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BY

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Forward Looking and Myopic Regional Computable General Equilibrium Models. How Significant is the Distinction?

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Abstract

We present a stylized intertemporal forward-looking model able that accommodates key regional economic features, an area where the literature is not well developed. The main difference, from the standard applications, is the role of saving and its implication for the balance of payments. Though maintaining dynamic forward-looking behaviour for agents, the rate of private saving is exogenously determined and so no neoclassical financial adjustment is needed. Also, we focus on the similarities and the differences between myopic and forward-looking models, highlighting the divergences among the main adjustment equations and the resulting simulation outcomes.

JEL classification: C68; D58; D91; R10

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1. Introduction

Regional Computable General Equilibrium (CGE) models solve complex optimization problems within individual time periods in order to determine a complete allocation of a region's resources between alternative uses. However, such models often lack forward-looking expectations and this has been presented as a weakness (Partridge and Rickman, 1998; 2010). In this paper we attempt to identify how significant the lack of forward looking expectations is in this setting. In particular, we build a stylized forward-looking CGE model applicable in a regional context. Results from simulations using this model are then compared to those from a similar model where the adjustment processes between periods have a myopic, backward-looking, recursive-dynamic structure.

In this comparison of results we find the simulation differences are small. The long-run equilibria are identical. Furthermore, the adjustment paths generated by the two models are not radically different. We suggest two possible reasons why the importance of incorporating forward-looking expectations into regional CGE models might have been overstated. First, in previous comparisons using national models, the fully dynamic forward-looking model has often been compared to either a static model or one with passive investment. Second, the usual mechanism and closures that are applied in national inter-temporal CGE models misrepresent the adjustment mechanisms that typically occur within an individual region.

The structure of the remainder of the paper is as follows. In Section 2 we provide a background discussion of the theoretical issues. In Section 3 we outline the model structure. In Section 4 we deal with the calibration method. In Section 5 we present the simulation strategy and in Section 6 we discuss the simulation results. We conclude in Section 7.

2. Background

The theoretical structure of many intertemporal forward-looking CGE models is that described in Abel and Blanchard (1983). Such a model can be solved as a decentralized economy where consumption decisions are made by intertemporal optimizing households, with savings and investment decisions separated. Financial balance equilibrium is maintained through adjustment of either foreign borrowing, the interest rate, or by means of fiscal policy that, in turn, affects the financial wealth of households. Firms' forward-looking behaviour influences their investment decisions which depend on the tax-adjusted Tobin's *q*. Furthermore, in their stylized form, such models usually make households fully liable for the financial needs of the system. Hence, household savings would cover not only the needs of domestic investment, but also, ultimately, trade and Government deficits. Accordingly, households have to save as much as is required to clear the financial sector which, in turn, implies the imposition of a balance of payments constraint.

In fact, forward-looking models are frequently calibrated on national data and their specification is nowadays becoming standardized. Their key characteristics are summarized in the first column of Table 1. However, the application of model specifications that imply a zero balance of payments and a savings rate obtained endogenously through financial balance equilibrium, may be inappropriate in a regional context since regions are likely to differ from the country as a whole in a number of significant respects.

It is widely recognised that regions are more open than nations and that regional economies typically do not have the full range of macroeconomic policy levers (and many regions have none at all). Both monetary and fiscal policy are centralized and are under the control of national Government so that policy instruments and some macroeconomic adjustment mechanisms, whose incorporation is uncontroversial in a national model, cannot routinely be assumed to apply to the case of a region[1]. Furthermore, regions, unlike nations, do not face a binding balance of payments constraint. There are at least two reasons for this. Firstly, the balance of payments is not required as a policy target since regions usually belong to a common currency area and to a nationally integrated financial system. As a result, fiscal and monetary policies cannot be used to produce balance of payments adjustments through control variables such as exchange rates, reserve assets and interest rates. Secondly, the subvention that regions receive from higher level authorities, such as centralized Government and the EU, may cause some distortionary effects so that a rigorous theory of the composition of the balance of payments is not really a regional issue. As pointed out by McGregor *et al* (1995), such subventions are key determinants of the regional trade deficits. As long as national governments are credibly committed to the maintenance of the monetary union, regions do not face binding balance of payments constraints. In the UK context, for example, it is well-known that Northern Ireland has over many years maintained a balance of payments (and public sector) deficit that would be unsustainable for a national economy. But the UK government is committed to the union and essentially underwrites this position.[2]

The point is that forward-looking models impose balance of payments equilibrium in order to maintain financial sector sustainability, but regions are not obliged to undergo this form of financial adjustment. For instance, if a region faces an unsustainable position in which a net foreign debt is accompanied by a persistent trade deficit, it is not required to adopt rigorous adjustment in order to produce a trade surplus to cover interest payments because there is no

[1]Even though some nations are likely to behave as regions (European countries for example).

[2] This does not threaten the sustainability of UK public finances because Northern Ireland accounts for only 2% of UK GDP.

superior authority to impose it. A superior institution such as central Government, may reduce the subvention to reduce its level of debt and, in turn, the region's implicit (unobservable) debt. However, this is a process that occurs outside the region. It implies that any adjustment is imposed exogenously, from outside the region; it does not operate as an automatic, endogenous adjustment mechanism. This also means that the Ricardian implication of the fiscal deficit which is usually embedded in consumers' optimal decisions might be unrealistic; typically a regional (i.e. sub-national) Government which has no significant devolution of tax or borrowing powers, cannot finance its expenditure by levying taxes or issuing bonds. In this context regional policy is exogenous to the region, reflecting the subvention received from outside the region.

Of course, given widespread movement towards greater devolution within the EU, more regions will be given the responsibility, and be equipped with the corresponding instruments, to deal with the reduction in subventions, thereby introducing specific sustainable targets that might bring about a partial endogenous financial adjustment operating within the region. However, only when regions start to behave like countries belonging to a common currency area, e.g. the European countries, does the balance of payments begin to be a matter at the regional level, and any adjustment in internal and foreign assets ceases to be exogenously determined. However, this does not necessarily imply that the traditional approach to the balance of payments becomes appropriate. Even in this case, and for such regions, it may be inappropriate to impose full interregional and international payments constraints.

Our view is that in a regional intertemporal model, the treatment of internal and external debt should differ from the usual application in a corresponding national model. Thus, in a stylized regional model, Government and external debt, with their correspondent internal and external deficit flows, should not be involved in the process that determines financial adjustment within the region. This also means that the role of savings should differ from that played in standard applications. In a region, the household savings decisions are independent of the regional financial system. In fact, such decisions are more likely to be affected by national adjustment which is, of course, exogenous in a single small, open regional economy model.

The intertemporal model developed in this paper maintains forward-looking behaviour for both households and firms, and investment and saving decisions are kept separate. However, unlike standard applications, in our formulation savings follow the Solow-Swan assumption so that the rate of savings is exogenous. This does not prevent the absolute level of savings from varying through time. The key characteristics of this model are summarised in the final column of Table 1.

We compare simulation results from myopic and forward-looking models. Under particular circumstances, we find that both models produce the same long-run steady state equilibrium. This outcome differs from those reported in the existing literature (e.g., Go, 1994; Devarajan and Go, 1998) where the long-run impact differs in both models. Major concern over incorporating forward-looking expectations has arisen when the policy to be evaluated has intrinsic long-run effects (as in trade liberalization policy, for example). Go (1994) and Devarajan and Go (1998) argue that myopic models fail to capture dynamic policy gains and, consequently, produce both inaccurate and incorrect results. For example, Devarajan and Go (1998) claim to demonstrate that the welfare gains of eliminating trade tariffs are greater in forward-looking models than in static models[3].

[3] Also see Dellink (2005) on environmental policy.

However, the underlying reason for these results is related, as we explain later, to the asymmetric model specifications incorporated in both models. Indeed, it would seem that the intertemporal forward-looking model has generally been compared to the simple static case that lacks any optimal capital adjustment rule, so that investment is either crudely assumed fixed to the base year level or is passive. The characteristics of this model are summarised in column 2 of Table 1. Consequently, myopic and forward-looking models have produced results that differ even in the long-run. In our approach we find the same long-run equilibrium for comparable myopic and the forward-looking models, although the transitional paths differ. Independently of the dynamic structure, forward-looking and myopic regional models should incorporate a separate investment function and the investment decision must be determined independently of the savings decision.

The myopic model used in this example, which follows the usual AMOS closures (McGregor *et al* 1995, 1996), allows investment to respond to the current rate of return to capital (column 3 of Table 1). In addition the analysis is enriched by assuming labour supply adjustment through migration, and by investigating the role of different labour market closures. CGE models based on myopic expectations have been criticised by the supporters of forward-looking models because of the intertemporal inconsistency involved in assuming backward-looking expectations. The models solve complex optimization problems within periods in order to determine the best allocation of resources. However, between periods they remain myopic, with consumption, saving and investment decisions abstracting from future periods (Devarajan and Go, 1998). We argue in this paper that such differences are the result of the different adjustment mechanisms incorporated into these models and not, in fact, the consequence of assuming myopia as against perfect foresight.

We proceed by specifying illustrative regional intertemporal (column 4) and myopic (column 3) models, calibrating them to a common database, and subjecting them to an identical disturbance. This allows us to conduct a systematic comparison of their simulation properties, and thereby isolate the significance of the distinction between myopic and forward looking regional models.

Furthermore, in order to clarify the significance of our particular assumptions about the nature of regional adjustment processes, we also develop both forward looking and myopic regional models that share key characteristics of the national models identified in Table 1. In particular, we impose a regional balance of payments constraint and saving behaviour that makes regional households responsible for financial equilibrium. By calibrating these models to the same database and subjecting them to the same disturbance as our preferred specifications for regional models, we can reveal the true source of key model properties. This allows us to identify the significance of alternative assumptions about macroeconomic processes, as well as alternative assumptions about expectations formation, for the properties of models of regional economies.

3. Model Description

A single-region dynamic CGE model is presented in this section. The complete mathematical representation is provided in Appendix A (A.1 - A.77).

Parameterisation is implemented through the well-known calibration method using a Social Accounting Matrix (SAM) for Sardinia for the year 2001 (Ferrari et al., 2009). The set of prices at which excess demand is zero is the result of an optimization process where market clearing prices equal marginal costs in each sector.

Three economic activities or sectors are considered: Primary, Manufacturing and Services. No distinction is made between traded and non-traded sectors. Sardinia is a very small open economy and almost all sectors compete in interregional and international markets. Even health care services, traditionally a sheltered sector, are now inter-regionally traded. Production inputs include primary factors and intermediate purchases. The model includes three domestic institutional sectors: Firms, Households and Government. External institutions are split into the Rest of Italy (ROI) and Rest of the World (ROW). We adopt assumptions typically used for a small open economy. The region is too small to affect prices in international and interregional markets and, as a consequence, the ROI and ROW prices are taken to be exogenous. The behaviour of Households and Firms is based on intertemporal optimization with perfect foresight. Government is a consolidated sector merging central and local Government levels whose expenditure can be either the result of an optimization process, where Government is simply treated as a new consumer maximizing utility subject to the budget constraints, or it is held constant in real terms.

Production. The model's production structure is illustrated in Figure 1. Intermediate inputs (*VV*), labour (*L*) and capital (*K*) constitute the production inputs of the model. *L* and *K* are combined in a CES production function in order to produce value added, *Y*, allowing for substitution among primary factors of production (A.17). The demand for *L* and *K* is obtained from the first order condition of profit maximization. This implies that the demand for both *K* and *L* is positively related to the volume of value added, *Y*, and is a decreasing function of their prices (*rk* and *w*, respectively). Leontief technology between *VV* and *Y* is imposed

(A.14), so the combination of value added and intermediate inputs can be shown with an L-shaped isoquant. Intermediate goods produced locally or imported are considered as imperfect substitutes. Basically, we mix regional and imported goods under the so called Armington assumption through a CES function. The demand function for regionally produced and imported intermediate inputs (from ROI and ROW) derives from the solution of a cost minimization problem (A.19-A.22). Regional commodities supply is bought by industries and by domestic and external institutions (A.24). That is to say, each industry in the region produces goods and services that can be exported or sold in the regional market. An export demand function closes the model where the foreign demand for Sardinian goods depends on the terms of trade effect and on the export price elasticity (A.23).

