{INT-1} \quad \text{(A124)}$$

$$KAB_N = -p_N \Delta b_{S,H,N} + p_S \Delta b_{N,H,S} - \Delta SEC_{S,B,N} + \Delta SEC_{N,B,S} - \Delta L_{INT} \quad \text{(A125)}$$

Appendix B. Endogenous variables

Symbol	Description
A_S	*Advances, Southern Region*
A_N	*Advances, Northern region*
B_S	*Value of Bonds, Southern Region*
B_N	*Value of Bonds, Northern region*
$B_{S,H,S}$	*Value of Southern Bonds, held by Households, Southern Region*
$B_{S,H,N}$	*Value of Southern Bonds, held by Households, Northern region*
$B_{N,H,S}$	*Value of Northern Bonds, held by Households, Southern Region*
$B_{N,H,N}$	*Value of Northern Bonds, held by Households, Northern region*
BP_S	*Profits, Banks, Southern Region*
BP_N	*Profits, Banks, Northern region*
$BP_{D,S}$	*Distributed Profits, Banks, Southern Region*
$BP_{U,S}$	*Undistributed Profits, Banks, Southern region*
$BP_{D,N}$	*Distributed Profits, Banks, Northern region*
$BP_{U,N}$	*Undistributed Profits, Banks, Northern region*
b_S	*Number of Bonds, Southern Region*
b_N	*Number of Bonds, Northern region*
$b_{S,H,S}$	*Number of Southern Bonds, held by Households, Southern region*
$b_{S,H,N}$	*Number of Southern Bonds, held by Households, Northern region*
$b_{N,H,N}$	*Number of Northern Bonds, held by Households, Northern region*
$b_{N,H,S}$	*Number of Northern Bonds, held by Households, Southern region*
C_S	*Consumption, Southern Region*
C_N	*Consumption, Northern region*
CAB_S	*Current Account Balance, Southern Region*
CAB_N	*Current Account Balance, Northern Region*
CAR_S	*Capital Adequacy Ratio, Southern Region*
CAR_N	*Capital Adequacy Ratio, Northern region*
CBP_S	*Profits, Central Bank, Southern Region*
CBP_N	*Profits, Central Bank, Northern Region*
CR_S	*Credit Rationing, Southern Region*
CR_N	*Credit Rationing, Northern region*
D_S	*Deposits, Southern Region*
D_N	*Deposits, Northern Region*
$D_{S,N}$	*Deposits, Southern Region*
$D_{N,N}$	*Deposits, Northern Region*
DP_S	*Distributed Corporate Profits, Southern region*
DP_N	*Distributed Corporate Profits, Northern region*
G_S	*Government Expenditures, Southern Region*
G_N	*Government Expenditures, Northern Region*
$g_{Y,S}$	*Output, Growth Rate, Southern Region*
$g_{Y,N}$	*Output, Growth Rate, Northern Region*
$g_{ULC,S}$	*Unit Labour Cost, Growth Rate, Southern region*
$g_{ULC,N}$	*Unit Labour Cost, Growth Rate, Northern region*
$g_{X,S}$	*Exports, Growth Rate, Southern Region*
$g_{X,N}$	*Exports, Growth Rate, Northern region*
$g_{\lambda,S}$	*Labour Productivity, Growth Rate, Southern Region*

$g_{\lambda,N}$	*Labour Productivity, Growth Rate, Northern region*
HPM_S	*High Powered Money, Southern Region*
HPM_N	*High Powered Money, Northern Region*
I_S	*Actual Investment, Southern Region*
I_N	*Actual Investment, Northern Region*
I_S^D	*Desired Investment, Southern Region*
I_N^D	*Desired Investment, Northern Region*
IM_S	*Imports, Southern Region*
IM_N	*Imports, Northern region*
int_{INT}	*Interbank Interest Rate*
K_S	*Capital Stock, Southern Region*
K_N	*Capital Stock, Northern region*
$K_{B,S}$	*Own Funds, Banks, Southern Region*
$K_{B,N}$	*Own Funds, Banks, Northern region*
KAB_S	*Capital Account Balance, Southern Region*
KAB_N	*Capital Account Balance, Northern Region*
L_S	*Loans, Southern Region*
L_N	*Loans, Northern region*
$lev_{B,S}$	*Leverage Ratio, Banks, Southern Region*
$lev_{B,N}$	*Leverage Ratio, Banks, Northern Region*
$lev_{F,S}$	*Leverage Ratio, Firms, Southern region*
$lev_{F,N}$	*Leverage Ratio, Firms, Northern region*
L_{INT}	*Interbank Loans*
LF_S	*Labour Force, Southern region*
LF_N	*Labour Force, Northern region*
N_S	*Number of Employees, Southern Region*
N_N	*Number of Employees, Northern Region*
NL_S	*Notional Demand for Loans, Southern Region*
NL_N	*Notional Demand for Loans, Northern Region*
p_S	*Price of Bonds, Southern Region*
p_N	*Price of Bonds, Northern Region*
r_S	*Rate of Profit, Southern region*
r_N	*Rate of Profit, Northern region*
re_S	*Rate of Employment, Southern region*
re_N	*Rate of Employment, Northern region*
RP_S	*Undistributed Corporate Profits, Southern Region*
RP_N	*Undistributed Corporate Profits, Northern Region*
SEC_S	*Government Securities, Southern Region*
$SEC_{S,H,S}$	*Government Securities, held by Southern Households, Southern Region*
$SEC_{S,H,N}$	*Government Securities, held by Northern Households, Southern Region*
$SEC_{S,B,S}$	*Government Securities, held by Southern Banks, Southern Region*
$SEC_{S,B,N}$	*Government Securities, held by Northern Banks, Southern Region*
$SEC_{S,CB}$	*Government Securities, held by the Southern Central Bank, Southern Region*
SEC_N	*Government Securities, Northern Region*
$SEC_{N,H,S}$	*Government Securities, held by Southern Households, Northern Region*
$SEC_{N,H,N}$	*Government Securities, held by Northern Households, Northern Region*
$SEC_{N,B,S}$	*Government Securities, held by Southern Banks, Northern Region*
$SEC_{N,B,N}$	*Government Securities, held by Northern Banks, Northern Region*
$SEC_{N,CB}$	*Government Securities, held by the Northern Central Bank, Northern Region*

