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North-South Financial Integration and Business Cycles

By: Michael A. Kouparitsas

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Michael A. Kouparitsas *
Federal Reserve Bank of Chicago
P.O. Box 834
Chicago IL 60690-0834
mkoup@frbchi.org

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Abstract

This paper examines the business cycle implications of increased North-South trade in financial assets. I build a quantitative general equilibrium model of North-South trade and compare the model's predictions under two asset market assumptions: a restricted setting in which asset trade is limited to a non-contingent one-period bond market; and a highly integrated setting in which agents have access to a complete contingent-claims market. Simulations of the North-South model suggest that increased North-South trade in asset markets (a) lowers Southern consumption and output volatility, and (b) weakens North-South output and consumption correlations, at business cycle frequencies.

Key words: North-South trade; Asset markets; Business cycles.

JEL classification: E32; F41.

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1 Introduction

The recent surge in capital flows to developing countries has helped to alleviate the relative scarcity of capital in these countries over the last decade, caused by limited access to international capital markets following the Third World Debt Crisis. The composition of capital flows to developing countries in the 1990's has changed dramatically. Recent capital inflows have largely been private direct investment and portfolio flows to private sector borrowers. This stands in stark contrast to earlier periods that were dominated by official flows and commercial bank lending to public sector borrowers. The increased financial market integration of developing and industrial countries suggests that the portfolio's of both the capital-exporting and recipient country have become more diversified.

Much of the recent capital flows to developing countries have followed improvements in the economic policies and economic performance of the recipient countries. For example, a significant proportion of the capital flows in 1990-94 occurred during recessions in the major industrial nations. Similarly, an improvement in industrial country activity in more recent years has been correlated with moderation in cyclically driven capital flows to developing countries. Mexico's recent experience revealed that sudden reversals of capital inflows can have a severe effect on the real economic performance of developing countries. With greater integration of world financial markets and increased portfolio diversification agents are potentially more insulated from idiosyncratic shocks, but it opens an additional route through which economic fluctuations in one country can influence another country's economic activity. Greater financial market linkages between industrial and developing countries may substantially alter the responses of these economies to typical business cycle shocks. So far economists have not developed models that provide insight into the potential effects that greater financial market integration will have on the business cycles of industrial (Northern) and developing (Southern) countries. This paper develops a model of North-South trade in which business cycles are caused by productivity shocks. I use this model to study the business cycle implications of increased North-South trade in financial assets.

I gauge the potential impact of increased financial market integration by examining the behavior of key macroeconomic time series–output, consumption, investment, the trade balance and terms of trade–under two different financial market settings. In particular, I follow Cole's (1988) approach to studying various risk-sharing arrangements by developing alternative models of North-South trade with different asset market settings.

I begin my analysis by developing a quantitative North-South trade model. In this benchmark model I assume that asset trade is restricted to a non-contingent bond market where agents trade one-period bonds only after observing all shocks to the economy. Other features of model are motivated by North-South trade and sectoral production data: (i) North-South trade is asymmetric: the North imports primary products (raw materials) from the South in exchange for exports of manufactured goods; (ii) manufacturing production requires labor, capital and intermediate inputs; (iii) manufacturing production is close to Leontief in the short run (i.e., there is a low elasticity of substitution between manufacturing inputs); (iv) primary products (raw materials) are chiefly used as an intermediate input in the production of manufactures; (v) fluctuations in primary goods supply are largely driven by exogenous innovations (i.e., land, weather, etc.); and (vi) Northern and Southern manufactured goods are complements.

These factors produce the following North-South business cycle mechanism. Positive shocks to Northern manufacturing production increases the demand for primary goods. Primary supply is inelastic in the short-run, so the increased demand raises the relative price of primary and manufactured goods (real commodity prices). The South is a net exporter of primary goods, so the improvement in real commodity prices leads to an improvement in the South's terms of trade and real income. Higher real incomes lead to increased consumption in the South. Northern and Southern goods are complements, so the increased demand is satisfied by increased imports from the North and increased Southern production of non-primary goods. Simulation results show that this model is successful in capturing many features of North-South business cycles. In particular, the strong pattern of North-South output and expenditure comovement, and the high volatility of the North-South terms of trade.