Investment. This follows Hayashy (1982) with the rate of investment as a function of marginal q (or average q)[4], the ratio of the value of firms (*VF*) to the replacement cost of capital $Pk \cdot K$. With adjustment costs that are quadratic in investment, the economy does not adjust instantaneously to the desired level of capital stock. Accordingly, firms respond to the shock by making continuous small investments over time. The dynamic path of investment is the result of an intertemporal programme that seeks to maximize *VF* subject to the capital accumulation equation, $\dot{K}$, (A.50). The value of firms, *VF*, is given by the present value of the net income or cash flow, *CF*, that is to say, the capital income Π_t less investment expenditure $J_{i,t}$. The investment expenditure equation (A.45) is defined as a function of the adjustment cost $\theta(x_t)$ (A.48) as in Devarajan and Go (1998), Go (1994) and Hayashi (1982). The

[4] As we are assuming that the firm is price taker, the marginal q is equal to the average q. For more detail see Hayashy (1982).

solution to this intertemporal problem[5] produces the time path of investment (A.46) along with the law of motion of the costate variable λ (A.47).

Consumption. Individuals optimise their lifetime utility function of consumption, *C* (A.26) subject to a lifetime wealth. Once the optimal path of consumption is obtained from the solution of the intertemporal problem (A27), aggregate consumption is allocated within each period and between different groups through a CES function (A.34). Household demand for regional and imported goods (A.35 and A.36) is the result of the intra-temporal cost minimization problem. According to the dynamic budget constraint, the discounted present value of consumption must not exceed total household wealth, *W*. The model distinguishes between financial wealth (*FW*) and non-financial wealth (*NFW*). So total Wealth, *W*, is given by:

$$W_t = NFW_t + FW_t \tag{1}$$

The NFW accumulate as follow:

$$NFW_t(1 + r_t) = NFW_{t+1} + YL_t \tag{2}$$

[5] The optimality conditions (or the canonic system which gives the system of differential equations in the optimal control problem) are given by the first order condition of the Hamiltonian in current value:

A. $\frac{\partial H}{\partial I} = 0 \Rightarrow J^{'}(I_t) = \lambda_t$
B. $\dot{\lambda} = -\frac{\partial H}{\partial K} \Rightarrow \dot{\lambda} = (r_t + \delta)\lambda_t - R_t^k$
C. $\lim_{t\to\infty} \mu_t \lambda_t K_t = 0$ (trasversality condition)

The canonic system [A, B and C] can be solved to yield the costate variable in terms of discounted future revenue of capital which in turn leads to equation (5). More detail about the dynamic solution can be found in Go (1994) and Devarajan and Go (1998).

where YL_t is the net labour income plus transfers of income from internal and external institutions. FW, unlike in the standard applications, is accumulated through saving, S as follows:

$$FW_t(1 + r_t) = FW_{t+1} + \Pi_t - S_t \tag{3}$$

and

$$S_t = mps \cdot YH_t \tag{4}$$

where Π_t is capital income, YH_t is total household current income (that is, $YL_t + \Pi_t$) whilst *mps* is a parameter calibrated from the SAM. This way of proceeding, although allowing us to deal with an exogenous rate of household saving, is wholly consistent with forward-looking consumption behaviour. In fact, consumption still depends on lifetime income. That is to say, consumers base consumption decisions on expected future income even thought now, saving is not affected by investment and from the current account situation.

In the traditional approach, financial wealth is obtained by assuming asset equilibrium so that financial wealth accumulates according to the following:

$$FW_t(1 + r_t) = FW_{t+1} + \Pi_t - \left(\sum_i J_{i,t} + FD_t - TB_t\right) \tag{5}$$

where *FD* is the fiscal deficit and *TB* is the trade balance. Then $\sum_i J_{i,t} + FD_t - TB_t$ gives us endogenous saving which replaces equation (2). This means that household financial wealth is equal to total assets, internal and external. That is to say:

$$FW_t = \sum_i VF_{i,t} + GD_t + D_t \qquad (6)$$

In others words the wealth derived from asset holdings consists of the value of firms (*VF*), public assets (*GD*) and foreign assets (*D*). The value of firms represents the wealth generated from assets that consist of domestic firms' shares. Foreign assets reflect holdings of foreign firms' shares. The value of public assets is derived from Government bonds issued to finance the fiscal deficit.

In this formulation, as described in equation (3) and (4), the balance of payments still clears and we do not need to impose any balance of payments adjustment because the total absorption equation is sufficient to guarantee equilibrium in the payments account since we are not considering money as a commodity. In contrast, implicit in equation (5) is the imposition of a balance of payments adjustment because savings are determined endogenously according to the financial needs of the regional system. This method is incoherent if a regional context is considered. As we have said in the introduction, it is plausible that the regional savings rate depends very much on the national economy and, unlike countries there is no saving-investment association. Furthermore, regions are unlikely to face a balance of payments problem because the multiregional capital market is highly integrated and capital moves freely across regions.

In other intertemporal models household savings have also been determined as a fixed share of income, as for instance in Go, (1994). He exploits Abel's and Blanchard's (1983) equivalence to delete the household budget constraint, solving the model as a centralized economy but imposing financial sector equilibrium and making foreign borrowing endogenous. We can also run the model as a master plan, not considering the motion equation of the state variable *W* (see Section 4).

Domestic private Assets. From Hayashi's (1982) work we know that if the firm is a price taker, then marginal q is equal to average q. Therefore we can specify the shadow price of capital λ as the ratio of the value of the firm *VF* to its capital stock *K* (A.59).

Foreign and public assets. The common hypothesis is that both internal and external debt accumulates over time in accordance with the level of deficit and interest payments. Moreover, terminal conditions for assets are imposed in order to avoid Ponzi games. As many CGEs are calibrated on steady state equilibrium, the need to maintain a sustainable position may generate a dataset that does not reflect the real situation of the region. For instance, the calibration of the foreign asset/debt is derived by imposing regional sustainability with respect to foreign creditors or debtors. In doing this, if the regional SAM registers a trade deficit, we need to impose (and suppose) that, in the past, the region has run in surplus for many years in order to accumulate assets; the presence of a trade surplus should imply foreign debt. But several regions are in a permanent Ponzi game condition. If we do not take this situation into account, the quantitative nature of the results may change. So, if foreign debt accumulates according to the following: $\dot{D} = rD_t + TB_t$ and the trade balance *TB* is positive (so a trade deficit), a sustainable long-run position should require interest-bearing foreign assets held by the private sector. Alternatively, a negative *TB* (trade surplus) in the long-run would be able to cover interest payments on any outstanding foreign debt. In a regional context we may suppose, instead, those capital inflows necessary to cover the trade deficit are partially constituted by subvention on which no interest is paid and that, therefore, will not reduce internal assets because these are resources coming free of charge. In Sardinia's case, trade deficits exist on both interregional and international side. Sardinia is a region that receives extensive capital subvention from the EU and the Italian Government: any payments from the Social or Structural funds of the EU are matched by the National Government. Such capital inflows are free of charge and not determined by the desire of an investor to acquire Sardinia assets. In this case the change in debt that may affect the sector financial balance should be net of this capital inflow. In modelling this situation we may assume that a proportion of debt, τ , is the amount of subvention that the region receives from the National Government or EU, and not because there is the desire to invest in the region:

$$\dot{D} = (r - \tau)D_t + TB_t \tag{7}$$

So the debt accumulates only if $TB > -(r - \tau)D_t$ and the net foreign debt is equal to the gross debt less the accumulated subvention on the assets in the gross debt.

As regards Government debt or assets, because Sardinia has an internal deficit, according to the usual calibration that imposes sustainability of fiscal deficits, we would need to suppose the presence of Government assets which reduce the total assets available for private agents. However for the same reasons, as explained above, we consider an "unsustainable" position as one in which the debt is going to accumulate net of the resources that the region receives from outside of the region (A.62).

Labour market regimes and labour supply. The model incorporates three labour market closures reflecting the form of wage setting: regional wage bargaining (RB), national bargaining (NB) and fixed real wage, (FRW). The wage-setting functions are defined below, where *w* is the nominal wage, *cpi* is the consumer price index, ω is a parameter calibrated to the steady state and u is the regional unemployment rate. ε is the elasticity of wages related to the level of unemployment rate and it can also be interpreted as an index of wage flexibility.

$$\text{Wage setting}\begin{cases} ln\left[\dfrac{w_t}{cpi_t}\right] = \omega - \varepsilon \ln(u_t) & \text{(Regional Bargaining)} \\ \dfrac{w_t}{cpi_t} = \dfrac{w_{t=0}}{cpi_{t=0}} & \text{(Fixed Real Wage)} \\ w_t = w_{t=0} & \text{(National Bargaining)} \end{cases} \quad (8)$$

In the regional wage bargaining regime, the labour market is defined by the wage curve (Blanchflower and Oswald, 1994) according to which wages and unemployment are negatively related[6]. Thus regional wages are directly related to workers' bargaining power and respond to excess demand for labour. NB is a typical Keynesian closure. It assumes that the nominal wage is fixed at the base year level. This could be motivated by a system in which the nominal wage is fixed at the national level by the presence of a nation-wide bargaining system (Harrigan et al., 1991). FRW is used to obtain an alternative counterfactual analysis, reflecting a "real-wage-resistance" hypothesis, where bargaining ensures that the purchasing power of wages remains stable over time.

As regards demographic developments and labour supply, we assume that there is no natural population change, but the labour force adjusts through a migration model commonly employed in AMOS (Harrigan et al.1996, McGregor at al. 1996). The migration model assumes the form specified in Layard et al. (1991) and Treyz et al. (1993) where the net migration flow is taken to be positively related to the gap between the log of regional and national (w^N/cpi^N) real wages, and negatively related to the difference between the log of regional and national, (u^N), unemployment rates:

[6] See application of this closure in McGregor et al. 1995 and 1996.

$$nim_t = \varsigma - \nu^u[\ln(u_t) - \ln(\bar{u}^N)] + \nu^w \left[ln\left(\frac{w_t}{cpi_t}\right) - ln\left(\frac{\bar{w}^N}{\overline{cpi}^N}\right)\right] \qquad (9)$$

where *nim* is the rate of net migration and ς is a parameter calibrated in order to ensure zero net migration in the base period. ν^u and ν^w are elasticities that measure the impact of the gap between the logs of regional and national unemployment and real wage rates.

4. Calibration

The model calibration process assumes the economy to be initially in steady state equilibrium. The parameters of the models are obtained from the SAM by means of the usual calibration method. Since, in a deterministic approach, some of the parameters remain unspecified, we need to find them from outside the model, so the elasticities of substitution and other behavioural parameters are based on econometric estimation or best guesses. For all sectors, trade elasticities are set equal to 2 whilst production elasticities are equal to 0.3. The wage curve elasticity is set to -0.033, following to a recent econometric estimation reported in Devicienti et al. (2008), whilst in the migration function ν^u and ν^w are set equal to -0.08 and 0.06, respectively[7]. These elasticities are commonly used in AMOS and econometrically estimated by Layard *et al*. (1991).

[7] We are using parameters estimated on UK data. However this can be a good approximation for European countries. For example, the values of these parameters are almost double for the US economy (see Treyz *et al*. 1993).

The values of adjustment cost parameters[8] α and β in equations (A.46-9) are assigned values 0 and 1.5, respectively. The World interest rate is set to 0.04, the rate of depreciation to 0.07 and the inter-temporal elasticity of substitution is equal to 1.5. Given the value of total investment, *J*, as supplied by the System of National Accounts (ISTAT, 2005) through the capital matrix[9], $KM_{i,\,j}$, the equality condition with total investment by origin in the SAM holds true. The price of capital goods, *Pk*, is set equal to unity since the benchmark prices on the consumption side are set equal to one. *W* corresponds to the discounted flow of current income, *NFW* to the discounted flow of net labour income, and *FW* is obtained by maintaining asset equilibrium. By imposing equality[10] between the rate of return to capital *rk* and the user cost of capital[11], *uck*, from the constraint equations (A.28), A(.40), (A.45-49), (A59) and (A.62-67), we obtain consistent values for the variables *I*, *K*, λ , *W*, *NFW* and *FW*.