T_S	*Taxes, Total, Southern Region*
T_N	*Taxes, Total, Northern Region*
$T_{H,S}$	*Income Taxes, Southern Region*
$T_{H,N}$	*Income Taxes, Northern Region*
$T_{F,S}$	*Corporate Taxes, Southern Region*
$T_{F,N}$	*Corporate Taxes, Northern Region*
$TP_{G,S}$	*Corporate Profits, Gross, Southern region*
$TP_{G,N}$	*Corporate Profits, Gross, Northern region*
TP_S	*Corporate Profits, Net, Southern region*
TP_N	*Corporate Profits, Net, Northern region*
ULC_S	*Unit Labour Force, Southern Region*
ULC_N	*Unit Labour Force, Northern region*
ur_S	*Rate of Unemployment, Southern Region*
ur_N	*Rate of Unemployment, Northern region*
$V_{H,S}$	*Households' Wealth, Southern Region*
$V_{H,N}$	*Households' Wealth, Northern region*
w_S	*Wage Rate, Southern Region*
w_N	*Wage Rate, Northern region*
X_S	*Exports, Southern Region*
X_N	*Exports, Northern region*
Y_S	*Output, Southern region*
Y_N	*Output, Northern region*
$Y_{HG,S}$	*Disposable Income, Gross, Southern Region*
$Y_{HG,N}$	*Disposable Income, Gross, Northern region*
$Y_{H,S}$	*Disposable Income, Net, Southern Region*
$Y_{H,N}$	*Disposable Income, Net, Northern Region*
$yield_S$	*Bonds' yield, Southern Region*
$yield_N$	*Bonds' yield, Northern Region*
λ_S	*Labour Productivity, Southern Region*
λ_N	*Labour Productivity, Northern Region*