Next I modify the asset market structure by allowing the North and South to face a complete contingent-claims market. In this highly integrated setting the agents pool their risk. In general it is argued that by having a more diversified portfolio an agents wealth is less sensitive to fluctuations in domestic activity and more dependent on foreign economic fluctuations. This weakens the link between domestic production and consumption, while raising the correlation between domestic consumption and foreign output. Overall, risk-pooling is expected to lower the volatility of domestic consumption and raise the correlation between domestic and foreign consumption (see Cole 1988, 1993, for details). Taking the bond economy as the benchmark I show that in my model economy portfolio diversification has a negligible impact on the business cycle of the relatively larger Northern economy, while it leads to less volatile business cycles in the relatively smaller Southern economy. In contrast to earlier research I find that diversification generates lower cross-region consumption correlations.

These result emerge because the risk-pooling arrangement weakens the model's endogenous business cycle transmission mechanism. In the complete markets setting the North and South pool their traded output, so under this arrangement the South has claim to a smaller share of world primary activity than in the bond economy. This means that the South experiences a smaller improvement in their real income than in the incomplete model, following a positive shock to Northern manufacturing. This results in smaller responses in Southern consumption and non-primary output following shocks to Northern manufacturing. Hence, I find that as the Southern portfolio becomes more diversified Southern wealth is more sensitive to fluctuations in domestic activity and less dependent on foreign economic fluctuations. This strengthens the link between domestic production and consumption, while lowering the correlation between domestic consumption and foreign output in the South.

The remainder of the paper is organized as follows. The bond market version of the North-South model used in this paper is developed in a companion paper Kouparitsas (1997a) that looks more generally at the North-South business cycle. In the earlier paper I assume that financial markets are described by a non-contingent one period bond market. In section 2 I describe the model in detail and develop the complete contingent-claims version. My discussion highlights key features of the underlying North-South trade model and its solution under the alternative asset market structures. Parameterization of the model is discussed in section 3. I compare the business cycle properties of the two North-South trade model's in section 4 by examining the volatility and covariance of key North-South macroeconomic time series at business cycle frequencies. I study the impulse response functions of the two models in section 5 to isolate differences in their underlying international business cycle transmission mechanisms. Finally, section 6 contains a brief summary of the main results.

2 Modeling North-South goods and asset markets

In my model, the Northern economy is modeled to reflect the industrial and trade structure of the major industrial economies (principally the United States (US), Japan and Germany), while the Southern specification is designed to reflect the industrial structure of developing non-fuel exporting economies. I denote Southern variables by $(j = s)$ and Northern variables by $(j = n)$.

2.1 Bond market economy

First I look at the North-South model under the bond market assumption. In this case the North and South have access to a non-contingent one-period bond market. Agents trade one-period bonds only after observing all shocks to the economy.

2.1.1 Preferences

Each region j has a single infinitely lived representative household who maximizes his expected lifetime utility from consuming a consumption good (c_{jt}) and leisure (L_{jt}):

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(c_{jt}^{\theta_c} L_{jt}^{1-\theta_c}\right)^{1-\sigma}}{1-\sigma}, \tag{2.1}$$

for $1 > \beta > 0$, $1 > \theta_c > 0$, and $j = n, s$.

2.1.2 Production technology

Each region produces two goods: primary raw materials $(i = 1)$ and manufactured goods $(i = 2)$. Primary production requires no materials inputs, so the gross value of primary output (y_{1jt}) is the same as primary value-added (y_{v1jt}). In contrast, manufacturing output (y_{2jt}) is a gross output concept because manufacturing production requires capital, labor and raw material inputs from the primary sector.