The model is solved by applying the usual procedure in solving an infinite time horizon model, by imposing steady state conditions at a specific point in time. In the first periods we impose factor constraints in order to identify short-run impact; however the transitional pathway is the result of the discrete time solution of the model[12].

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[8] In many applications the parameter α is set to zero. The value of β is set to 0.9 in Dissou (2002) in a model of Senegal and in Go (1994) and Devarajan and Go (1998) in their model of Philippine is set at 2.

[9] For detail about the construction of the Sardinian capital matrix, see Garau and Lecca (2008).

[10] The equality between *rk* and *uck* is necessary since we are proposing the same calibration method for the myopic and the intertemporal model.

[11] Given that the interest rate and the depreciation rate are fixed, the user cost of capital depends on the variation of the capital good price, *Pk*.

[12] The model is run simultaneously for 100 periods. Since we impose capacity constraints in the short-run and labour supply adjustment through migration with analysis of different wage setting, it may take longer for a steady state to be reached compare to conventional intertemporal CGE model that usually apply a vertical labour supply closure where wages are totally flexible and labour supply fixed.

The myopic model developed here, and which is compared with the intertemporal model, is not obtained recursively, rather the equations of the model are solved simultaneously for a given finite time horizon. Since the myopic model does not incorporate jumping variables the results correspond, of course, to those of the recursive one. In addition, the model incorporates an adjustment cost function through which investment is determined independently of savings. The adjustment rule introduced in the myopic model follows that employed in AMOS (McGregor et al., 1996) which is consistent with the neoclassical formulation developed in Jorgenson (1963) and Eisner-Stroz (1963); the optimal path of investment is derived through the accelerator mechanism v:

$$I = v\,[K^{*} - K]$$

where K^{*} is the desired level of capital. This is wholly compatible with the Uzawa formulation of adjustment cost where the investment capital ratio (φ) is determined by the rate of return to capital (*rk*) and the user cost of capital (*uck*), allowing the capital stock to reach its desire level in a smooth fashion over time:

$$\varphi = \varphi(rk, uck)$$

$$\frac{\partial \varphi}{\partial rk} > 0; \ \frac{\partial \varphi}{\partial uck} < 0$$

Although Uzawa's formulation and Tobin's q theory are formally different, they are in essence "equivalent," as noted in Hayashi[13] (1982).

[13] This equivalence allows Hayashy to integrate the two theories deriving a rate of investment function of q.

The myopic model can also be run for two static conceptual time closures: the Short-Run (SR) and the Long-Run (LR). In the SR, capital and labour supplies are fixed at their base year values and the initial distribution across sectors is also maintained; in the LR, factor constraints are relaxed allowing for complete capital and labour adjustment. Capital stock is at its optimum level, with rental rates equal to user cost of capital. With regard to labour supply, the population is fully adjusted so that the system exhibits zero net migration. We also allow for perfect mobility across sectors. This kind of adjustment is quite similar to those reported in AMOS, a CGE for Scotland (McGregor et al., 1996).

5. Simulation strategy

We present several simulations in order to compare different forward-looking model specifications (which are declared by an FL prefix). Comparisons between forward-looking and myopic models (MYP prefix) are also carried out. In all simulations the disturbance takes the form of a 10% increase in interregional exports. We prefer a simple demand shock since this simplifies the analysis (and we do not focus here directly on policy issues), but its aim is to highlight the main differences that may arise by changing the dynamic structure of the model and some household closure rules.

We present the proportionate changes from base year values for a set of key economic variables in Tables 2 and 3 for the intertemporal and myopic models, respectively. In the tables, only the short-run and long-run results are reported, along with outcomes related to the three labour market regimes: Regional Bargaining (RB), National Bargaining (NB) and Fixed Real Wage (FRW). We distinguish between models with fixed saving rate (FL1 and MYP1) and models where the saving rate is endogenous (FL2 and MYP2). The first case correspond sto the model that closer to a regional economic system, while the second specification should be instead apply only in the national context. The main difference between the regional forward looking model (FL1) and its myopic counterpart (MYP1), and the forward looking (FL2) and myopic (MYP2) models run with national closure is in the financial adjustment process and its implication for the balance of payments.

In FL1, we try to design a hypothetical stylized regional intertemporal model where household saving decisions do not involve any financial adjustment process. We are aware that this may change the nature of the intertemporal model. However, as we have explained above, in a regional economic framework it does not seems appropriate to incorporate household saving decisions in the manner usually applied in intertemporal models, as in equation (5).

The outcomes obtained can also be replicated by running the model as a centralized solution by exploiting Abel's and Blanchard's equivalence (Abel and Blanchard, 1983). Such a solution has also been used in Go (1994) to remove the household budget constraint. As a result, this reduces the dimensions of the problem. Go (1994) thus closes the model by imposing equality between total savings and investment through adjustment in the level of foreign borrowing.

However, this is not the method we use. We may exploit Abel's and Blanchard's (1983) equivalence to delete the motion equation of the state variable W and re-solve the problem as a centralized economy as in Go (1994), but without imposing financial sector equilibrium. This is consistent with a regional macroeconomic framework in which the constant savings rate (Solow-Swan assumption) does not involve an adjustment of the private sector financial balance, as seen above. That is, regional private assets, Government and foreign borrowing do not take part in determining the consumer's intertemporal decisions (compared with e.g. Devarajan and Go, 1998, Go, 1994 and Dissou, 2002).

Such a specification does not prevent the consumer from behaving with perfect foresight. Indeed, consumers still take decisions on the basis of future wealth, preserving the condition of instability between current consumption and wealth during the transitional pathway. Of course, in the long-run, the trasversality condition is satisfied and stability restored.

MYP1 represents the traditional myopic regional model. This model, as noted above, is quite similar to the type of adjustment present in AMOS (McGregor et al. 1996). Household savings are a fixed proportion of income and consumption is obtained from a simple budget constraint equation.

The national configuration of the model is represented in FL2, where households are responsible for all of the financial needs of the regional system, so their financial wealth is related to outstanding foreign debt, the value of firms and Government debt. We are assuming that the Government is financing the debt by issuing bonds that are borne exclusively by households. In this case, the imposition of sectoral financial equilibrium is equivalent to the imposition of a balance of payments constraint which requires saving to adjust in order to satisfy the intertemporal payment constraint.

In order to make a comparison with a myopic formulation, in MYP2 not only the balance of payment holds, moreover we attempt to emulate the same financial adjustment that would occur in FL2. In doing so the household budget constraint equation and the financial balance equilibrium are included in the myopic model.

All models are run in order to generate an endogenous updating of the working population through migration (see equation 9). Indeed, imperfect labour markets and labour supply adjustment obtained through the introduction of quantity signals (given by the unemployment rate), and migration, are key factors in regional economic models. Such elements make regional models different to their national counterparts where the wage is often fully flexible and labour supply is exogenous.

6. Simulation results

6.1. The long run impact: myopic vs. forward looking.

From Tables 2 and 3 we immediately note that, in the long run, for all closures and in all cases we obtain Leontief-type results (see McGregor et al., 1996), characterized by changes in quantities but no change in prices. This reflects the complete adjustment of all factors of production. Indeed, both capital and labour endogenously adjust over time. Capital stock increases with investment which, in turn, is affected by its real shadow price. As aggregate demand rises, prices increase and so do firms' profit expectations. This leads to an increase in investment that is moderated by the replacement cost of capital reflected in the real shadow price. In-migration increases in response to a rise in real wages and falling unemployment until, in the long run, the labour market is cleared and all the increase in employment is covered by the increase in working population. In turn, the growth in labour supply puts downward pressure on wages until the labour market is in long-run equilibrium, in which the real wage is restored to its original level and goods' prices adjust fully.

From the tables we can also see that there are no differences in the long-run impact between myopic and forward-looking models (LR: FL1≡MYP1 and FL2≡MYP2). This equivalence arises because, in the myopic model, consumption is passive and results from the budget constraint. Its long-run value should equal that obtained in forward-looking models given that the transversality condition is satisfied, consequently eliminating divergences between current income and current consumption. On the investment side of the forward-looking model, the accumulation rate adjusts fully as Tobin's q equalizes. Such a situation corresponds, in the myopic formulation, to a zero gap between desired and actual level of capital (if we adopt a Jorgenson-type adjustment) or that the change in the rate of return to capital equals that of the user cost of capital (if Uzawa-type adjustment is applied).

6.2. *Fixed saving rate***.**

We begin by analysing simulation results from the regional forward looking model. As we are analysing models that embody three distinct labour market closures, the main differences between these models are driven by wage dynamics. However, wage behaviour affects results only in the short run and the transitional path since in the long run labour supply adjustment allows the economy to reach Leontief-type results. Under regional bargaining and in the first period, which corresponds to the short-run solution, the demand stimulus increases labour demand which reduces the unemployment rate by 1.34% increasing, as a consequence, the bargaining power of workers and so the real wage (0.05%). For the national bargaining case, the real wage is below its initial equilibrium (-0.91%). As workers cannot bargain wages within the region, the increase in aggregate demand raises prices, thereby lowering the purchasing power of wages. In the fixed real wage scenario, the increase in the consumer price index increases the nominal wage by the same amount (1.11%).

Given that in national bargaining (NB), workers cannot bargain for higher real wages, the rise in employment and the reduction in the unemployment rate occur more rapidly than for the regional bargaining and fixed real wage cases. Furthermore, as the price of goods adjusts according to the wage dynamic by making the supply smoothly responsive, the analysis of the transitional path suggests that the capacity to reach the new steady state faster will depend on the speed of price adjustment. In national bargaining, prices adjust faster than the other two labour market closures because nominal wages are fixed, implying less resistance to reaching their long-run equilibrium, as we can see from Figures 2 and 3. Note that the fall in the real wage in the short-run under national bargaining has stimulating effects on the economy. In particular, this stimulates investment, so the economy adjusts more quickly under this labour market closure.

In the short-run, the increase in interregional exports is not enough to cover the rise in total imports. The total trade deficit increases and for all labour market closures the ROI trade deficit improves while the ROW deficit gets worse. This is happening as the exogenous increase in interregional exports raises competitiveness with respect to the Rest of Italy, but the augmented aggregate demand generates an increase in production that needs to be satisfied by increasing the demand for import goods. This is driven also by the increase in regional prices. The result is a substitution effect which lowers ROW exports and raises ROW imports.

In the long-run, as prices adjust back to their benchmark values, the terms of trade effect is nullified, generating a full (10%) adjustment in interregional exports and zero change in international exports. So, as imports are increasing to satisfy production needs, the international current account get worse, although generating a total positive effect (current account ROI+ROW, -3.14%) given that part of the interregional current account improves by 17.87%.

In the first period, household consumption increases only for the case of national bargaining (0.10%). For regional bargaining and fixed real wage closures the proportionate change is negative. This is the distinctive impact we would expect in an intertemporal model that incorporates permanent income type behaviour; it implies that when households make decisions on current consumption, they take into consideration their future earnings, thus creating instability between current income and current consumption. Such instability disappears in the long-run where the change in consumption equals the positive variation in total wealth (1.48%).

Change in the real shadow price drives the impact on investment which rises in the short-run, settling in the long-run at a level of 2.03% higher than the initial steady state. The reason is that the increase in exports affects domestic goods prices, raising profit expectations for firms in every sector. Indeed, in the first period we see that the change in the shadow price of capital is greater than the change in the capital goods price. Furthermore, change in investment is greater in national bargaining than in the other labour market closures (*J*: NB>FRW>RB). The reason can be identified in the variation of the replacement cost of capital which is higher in regional bargaining (1.08%) and lower in national bargaining (0.86%). The national bargaining case is less sensitive to factor constraints because workers do not have the power to re-establish their purchasing power (the real wage falls by 0.91%) under centralized wage bargaining, leading to less upward pressure on the prices of consumption goods.