Appendix C. Parameters

Symbol	Description
$c_{1,S}$	*Propensity to Consume out of Wages, Southern Region*
$c_{1,N}$	*Propensity to Consume out of Wages, Northern Region*
$c_{2,S}$	*Propensity to Consume out of non-Wage Income, Southern Region*
$c_{2,N}$	*Propensity to Consume out of non-Wage Income, Northern Region*
$c_{3,S}$	*Propensity to Consume out of Wealth, Southern Region*
$c_{3,N}$	*Propensity to Consume out of Wealth, Northern Region*
$coupon_S$	*Coupon, Bonds, Southern Region*
$coupon_N$	*Coupon, Bonds, Northern Region*
gov_S	*Government Expenditure to Output ratio, Southern Region*
gov_N	*Government Expenditure to Output ratio, Northern Region*
$h_{1,S}$	*Minimum Reserve Requirements*
$h_{2,S}$	*Percentage of Banks' Funds, held as Southern Government Securities*
$h_{3,N}$	*Percentage of Banks' Funds, held as Northern Government Securities*
h_S	*Hours Worked, Southern Region*
h_N	*Hours Worked, Northern Region*
$int_{D,S}$	*Interest Rate, Deposits, Southern Region*
$int_{D,N}$	*Interest Rate, Deposits, Northern Region*
$int_{L,S}$	*Interest Rate, Loans, Southern Region*
$int_{L,N}$	*Interest Rate, Loans, Northern Region*
int_{DF}	*Interest Rate, Deposit Facility, European Central Bank*
int_{MRO}	*Interest Rate, Main Refinancing Operations, European Central Bank*
$int_{S,S}$	*Interest Rate, Government Securities, Southern Region*
$int_{S,N}$	*Interest Rate, Government Securities, Northern Region*
$l_{0,S}$	*Sensitivity of Credit Rationing to Exogenous Parameters, Southern Region*
$l_{0,N}$	*Sensitivity of Credit Rationing to Exogenous Parameters, Northern Region*
$l_{1,S}$	*Sensitivity of Credit Rationing to Corporate Debt Ratio, Southern Region*
$l_{1,N}$	*Sensitivity of Credit Rationing to Corporate Debt Ratio, Northern Region*
$l_{2,S}$	*Adjustment Parameter to Target Capital Adequacy Ratio, Southern Region*
$l_{2,N}$	*Adjustment Parameter to Target Capital Adequacy Ratio, Northern Region*
$l_{3,S}$	*Adjustment Parameter to Target Debt Ratio, Banks, Southern Region*
$l_{3,N}$	*Adjustment Parameter to Target Debt Ratio, Banks, Northern Region*
$\bar{p}_S$	*Par value of Southern Bonds*
$\bar{p}_N$	*Par value of Northern Bonds*
rep_S	*Corporate Debt repayment/rollover, Southern Region*
rep_N	*Corporate Debt repayment/rollover, Northern Region*
$s_{F,S}$	*Corporate Retention Rate, Southern Region*
$s_{F,N}$	*Corporate Retention Rate, Northern Region*
$s_{B,S}$	*Banking Retention Rate, Southern Region*
$s_{B,N}$	*Banking Retention Rate, Northern Region*
$s_{w,S}$	*Wage Share, Southern Region*
$s_{w,N}$	*Wage Share, Northern Region*
w_L	*Weight, Loans, Capital Adequacy Ratio*
w_S	*Weight, Securities, Capital Adequacy Ratio*
$\mathrm{x_S}$	*Proportion of Desired Investment Financed by Corporate Bonds, Southern Region*
$\mathrm{x_N}$	*Proportion of Desired Investment Financed by Corporate Bonds, Northern Region*
β_S	*Size of the Tradable Goods Sector, Southern Region*
β_N	*Size of the Tradable Goods Sector, Northern Region*
$\gamma_{0,S}$	*Sensitivity of Investment to Animal Spirits, Southern Region*
$\gamma_{0,N}$	*Sensitivity of Investment to Animal Spirits, Northern Region*
$\gamma_{1,S}$	*Sensitivity of Investment to Profitability, Southern Region*
$\gamma_{1,N}$	*Sensitivity of Investment to Profitability, Northern Region*
$\gamma_{2,S}$	*Sensitivity of Investment to the Debt Ratio, Southern Region*

$\gamma_{2,N}$	*Sensitivity of Investment to the Debt Ratio, Northern Region*
$\gamma_{3,S}$	*Sensitivity of Investment to the yield, Southern Region*
$\gamma_{3,N}$	*Sensitivity of Investment to the yield, Southern Region*
ζ_1	*Sensitivity of Interbank Loans to balance sheet changes*
$\lambda_{10,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{20,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{30,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{40,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{11,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{21,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{31,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{41,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{12,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{22,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{32,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{42,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{13,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{23,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{33,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{43,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{14,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{24,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{34,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{44,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{15,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{25,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{35,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{45,S}$	*Parameter of Households' Portfolio Choice, Southern Region*
$\lambda_{10,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{20,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{30,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{40,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{11,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{21,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{31,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{41,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{12,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{22,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{32,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{42,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{13,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{23,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{33,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{43,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{14,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{24,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{34,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{44,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{15,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{25,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{35,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\lambda_{45,N}$	*Parameter of Households' Portfolio Choice, Northern Region*
$\sigma_{0,S}$	*Exogenous Labour Productivity Growth Rate, Southern Region*
$\sigma_{0,N}$	*Exogenous Labour Productivity Growth Rate, Northern Region*
$\sigma_{1,S}$	*Sensitivity of Labour Productivity Growth Rate to Kaldor-Verdoorn Effect, Southern Region*

$\sigma_{1,N}$	*Sensitivity of Labour Productivity Growth Rate to Kaldor-Verdoorn Effect, Northern Region*
$\tau_{F,S}$	*Tax Rate, Corporate Profits, Southern Region*
$\tau_{F,N}$	*Tax Rate, Corporate Profits, Northern Region*
$\tau_{H,S}$	*Tax Rate, Disposable Income, Southern Region*
$\tau_{H,N}$	*Tax Rate, Disposable Income, Northern Region*
$\chi_{0,S}$	*Exogenous Growth Rate of Exports, Southern Region*
$\chi_{0,N}$	*Exogenous Growth Rate of Exports Northern Region*
$\chi_{1,S}$	*Sensitivity of the Growth Rate of Exports to Unit Labour Costs, Southern Region*
$\chi_{1,N}$	*Sensitivity of the Growth Rate of Exports to Unit Labour Costs, Northern Region*
$\chi_{2,S}$	*Sensitivity of the Growth Rate of Exports to Foreign Income, Southern Region*
$\chi_{2,N}$	*Sensitivity of the Growth Rate of Exports to the Growth Rate of the Northern Region's Income*
$\chi_{3,S}$	*Sensitivity of the Growth Rate of Exports to Growth rate of the Southern Region's Tradable Goods Sector Capital Stock*
$\chi_{3,N}$	*Sensitivity of the Growth Rate of Exports to Growth rate of the Northern Region's Tradable Goods Sector Capital Stock*