With regard to sectoral impacts, all three sectors receive permanent benefits. Breaking down the commodity composition of total exports, although the primary sector makes up the smallest share of total exports, it seems to be the sector that has the largest proportionate gains in terms of real output and investment, both in the short-run and in the long-run. Since the policy analysed here is a simple demand side shock, the initial steady state coefficients matter for the long-run outcome. In fact, exports represent 28% of primary sector output compared to 12% in Manufacturing and 2% in Services.

By comparing the results with the myopic case we see that, as expected, they exhibit the same long-run equilibrium[14]. Furthermore, if we look at the GRP charts in Figure 4, we can see that the adjustment paths are very similar. Indeed, in both models investment is responsive to the rate of return to capital and its increase is tempered by adjustment costs. Usually, the intertemporal model is compared to the myopic model in which investment is passive and roughly determined by available savings expressed as a fixed share of income. Here instead, the behaviour of investment is quite similar in both the myopic and the forward-looking models. Furthermore, saving rate is fixed in both intertemporal and myopic cases.

However, the transitional pathway towards the long-run may differ since, in the myopic model, agents' expectations are based on the past, whilst in the forward-looking model both consumption and the shadow price of capital depend on future conditions. In Figure 4, it can

[14] These results seem in contrast with Devarajan and Go (1998) where the static and the intertemporal model produce different results.

be seen that only for the cases of regional bargaining and fixed real wage does the forward looking model achieve the steady state equilibrium faster than its myopic counterpart.

In Figure 5 we present the adjustment paths of those variables subject to forward-looking behaviour, namely consumption and investment. In the regional bargaining case, only after the 30th period does consumption in the intertemporal model exceed that in the myopic model. For investment, the forward looking model adjusts more rapidly than its myopic counterpart.

These results, however, are strongly conditioned by the parameters of the models. In the myopic model, the adjustment parameter (which is applied to the gap between actual and desired level of capital stock) in the investment function, set to 0.5, is the major driver of the speed of adjustment; in the forward-looking model the speed of adjustment is particularly sensitive to the intertemporal elasticity of substitution, here equal to 1.5, that generates consumer preferences between periods. As we shall see in 6.4, it is not necessarily the case that the model with perfect foresight reaches long-run equilibrium faster than its myopic couterpart.

6.3. *Endogenous saving rate*.

When the saving rate is endogenous we are to some extent introducing an intertemporal constraint that leads to payments equilibrium through sectoral financial flows, and in turn, imposes a balance of payments adjustment constraint according to which savings depends on domestic and foreign financial assets. According to our experiment this has the effect of inverting the behaviour of saving in the short-run and raising the long-run impact of an increase in exports.

We do not find much difference with respect to the regional model configuration as far as the direction of the effect is concerned. This is true even for price adjustment, which seems quite similar to the FL1 scenario, as does the impact of different labour market closures. The price of domestic goods drives up the increase in the consumption price and the capital goods price. Price adjustments seem more affected by the wage dynamic, as in the previous case, than by the balance of payments equilibrium constraint.

In the short-run, for all labour market regimes, the rate of saving falls due to the rise in the trade and Government deficits. In fact, although investment is increasing this is unable to counterbalance the negative impact on internal and external balance. So, the intertemporal constraint makes households' decisions part of the regional financial mechanism, though this does not seem realistic where regions do not possess fiscal autonomy.

Table 2 indicates that, in the long-run, there is a bigger impact on real variables in the national than the regional configuration. Gross Regional Product is above its benchmark equilibrium by 2.06% in FL2 and 1.91% in FL1. Such differences are driven by consumption which is greater in FL2 (1.85%) than FL1 (1.48%). So the long-run difference between the two models is due substantially to consumption, which in turn is affected by total wealth.

Wealth increases more in FL2 than in FL1. Wealth, in fact, is composed of NFW and FW. NFW is determined in the same way in both models but FW is the result of different specifications. In the national configuration, the increase in assets also raises total wealth, and consumption is positively affected. Consequently, household financial wealth increases as the value of the firm is above its benchmark equilibrium (1.97%), and the decrease in

Government debt (-1.54%) is not able to offset the fall in foreign debt (-2.77%). The change in total assets is positive (see Fig. 6a). This will affect consumption since, in the long-run, the instability between current wealth and consumption disappears.

Surprisingly, the same type of adjustment is also obtained in the myopic counterpart of FL2. First, in the short-run, the rate of saving falls for the reason explained above and furthermore the long-run impact coincides with the forward looking model.

From Figure 6, we see that in both models, savings fall in the initial periods and then rise. Financial Wealth rises immediately in the first period and then decreases (maintaining positive change) because foreign debt rises. As soon as the change in foreign debt became negative, the financial wealth curve rises gently tempered by the fall in Government assets held by households.

This path analysis confirms that little differences in adjustment and impact exist between myopic and forward-looking models[15]. Previous literature has emphasised the incapacity of the myopic model to produce results that are consistent with rational behaviour (under perfect foresight). In these experiments instead we demonstrate that both models may reproduce similar behaviour for the main macroeconomic variables provided effort considerable effort is devoted to ensure that both models are otherwise comparable in structure.

6.4. *Sensitivity analysis***.**

As we have seen above, the only difference between myopic and forward-looking models is in the transitional pathway towards a new steady state. In particular, due to the characteristics of both models, two parameters are able to govern and alter the speed of adjustment: the myopic

[15] We should say, however, that with supply-side shocks the adjustment path between myopic and forward looking can be dramatically different. Though, the long-run impact is the same.

model is highly sensitive to the parameter, v, in the investment equation, whilst the inverse of the constant elasticity of marginal utility, $1/\sigma$, is the parameter that more than any other alters the rate at which the new steady state equilibrium is reached in the forward-looking model.

In Figure 7 and 8 we show the differences of changing the parameters v and σ in the myopic and forward looking models, respectively. As in the preceding simulations, we increase interregional exports by 10%. Increasing v the curve of the proportionate change in the accumulation rate tends to approach the stable point (zero change) rapidly. Given that capital stock accumulates over time due to past net investment, a positive shock produces a growth of GRP generating a large gap between desired and actual K. This causes current net investment to rise. This rise in investment will increase with the parameter v, thereby increasing the speed of adjustment of the accumulation rate.

In Figure 8, we report the percentage change of consumption obtained by changing the value of σ. Given an intertemporally additive utility function, the Euler equation for expected utility maximization under rational expectations implies that, by increasing the value of the marginal utility of consumption and keeping fixed the *sacrifice* of not consuming (the interest rate), the cost of reallocating consumption between the present and the future will decrease. So changing σ, we modify the cost of reallocating consumption between periods that, according to the figures, imply that, for a positive shock, consumption will reach the new steady state faster when σ is high or its inverse $(1/\sigma)$ is low. When σ is equal to 0.5 and 0.4, consumption in the initial periods falls due to the fact that households prefer to save in these periods and allocate more consumption to future periods.

7. Conclusions

Since regional CGE models are often based on a recursive dynamic structure, the lack of forward-looking expectations has been stressed as an important drawback of such models (Partridge and Rickman, 1998; 2011). The focus of this paper is to produce a simple stylized forward-looking model applicable in a regional context, given that the application of the usual mechanism and closures applied in national intertemporal CGE models would misrepresent the adjustment mechanisms that are likely to occur in a region.

The main conclusion is that conventional intertemporal consumer optimization, based on neoclassical or Fisherian analysis of intertemporal resource allocation, seems to be inappropriate from a regional point of view. The consumer intertemporal maximization process not only yields the time path of consumption, but also the time path of savings which became a function of total financial assets. Thus, not only is the instability between current income and current consumption, related to the permanent income hypothesis approach, relevant here, but more emphasis is put on the dynamic path of savings where households are liable for all the financial needs of the region. In turn, this implies an imposed balance of payments adjustment mechanism. Furthermore, we question the plausibility, from a regional point of view, of the imposition of an intertemporal budget constraint where internal and external debts are made repayable from the private sector. No internal and external debt sustainability problems occur in a region. Deficit in the current account cannot be seen as hypothetical surplus in later periods making external debt repayable because there is no requirement to do so, and foreign debt, especially for declining regions, is the result of capital subvention supplied by supra-regional institutions, such as a national Government or the European Union. Regional public deficits are not a problem at all, given only that the national government remains committed to the maintenance of the Union. It would, therefore, be a mistake to allow consumers to take the public deficit into account in their intertemporal optimization problem, as no taxes will be imposed to cover it and no change in consumption plans is required. As we noted above, regional policy is an exogenous variable for regions so no Ricardian equivalence of regional fiscal deficits applies.

We have also argued that some of the objections to myopic models, such as the presumed lack of capital adjustment in the myopic model and differences in long-run steady state results between myopic and forward-looking models, cannot be correct. In some articles, forward-looking models are compared with myopic specifications that preclude any adjustment in investment and consumption. The usual assumptions are passive investment (or investment held constant to the base year in real terms) and consumption simply obtained as a fixed share of current income. In this paper, myopic and forward-looking models that are genuinely comparable generate the same results in the long-run. The only difference, though of course it may be a significant one, is in the transitional pathway where consumption and investment might diverge: perfect foresight agents have rational expectations whilst myopic foresight agents take decisions according to adaptive expectations and so make no intertemporal preferences between periods on future profits and incomes. Furthermore, from the sensitivity analysis we show that the transitional path may be affected by the two types of adjustment parameters: the speed of adjustment parameter in the myopic model and the intertemporal elasticity of substitution in the forward-looking model. In the myopic model we have an adjustment equation in investment while in the forward looking model we have two equations which influence adjustment speed, one in investment and the other in consumption. The latter can be interpreted in fact as a flexible accelerator mechanism (like for investment) where the parameter that governs intertemporal preferences, $1/\sigma$, can also be seen as an adjustment parameter. This is the main structural difference between the myopic and forward looking models presented in this paper.

It is crucial to appreciate that, independently of the dynamic structure of the model, in the long-run we obtain identical results for forward-looking and myopic models. This outcome is much more intuitive than the results obtained in some past studies where the two models' results differed even in the long-run. Such differences have been attributed to the inability of the myopic model to produce outcomes consistent with fully rational behaviour due to the lack of perfect foresight. However, we have shown that comparable regional myopic and forward-looking CGE models produce equivalent results in the long-run and that the differences encountered in the past should be attributed to fundamental differences in model structure, specifically to differences in macroeconomic adjustment processes.

APPENDIX A

The mathematical presentation of the model

Prices

$$PM_{i,t} = \varepsilon_t \cdot PWM_i \cdot (1 + MTAX_i) \qquad \textbf{(A.1)}$$

$$PE_{i,t} = \varepsilon_t \cdot PWE_i \cdot (1 - TE_i) \qquad \textbf{(A.2)}$$

$$PX_{i,t} = \frac{PR_{i,t} \cdot R_{i,t} + PE_{i,t} \cdot E_{i,t}}{R_{i,t} + E_{i,t}} \qquad \textbf{(A.3)}$$

$$PQ_{i,t} = \frac{PR_{i,t} \cdot R_{i,t} + PM_{i,t} \cdot M_{i,t}}{R_{i,t} + M_{i,t}} \qquad \textbf{(A.4)}$$

$$PIR_{j,t} = \frac{\sum_i VR_{i,j,t} \cdot PR_{j,t} + \sum_i VI_{i,j,t} \cdot \overline{PI}_j}{\sum_i VIR_{i,j,t}} \qquad \textbf{(A.5)}$$

$$PY_{j,t} \cdot a_j^Y = \left(PX_{j,t} \cdot \left(1 - btax_j - sub_j - dep_j\right) - \sum_i a_{i,j}^V PQ_{j,t} \right) \qquad \textbf{(A.6)}$$

$$UCK_t = Pk_t \cdot (ir + \delta) \qquad \textbf{(A.7)}$$

$$PC_t^{1-\sigma^c} = \sum_j \sum_h \delta_{j,h}^f \cdot PQ_{j,t}^{1-\sigma^c} \qquad \textbf{(A.8)}$$

$$Pgov_t^{1-\sigma^g} = \sum_j \delta_j^g \cdot PQ_{j,t}^{1-\sigma^g} \qquad \textbf{(A.9)}$$

$$w_t^b = \frac{w_t}{(1 + sscee + sscer) \cdot (1 + ire)} \qquad \textbf{(A.10)}$$

$$\text{Wage setting} \begin{cases} ln\left[\dfrac{w_t}{cpi_t}\right] = \beta - \varepsilon \ln(u_t) & \text{(Regional Bargaining)} \\ \dfrac{w_t}{cpi_t} = \dfrac{w_{t=0}}{cpi_{t=0}} & \text{(Fixed Real Wage)} \\ w_t = w_{t=0} & \text{(National Bargaining)} \end{cases} \qquad \textbf{(A.11)}$$

$$rk_{j,t} = PY_{j,t} \cdot \delta_j^k \cdot A(\xi_{j,t})^{\varrho_j} \cdot \left(\frac{Y_{j,t}}{K_{j,t}}\right)^{1-\varrho_j} \tag{A.12}$$

$$Pk_t = \frac{\sum_j PQ_{j,t} \cdot \sum_i KM_{i,j}}{\sum_i \sum_j KM_{i,j}} \tag{A.13}$$

Production technology

$$X_{i,t} = min\left(\frac{Y_{i,t}}{a_i^Y}; \frac{V_{i,j,t}}{a_{i,j}^V}\right) \tag{A.14}$$

$$Y_{i,t} = a_i^Y \cdot X_{i,t} \tag{A.15}$$

$$V_{i,t} = a_{i,j}^V \cdot X_{i,t} \tag{A.16}$$

$$Y_{i,t} = A(\xi_{i,t}) \cdot \left[\delta_i^k \cdot K_{i,t}^{\rho_i} + \delta_i^l \cdot L_{i,t}^{\rho_i}\right]^{\frac{1}{\varrho_i}} \tag{A.17}$$

$$L_{j,t} = \left(A(\xi_{j,t})^{\rho_i} \cdot \delta_j^l \cdot \frac{PY_{j,t}}{w_t}\right)^{\frac{1}{1-\rho_j}} \cdot Y_{j,t} \tag{A.18}$$

Trade

$$VV_{i,j,t} = \gamma_{i,j}^{vv} \cdot \left[\delta_{i,j}^{vm} VM_{i,t}^{\rho_i^A} + \delta_{i,j}^{vir} VIR_{i,t}^{\rho_i^A}\right]^{\frac{1}{\rho_i^A}} \tag{A.19}$$

$$\frac{VM_{i,j,t}}{VIR_{i,j,t}} = \left[\left(\frac{\delta_{i,j}^{vm}}{\delta_{i,j}^{vir}}\right) \cdot \left(\frac{PIR_{i,t}}{PM_{i,t}}\right)\right]^{\frac{1}{1-\rho_i^A}} \tag{A.20}$$

$$VIR_{i,j,t} = \gamma_{i,j}^{vir} \cdot \left[\delta_{i,j}^{vi} VI_{i,t}^{\rho_i^A} + \delta_{i,j}^{vr} VR_{i,t}^{\rho_i^A}\right]^{\frac{1}{\rho_i^A}} \tag{A.21}$$

$$\frac{VR_{i,j,t}}{VI_{i,j,t}} = \left[\left(\frac{\delta_{i,j}^{vr}}{\delta_{i,j}^{vi}}\right) \cdot \left(\frac{PI_{i,t}}{PR_{i,t}}\right)\right]^{\frac{1}{1-\rho_i^A}} \tag{A.22}$$

$$E_{i,t} = \bar{E}_i \cdot \left(\frac{PE_{i,t}}{PR_{i,t}}\right)^{\sigma_i^x} \tag{A.23}$$

Regional Demand

$$R_{i,t} = \sum_j VR_{i,j,t} + \sum_h QHR_{i,h,t} + QVR_{i,t} + QGR_{i,t} + QHK_{i,t} \tag{A.24}$$

Total Production

$$X_{i,t} = R_{i,t} + E_{i,t} \tag{A.25}$$

Households and other Domestic Institutions

$$\sum_{t=0}^{\infty} (1+\rho)^{-t} \frac{C_t^{1-\sigma} - 1}{1-\sigma} \tag{A.26}$$

$$\frac{C_t}{C_{t+1}} = \left[\frac{PC_t \cdot (1+\rho)}{PC_{t+1} \cdot (1+r)}\right]^{-\left(\frac{1}{\sigma}\right)} \tag{A.27}$$

$$W_t = NFW_t + FW_t \tag{A.28}$$

$$\begin{aligned} NFW_t(1+r_t) = NFW_{t+1} &+ \sum_h dtr_h \cdot (ssce + ire) \cdot \sum_j L_{j,t} \cdot w_t \\ &+ \sum_h \sum_{dnginsp} TRSF_{h,dnginsp,t} + \sum_h TRG_h \cdot PC_t + \sum_h REM_h \cdot \varepsilon_t \\ &- \sum_{dnginsp} \sum_h TRSF_{dnginsp,h,t} \end{aligned} \tag{A.29}$$

$$FW_t(1+r_t) = FW_{t+1} + d_{dngins}^K \cdot rk_{i,t} \cdot \sum_i K_i - \sum_h SAV_h \tag{A.30}$$

$$\begin{aligned} YNG_{dngins,t} = d_{dngins}^L \cdot w_t \cdot \sum_i L_i + d_{dngins}^K \cdot rk_{i,t} \cdot \sum_i K_i + d_{dngins}^h \cdot rh_{i,t} \sum_i H_i \\ + \sum_{dnginsp} TRSF_{dngins,dnginsp,t} + PC_t \cdot TRG_{dngins} + \varepsilon_t \cdot REM_{dngins} \end{aligned} \tag{A.31}$$

$$TRSF_{dngins,dnginsp,t} = PC_t \cdot \overline{TRSF}_{dngins,dnginsp} \tag{A.32}$$

$$SAV_{dngins,t} = mps_{dngins} \cdot YNG_{dngins,t} \tag{A.33}$$

$$QH_{i,h,t} = \delta_{i,h}^{f\ \rho_i^c} \cdot \left(\frac{PC_{i,t}}{PQ_{i,t}}\right)^{\rho_i^c} \cdot C_t \tag{A.34}$$

$$QH_{i,h,t} = \gamma_{i,h}^f \cdot \left[\delta_{i,h}^{hr} \cdot QHR_{i,h,t}^{\rho_i^A} + \delta_{i,h}^{hm} \cdot QHM_{i,h,t}^{\rho_i^A}\right]^{\frac{1}{\rho_i^A}} \tag{A.35}$$

$$\frac{QHR_{i,h,t}}{QHM_{i,h,t}} = \left[\left(\frac{\delta_{i,h}^{hr}}{\delta_{i,h}^{hm}}\right) \cdot \left(\frac{PM_{i,t}}{PR_{i,t}}\right)\right]^{\frac{1}{1-\rho_i^A}} \tag{A.36}$$

Government

$$FD_t = \sum_i QG_{i,t} \cdot PQ_{i,t} + \overline{GSAV} + \sum_{dngins} TRG_{dngins,t} \cdot PC_t$$
$$- \left(d_g^k \cdot \sum_i rk_{i,t} \cdot K_{i,t} + d_g^h \cdot \sum_i rh_{i,t} \cdot H_{i,t} + \sum_i IMT_{i,t} + \sum_h dtr_h \cdot (ssce + ire) \right. \quad \textbf{(A.37)}$$
$$\left. \cdot \sum_j L_{j,t} \cdot w_t \quad + \overline{FE} \cdot \varepsilon_t \right)$$

$$QG_{i,t} = \gamma_i^g \cdot \left[\delta_i^{gr} \cdot QGR_{i,t}^{\rho_i^A} + \delta_i^{gm} \cdot QGM_{i,t}^{\rho_i^A} \right]^{\frac{1}{\rho_i^A}} \quad \textbf{(A.38)}$$

$$\frac{QGR_{i,t}}{QGM_{i,t}} = \left[\left(\frac{\delta_i^{gr}}{\delta_i^{gm}} \right) \cdot \left(\frac{PM_{i,t}}{PR_{i,t}} \right) \right]^{\frac{1}{1-\rho_i^A}} \quad \textbf{(A.39)}$$

Investment Demand

$$QV_{i,t} = \sum_j KM_{i,j} \cdot J_{j,t} \quad \textbf{(A.40)}$$

$$QV_{i,t} = \gamma_i^v \cdot \left[\delta_i^{qvm} \cdot QVM_{i,t}^{\rho_i^A} + \delta_i^{qvir} \cdot QVIR_{i,t}^{\rho_i^A} \right]^{\frac{1}{\rho_i^A}} \quad \textbf{(A.41)}$$

$$\frac{QVM_{i,t}}{QVIR_{i,t}} = \left[\left(\frac{\delta_i^{qvm}}{\delta_i^{qvir}} \right) \cdot \left(\frac{PIR_{i,t}}{PM_{i,t}} \right) \right]^{\frac{1}{1-\rho_i^A}} \quad \textbf{(A.42)}$$

$$QVIR_{i,t} = \gamma_i^{vir} \cdot \left[\delta_i^{qvi} \cdot QVI_{i,t}^{\rho_i^A} + \delta_i^{qvr} \cdot QVR_{i,t}^{\rho_i^A} \right]^{\frac{1}{\rho_i^A}} \quad \textbf{(A.43)}$$

$$\frac{QVR_{i,t}}{QVI_{i,t}} = \left[\left(\frac{\delta_i^{qvr}}{\delta_i^{qvi}} \right) \cdot \left(\frac{PI_{i,t}}{PR_{i,t}} \right) \right]^{\frac{1}{1-\rho_i^A}} \quad \textbf{(A.44)}$$

Time path of investment

$$J_{i,t} = I_{i,t} \left(1 - bb - tk + \frac{\beta}{2} \frac{\left(\frac{I_{i,t}}{K_{i,t}} - \alpha \right)^2}{\frac{I_{i,t}}{K_{i,t}}} \right) \quad \textbf{(A.45)}$$

$$\frac{I_t}{K_t} = \alpha + \frac{1}{\beta} \cdot \left[\frac{\lambda_{i,t}}{Pk_t} - (1 - bb - tk) \right] \quad \textbf{(A.46)}$$

$$\dot{\lambda}_{i,t} = \lambda_{i,t}(r_t + \delta) - R_{i,t}^k \tag{A.47}$$

$$\theta(x_t) = \frac{\beta}{2}\frac{(x_t - \alpha)^2}{x_t}; \text{ and } x_t = \frac{I_t}{K_t} \tag{A.48}$$

$$R_{i,t}^k = rk_t - Pk_t\left[\frac{I_{i,t}}{K_{i,t}}\right]^2 \theta'_t(I/K) \tag{A.49}$$

Factors accumulation

$$KS_{i,t+1} = (1-\delta)\cdot KS_{i,t} + I_{i,t} \tag{A.50}$$

$$LS_{i,t+1} = \left(1 + \left(\varsigma - \nu^u[ln(u_t) - ln(\bar{u}^N)] + \nu^w\left[ln\left(\frac{w_t}{cpi_t}\right) - ln\left(\frac{w^N}{cpi^N}\right)\right]\right)\right)\cdot LS_{i,t} \tag{A.51}$$

$$K_{i,t} = KS_{i,t} \tag{A.52}$$

$$LS_t\cdot(1-u_t) = \sum_j L_{j,t} \tag{A.53}$$

Indirect taxes and subsidies

$$IBT_{i,t} = btax_i\cdot X_{i,t}\cdot PX_{i,t} \tag{A.54}$$

$$IMT_{j,t} = \sum_i MTAX_j\cdot VM_{i,j,t}\cdot PM_{i,t} \tag{A.55}$$

$$SUBSY_{i,t} = SUB_i\cdot X_{i,t}\cdot PX_{i,t} \tag{A.56}$$

Total demand for import and current account

$$M_{i,t} = \sum_j VI_{i,j,t} + \sum_j VM_{i,j,t} + \sum_h QHM_{i,h,t} + QGM_{i,t} + QVI_{i,t} + QVM_{i,t} \tag{A.57}$$

$$TB_t = \sum_i M_{i,t}\cdot PM_{i,t} - \sum_i E_{i,t}\cdot PE_{i,t} + \varepsilon_t\cdot\left(\sum_{dngins}\overline{REM}_{dngins} + \overline{FE}\right) \tag{A.58}$$

Assets

$$VF_{i,t} = \lambda_{i,t} \cdot K_{i,t} \tag{A.59}$$

$$D_{t+1} = (1 + r - \tau) \cdot D_t + TB_t \tag{A.60}$$

$$Pgov_{t+1} \cdot GD_{t+1} = \left[1 + r - \tau g + \left(\frac{Pc_{t+1}}{Pc_t} - 1\right)\right] \cdot GD_t \cdot Pgov_t + FD_t \tag{A.61}$$

Steady State conditions

$$KS_{i,T}\delta = I_{i,T} \tag{A.62}$$

$$R_{i,T}^k = \lambda_{i,T}(r_T + \delta) \tag{A.63}$$

$$FD_T = -\left[r - \tau g + \left(\frac{Pc_{t+1}}{Pc_t} - 1\right)\right] \cdot Pgov_T \cdot GD_T \tag{A.64}$$

$$TB_T = -(r - \tau) \cdot D_T \tag{A.65}$$

$$\begin{aligned} NFW_T \cdot r_T = {} & \sum_h dtr_h \cdot (ssce + ire) \cdot \sum_j L_{j,T} \cdot w_T + \sum_h \sum_{dnginsp} TRSF_{h,dnginsp,T} + \sum_h TRG_h \cdot PC_T \\ & + \sum_h REM_h \cdot \varepsilon_T - \sum_{dnginsp} \sum_h TRSF_{dnginsp,h,T} \end{aligned} \tag{A.66}$$

$$FW_t \cdot r_T = d_{dngins}^K \cdot rk_{i,t} \cdot \sum_i K_i - \sum_h SAV_{h,T} \tag{A.67}$$

In order to produce short-run results, we have that

$$KS_{i,t=1} = KS_{i,t=0} \tag{A.68}$$

$$LS_{=1} = LS_{t=0} \tag{A.69}$$

$$GD_{t=1} = GD_{t=0} \tag{A.70}$$

$$D_{t=1} = D_{t=0} \tag{A.71}$$

For FL2 equation (A.33) disappear if *dngins=h. We* also add:

$$FW_t(1+r_t) = FW_{t+1} + \Pi_t - \left(\sum_i J_{i,t} + FD_t - TB_t\right) \tag{A.72}$$

In order to run the myopic model from the consumption side, equations (A.26) and (A.27) are substitute with the following:

$$C_t = \sum_{dngins \in \langle H \rangle} YNG_{dngins,t} - \sum_{dngins \in \langle HH \rangle} SAV_{dngins,t} - HTAX_t - \sum_{dngins} \sum_h TRSF_{dngins,h,t} \tag{A.73}$$

To obtain the path of investment equations (A.46 – A.49) disappear and we introduce:

$$I_{i,t} = v \cdot \left[KS^*_{i,t} - KS_{i,t}\right] + \delta \quad \cdot KS_{i,t} \tag{A.74}$$

$$KS^*_{i,j} = \left(A\left(\xi_{j,t}\right)^{\rho_i} \cdot \delta^k_j \cdot \frac{PY_{j,t}}{uck_t}\right)^{\frac{1}{1-\rho_j}} \cdot Y_{j,t} \tag{A.75}$$

Alternatively we can use the following:

$$\frac{I_{i,t}}{KS_{i,t}} = \delta \quad \cdot \left[\frac{rk_{i,t}}{uck_t}\right]^v \tag{A.76}$$

Where v equal 0.5 in (A.75) and 2 in (A.76)

Glossary

i,j	the set of goods or industries
ins	the set of institutions
$dins$ ($\subset ins$)	the set of domestic institutions
$dngins$ ($\subset dins$)	the set of non-government institutions
h ($\subset dngins$)	the set of households

Prices

$PX_{i,t}$	output price
$PY_{i,t}$	value added price
$PR_{i,t}$	regional price
$PQ_{i,t}$	commodity price
$PIR_{i,t}$	national commodity price (regional + ROI)
$PI_{i,t}$	ROI price
$rk_{i,t}$	rate of return to capital
w_t	unified nominal wage
w_t^b	after tax wage
Pk_t	capital good price
UCK_t	user cost of capital
$\lambda_{i,t}$	shadow price of capital
PC_t	aggregate consumption price
$PGov_t$	aggregate price of Government consumption goods
ε_t	exchange rate [fixed]

Endogenous variables

$X_{i,t}$	total output
$R_{i,t}$	Regional supply
$M_{i,t}$	total import

$E_{i,t}$	total export (interregional + international)
$Y_{i,t}$	value added
$L_{i,t}$	labour demand
$K_{i,t}$	physical capital demand
$KS_{i,t}$	capital stock
$LS_{i,t}$	labour supply
$VV_{i,jt}$	Total intermediate inputs
$VR_{i,jt}$	regional intermediate inputs
$VM_{i,jt}$	ROW intermediate inputs
$VIR_{i,jt}$	national intermediate inputs (REG+ROI)
$VI_{i,jt}$	ROI intermediate inputs
$QGR_{i,t}$	regional government expenditure
$QGM_{i,t}$	government expenditure(ROI+ROW)
C_t	aggregated household consumption
$QH_{i,h,t}$	total households consumption in sector *i* for *h*
$QHR_{i,h,t}$	regional consumption in sector *i* for group *h*
$QHM_{i,h,t}$	import consumption in sector *i* for group *h*
$QV_{i,t}$	total investment by sector of origin *i*
$QVR_{i,t}$	regional investment by sector of origin *i*
$QVM_{i,t}$	ROW investment demand
$QVIR_{i,t}$	national investment (REG+ROI)
$QVI_{i,t}$	ROI investment demand
$I_{j,t}$	investment by sector of destination *j*
$J_{j,t}$	investment by destination *j* with adjustment cost
u_t	regional unemployment rate
$R^k_{i,t}$	marginal net revenue of capital
$SAV_{dngins,t}$	domestic non-government saving

$YNG_{dngins,t}$	domestic non-government income
$TRSF_{dngins,dnginsp,t}$	transfer among *dngins*
$HTAX_t$	total household tax
TB_t	current account balance
$SUBSY_t$	production subsidies

Exogenous variables

$\overline{REM}_t$	remittance for *dngins*
$\overline{FE}_t$	remittance for the Government
$QG_{i,t}$	government expenditure
$GSAV_t$	government saving
r_t	interest rate

Elasticities

σ	constant elasticity of marginal utility
ϱ_j	between labour and capital in sector *j*
ρ_i^A	in Armington function
σ_i^x	of export with respect to term of trade
μ	of real wage with respect to unemployment rate

Parameters

$a_{i,j}^V$	Input-output coefficients for *i* used in *j*
a_j^Y	share of value added on production
$\delta_j^{k,l}$	shares in value added function in sector *j*
$\delta_{i,j}^{vir,vm,vr,vi}$	shares parameters in CES function for intermediate goods
$\delta_{i,j}^{qvir,qvm,qvr,qvi}$	shares parameters in CES function for investment goods
$\delta_{i,h}^{hr,hm}$	shares parameters in CES function for households

	consumption
$\delta_i^{gr,gm}$	shares parameters in CES function for government consumption
$\gamma_{i,j}^{vv,vir}$	shift parameter in CES functions for intermediate goods
γ_i^f	shift parameter in CES function for households consumption goods
γ_i^g	shift parameter in CES function for government consumption
$btax_i$	business tax
sub_i	rate of production subsidy
$MTAX_i$	rate of import tax
$KM_{i,j}$	physical capital matrix
mps_{dngins}	rate of saving in institutions *dngins*
$ssce$	rate of social security paid by employees
$sscer$	rate of social security paid by employer
ire	rate of income tax
ρ	pure rate of consumer time preference
bb	rate of distortion or incentive to investment
δ	rate of depreciation

Tables and Figures

Table 1.

Intertemporal, Myopic and Regional Models

	Intertemporal models	Myopic models	Regional Myopic models (e.g. AMOS)	Regional forward looking model (aim of the paper)
Dynamic Structure	Forward Looking	Recursive	Recursive	Forward Looking
Consumption	Jump variable (derived from intertemporally additive utility function)	Abstracting from future periods (derived from a simple budget equation or as a fixed share of income)	Abstracting from future periods (derived from a simple budget equation)	Jump variable (derived from intertemporally additive utility function)
Saving rate	Endogenous	Exogenous	Exogenous	Exogenous
Investment	Jump variable (Tobin's q)	Usually passive (not determined independently of saving)	Independent of saving. Uzawa (1969) or Jorgenson (1963)	Jump variable (Tobin's q)
Balance of payments (BOP)	BOP constraint, imposing financial sector equilibrium	Often BOP constraint through passive investment	No constraint	No constraint

Table 2 - Forward-Looking models. The short-run and long-run impact of 10% increase in interregional export under three different labour market closures and three types of financial sector adjustment. Percentage change with respect to the initial steady state.

	FL1				FL2			
	Short-Run			Long-Run	Short-Run			Long-Run
	RB	NB	FRW	RB=NB=FRW	RB	NB	FRW	RB=NB=FRW
GRP Factor Cost	0.039	0.247	0.049	1.859	0.044	0.273	0.055	2.060
Consumer Price Index	1.114	0.918	1.107	0.000	1.231	1.014	1.223	0.000
Unemployment Rate	-1.337	-8.431	-1.671	0.000	-1.496	-9.335	-1.871	0.000
Total Employment	0.149	0.937	0.186	1.956	0.166	1.037	0.208	2.155
Nominal Wage	1.159	0.000	1.107	0.000	1.282	0.000	1.223	0.000
Real Wage	0.045	-0.910	0.000	0.000	0.050	-1.004	0.000	0.000
Replacemnet cost of capital	1.073	0.861	1.065	0.000	1.193	0.959	1.184	0.000
Government Deficit	-0.004	-0.414	-0.025	-1.452	0.044	-0.409	0.021	-1.575
Labour Supply	0.000	0.000	0.000	1.956	0.000	0.000	0.000	2.155
Households Cons	-0.184	0.105	-0.174	1.480	0.006	0.326	0.017	1.849
Households Saving	1.302	1.389	1.309	1.407	-2.033	-2.215	-2.160	0.806
Financial Wealth	3.496	5.195	3.714	3.985	5.299	4.870	5.301	8.342
Non Financial Wealth	1.164	1.220	1.174	1.333	1.283	1.344	1.294	1.469
Total Wealth	1.292	1.439	1.314	1.480	1.505	1.539	1.516	1.849
Gov. Expenditure	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Current Account ROI+ROW	0.140	0.937	0.215	-3.143	0.893	1.772	0.975	-2.629
Current Account ROI	-10.746	-9.771	-10.639	-17.873	-9.567	-8.494	-9.451	-17.120
Current Account ROW	7.302	7.982	7.356	6.550	7.776	8.526	7.835	6.905
Investment	1.077	3.087	1.212	2.026	1.157	3.373	1.305	2.224
Value added								
Primary	0.963	1.797	1.002	4.980	0.916	1.837	0.959	5.130
Manufacturing	0.327	1.034	0.363	3.184	0.317	1.098	0.357	3.371
Services	0.002	0.454	0.023	1.473	0.021	0.520	0.045	1.678
Interregional exports								
Primary	6.279	6.934	6.306	10.000	6.147	6.869	6.177	10.000
Manufacturing	6.112	6.340	6.110	10.000	5.881	6.134	5.879	10.000
Services	7.520	8.140	7.544	10.000	7.186	7.870	7.214	10.000
International exports								
Primary	-3.382	-2.788	-3.358	0.000	-3.503	-2.846	-3.475	0.000
Manufacturing	-3.534	-3.327	-3.536	0.000	-3.745	-3.515	-3.746	0.000
Services	-2.255	-1.691	-2.233	0.000	-2.558	-1.937	-2.533	0.000
Investment demand								
Primary	2.772	5.792	2.997	3.184	2.711	6.034	2.958	3.371
Manufacturing	1.117	3.147	1.253	2.052	1.193	3.432	1.344	2.250
Services	0.841	2.729	0.965	1.872	0.938	3.022	1.076	2.072
Shadow price of capital								
Primary	2.331	2.790	2.372	0.000	2.400	2.906	2.446	0.000
Manufacturing	1.611	1.981	1.647	0.000	1.720	2.126	1.759	0.000
Services	1.111	1.199	1.122	0.000	1.258	1.355	1.270	0.000
Value added price								
Primary	2.071	1.698	2.055	0.000	2.149	1.736	2.131	0.000
Manufacturing	1.652	1.561	1.654	0.000	1.760	1.659	1.762	0.000
Services	1.163	0.868	1.151	0.000	1.322	0.996	1.309	0.000

Table 3 - Myopic models. The short-run and long-run impact of 10% increase in interregional export under three different labour market closures and three types of financial sector adjustment. Percentage change with respect to the initial steady.

	MYP 1				MYP2			
	Short-Run			Long-Run	Short-Run			Long-Run
	RB	NB	FRW	RB=NB=FRW	RB	NB	FRW	RB=NB=FRW
GRP Factor Cost	0.049	0.308	0.061	1.859	0.044	0.267	0.055	2.060
Consumer Price Index	1.338	1.137	1.328	0.000	1.226	0.987	1.216	0.000
Unemployment Rate	-1.666	-10.522	-2.084	0.000	-1.514	-9.117	-1.891	0.000
Total Employment	0.185	1.169	0.232	1.956	0.168	1.013	0.210	2.155
Nominal Gross Wage	1.394	0.000	1.328	0.000	1.278	0.000	1.216	0.000
Real Gross Wage	0.056	-1.124	0.000	0.000	0.051	-0.977	0.000	0.000
Capital Good Price	1.307	1.088	1.296	0.000	1.193	0.937	1.182	0.000
Government Deficit	0.115	-0.366	0.092	-1.452	0.068	-0.377	0.046	-1.575
Labour Supply	0.000	0.000	0.000	1.956	0.000	0.000	0.000	2.155
Households Cons	0.272	0.731	0.293	1.480	0.087	0.379	0.105	1.849
Households Saving	1.587	1.749	1.595	1.407	-1.107	-0.257	-1.078	0.806
Financial Wealth	3.838	5.562	4.015	3.985	3.433	3.141	3.424	8.342
Non Financial Wealth	1.225	1.246	1.227	1.333	1.191	1.266	1.199	1.469
Total Wealth	1.369	1.485	1.381	1.480	1.315	1.370	1.322	1.849
Gov. Expenditure	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Current Account ROI+ROW	1.370	2.546	1.425	-3.143	0.661	1.268	0.701	-2.629
Current Account ROI	-8.842	-7.349	-8.772	-17.873	-9.951	-9.301	-9.903	-17.120
Current Account ROW	8.089	9.057	8.135	6.550	7.643	8.223	7.678	6.905
Investment	0.816	3.180	0.928	2.026	0.756	2.775	0.857	2.224
Value added								
Primary	0.867	1.881	0.915	4.980	0.912	1.819	0.956	5.130
Manufacturing	0.281	1.144	0.322	3.184	0.292	1.047	0.329	3.371
Services	0.047	0.616	0.074	1.473	0.029	0.512	0.053	1.678
Interregional Exports								
Primary	6.031	6.797	6.068	10.000	6.158	6.897	6.193	10.000
Manufacturing	5.751	5.984	5.762	10.000	5.968	6.297	5.982	10.000
Services	6.847	7.479	6.877	10.000	7.164	7.901	7.196	10.000
International Export								
Primary	-3.608	-2.911	-3.575	0.000	-3.493	-2.821	-3.461	0.000
Manufacturing	-3.863	-3.651	-3.853	0.000	-3.665	-3.366	-3.653	0.000
Services	-2.866	-2.292	-2.839	0.000	-2.578	-1.908	-2.549	0.000
Investment demand								
Primary	1.553	4.798	1.707	3.184	1.605	4.454	1.745	3.371
Manufacturing	0.835	3.216	0.948	2.052	0.778	2.813	0.879	2.250
Services	0.703	2.964	0.810	1.872	0.629	2.550	0.725	2.072
Rate of return to capital								
Primary	5.203	8.307	5.349	0.000	5.284	8.028	5.418	0.000
Manufacturing	2.777	5.659	2.912	0.000	2.710	5.171	2.832	0.000
Services	1.645	3.275	1.722	0.000	1.430	2.717	1.496	0.000
Value added price								
Primary	2.216	1.778	2.195	0.000	2.142	1.720	2.122	0.000
Manufacturing	1.819	1.729	1.814	0.000	1.718	1.581	1.712	0.000
Services	1.485	1.182	1.471	0.000	1.333	0.981	1.318	0.000

Figure 1

The production structure of the model

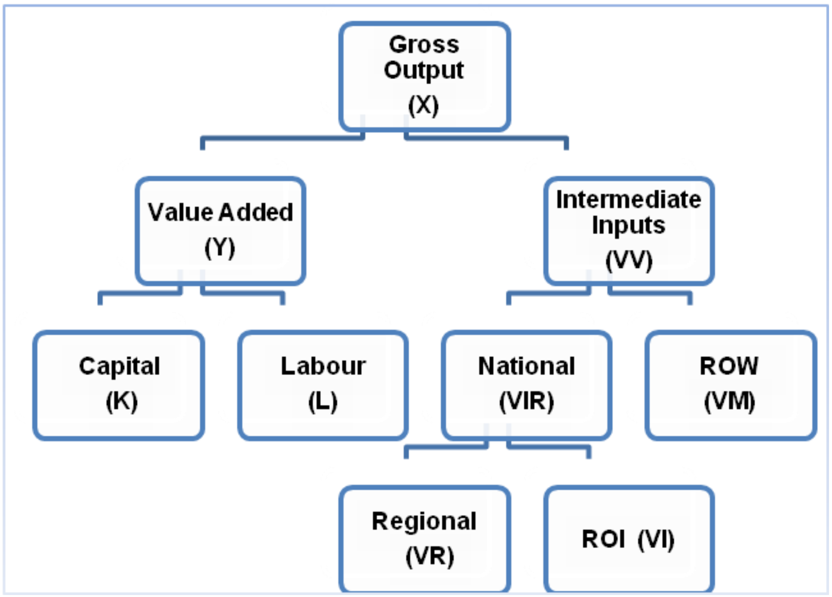


Figure 2

Gross Regional Product, Model FL1

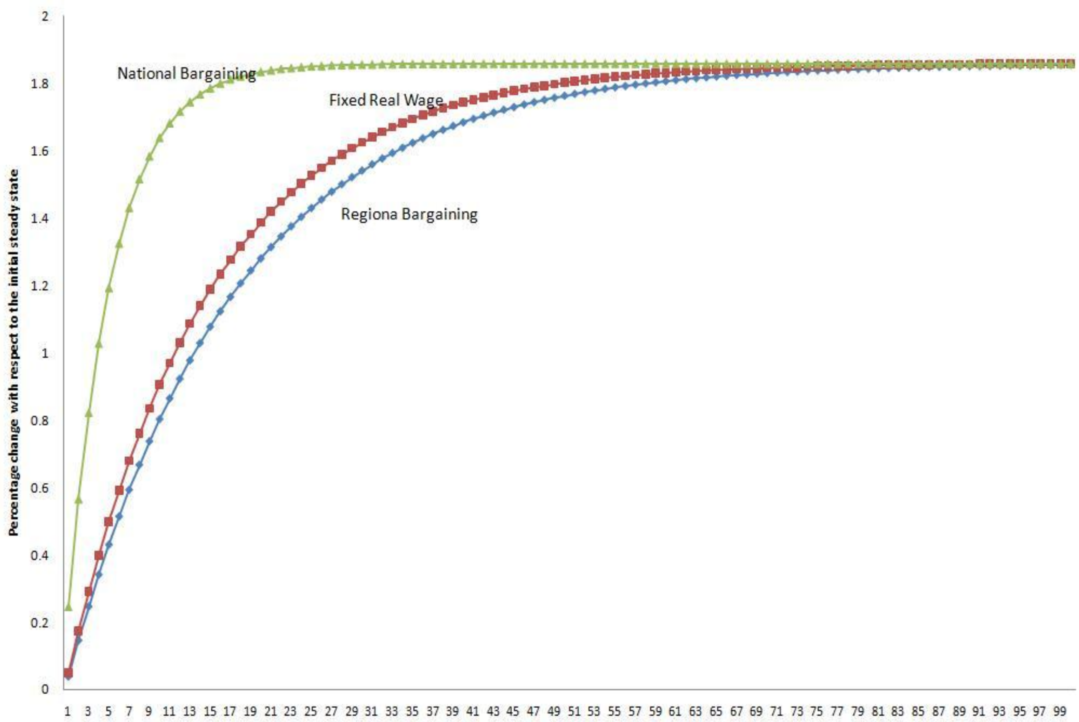


Figure 3

Consumer Price Index, Model FL1

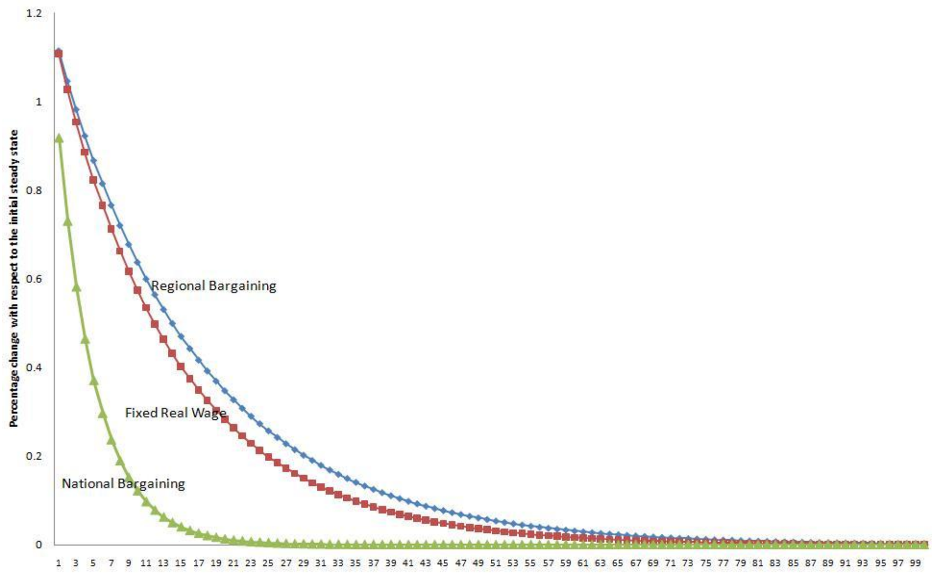


Figure 4

Gross Regional Product: a comparison between FL1 and MYP1

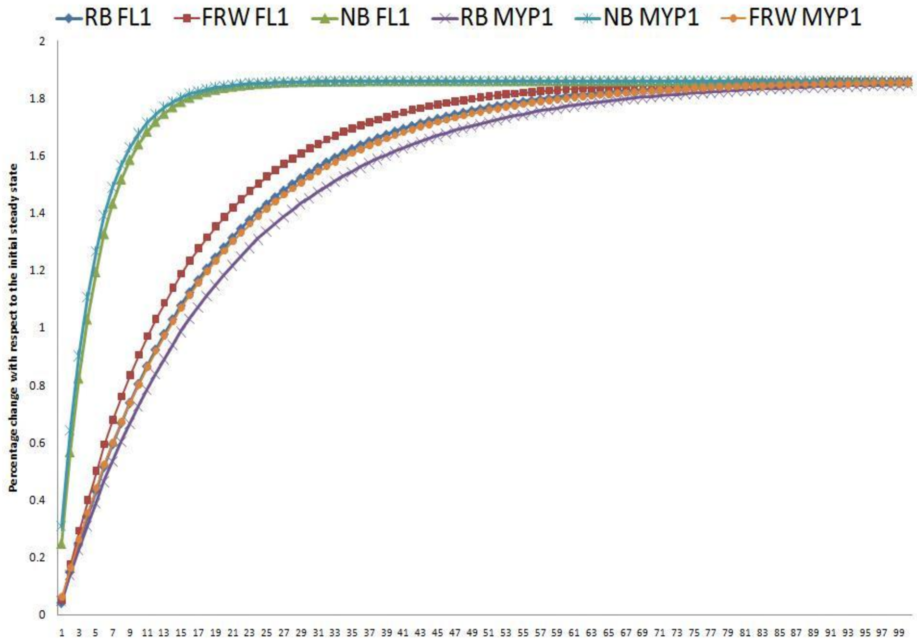


Figure 5

Consumption and Investment under Regional bargaining. Forward looking vs. Myopic model

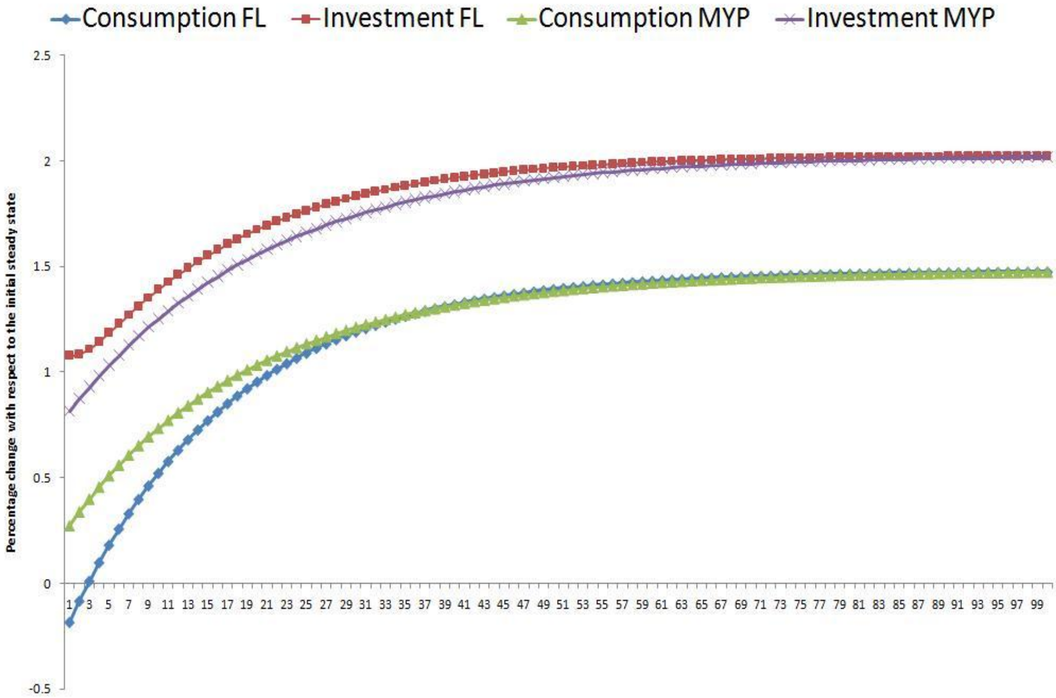
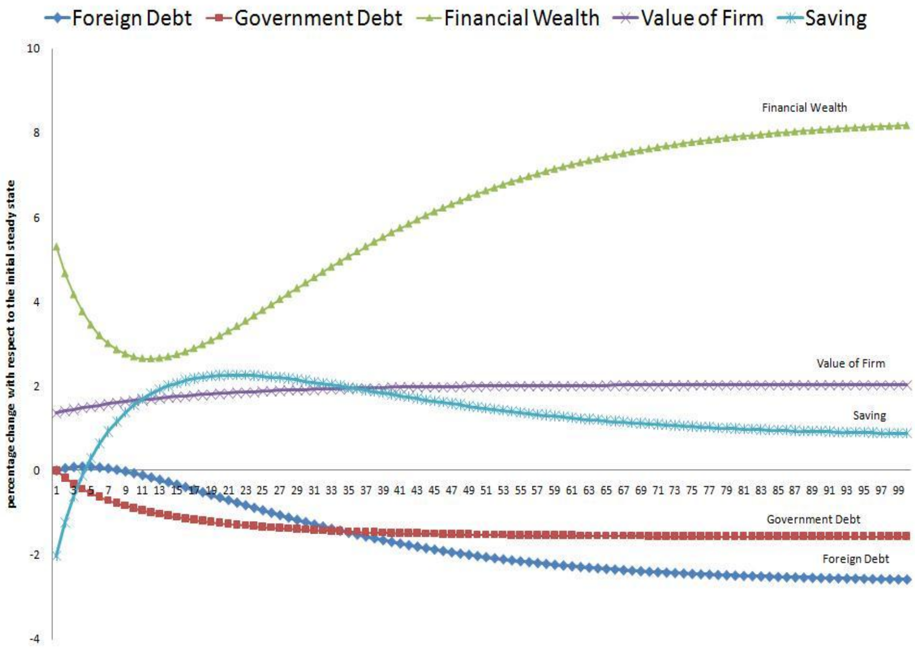


Figure 6

Financial wealth and household savings

a) Model FL2



b) Model MYP2

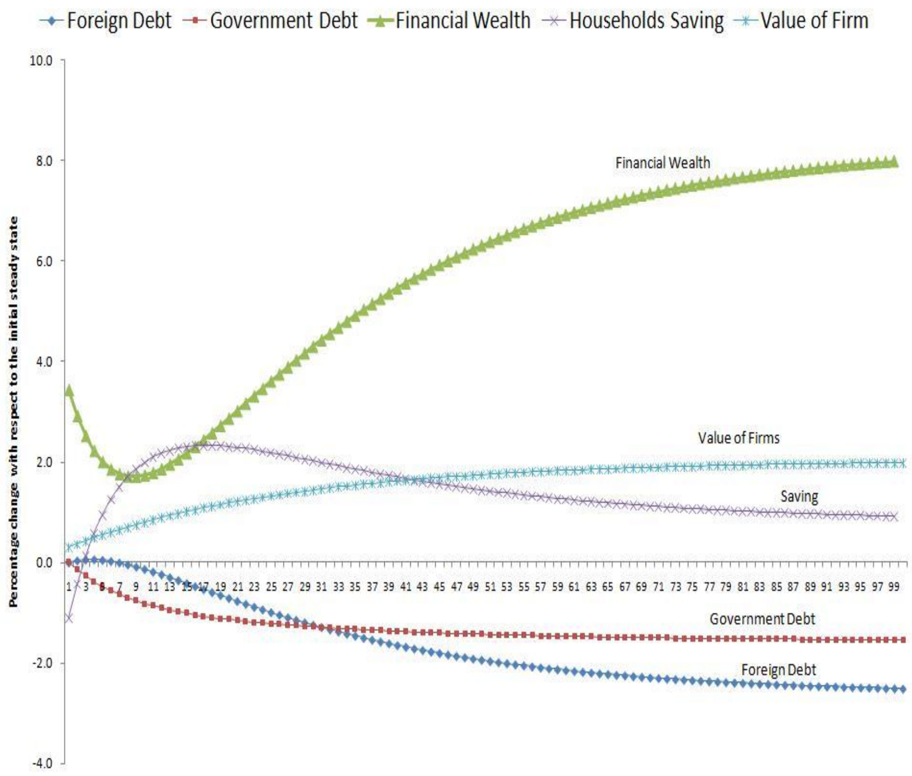


Figure 7

Accumulation rate for different value of the speed of adjustment

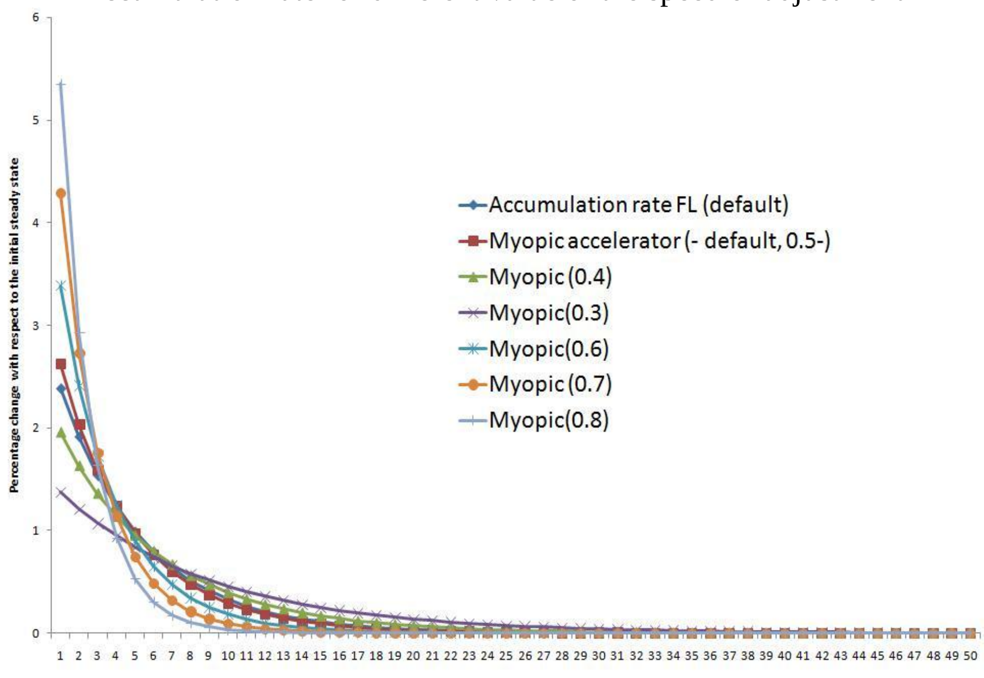
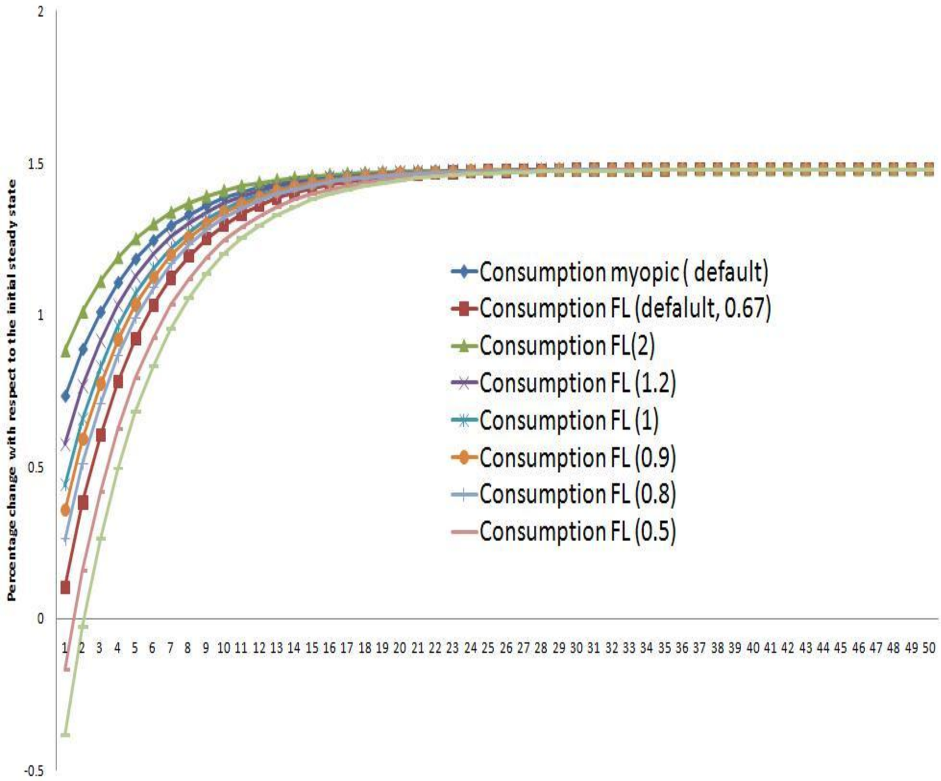


Figure 8

Consumption for different value of σ



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