Primary Primary output is essentially value-added–that part of production attributable to non-materials inputs. Primary production (y_{1jt}) uses capital (k_{1jt}), labor (N^s_{1jt}) and land (T_{1jt}) as inputs. I assume value-added production is described by Cobb-Douglas technology:

$$y_{1jt} = y_{v1jt} = A_{1jt} N^{s\theta_1}_{1jt} k^{\alpha_1}_{1jt} T^{1-\theta_1-\alpha_1}_{1jt}, \tag{2.2}$$

for $\alpha_1, \theta_1 \geq 0, 1 \geq \theta_1 + \alpha_1 \geq 0$, and $j = n, s$. A_{1jt} is an exogenous productivity shift parameter.

Manufactures Primary goods are typically consumed as intermediate goods. The model responds to this by requiring manufacturing production to use primary goods as intermediate goods inputs, in addition to capital and labor. I make the standard assumption that manufacturing gross production (y_{2jt}) is described by a two-level constant elasticity of substitution (CES) function:[1]

$$y_{2jt} = \left\{ \omega_y y^{1-1/\sigma_\varepsilon}_{v2jt} + (1-\omega_y) m^{1-1/\sigma_\varepsilon}_{jt} \right\}^{\frac{1}{1-1/\sigma_\varepsilon}}, \tag{2.3}$$

for $1 \geq \omega_y \geq 0$, $\sigma_\varepsilon > 0$ and $j = n, s$. The first level of production involves a value-added component and an aggregate intermediate goods component. Again I assume that the value-added production component (y_{v2jt}) is modeled as Cobb-Douglas technology which requires capital (k_{2jt}) and labor (N^s_{2jt}):

$$y_{v2jt} = A_{2jt} N^{s\theta_2}_{2jt} k^{1-\theta_2}_{2jt}, \tag{2.4}$$

for $1 \geq \theta_2 \geq 0$ and $j = n, s$. A_{2jt} is the manufacturing productivity shift term. The other factor of production is the aggregate intermediate input (m_{jt}). The elasticity of substitution between value-added and the intermediate input is σ_ε.

2.1.3 Investment behavior

There are two types of investment goods. The first type are durable capital goods which depreciate at rate $0 < \delta_k \leq 1$. All capital goods are used as inputs in the production of

[1] See, for examples, Kydland and Prescott 1988, and Whalley 1985.

other goods, and are only produced in the non-primary sector. The second type are intermediate goods which are held as inventories and completely consumed in the production of next period's manufactured goods (i.e., the current stock of inventories is next period's intermediate good inputs).[2]

Capital goods I assume there are costs of adjusting capital stocks (k_{ijt}) in both regions. Following Baxter and Crucini (1993) I employ a convex cost of adjustment function where: $\phi_{ki}(x) > 0, \phi'_{ki}(x) > 0$, and $\phi''_{ki}(x) < 0$. By allowing i_{ijt} to denote investment in sector i region j capital and δ_k the capital depreciation rate I can describe accumulation in the region j, sector i, capital good in the following manner:

$$k_{ijt+1} = k_{ijt}(1-\delta_k) + \phi_{ki}\left(\frac{i_{ijt}}{k_{ijt}}\right)k_{ijt}, \tag{2.5}$$

for $i = 1, 2$ and $j = n, s$.

Intermediate goods I assume that intermediate goods require one period to put in place, so that period $t+1$ inputs are produced in period t. I summarize region j's intermediate investment (i_{mjt}) behavior in the following way:

$$m_{jt+1} = i_{mjt}, \tag{2.6}$$

for $j = n, s$.

2.1.4 Trade flows

The North and South export both manufactured and primary goods, albeit in different proportions (i.e., cross-hauling). To allow for incomplete specialization in production and cross-hauling I assume traded goods are differentiated by production location.[3]In particular, home produced (h_{1jt}) and imported (f_{1jt}) primary goods are aggregated according to the following CES function:

[2]The theoretical model of Kydland and Prescott 1982, 1988, and the empirical model of Ramey 1989 also assume that all inventories are intermediate goods.

[3]See Baxter 1992 for a discussion of how complete specialization, along the lines of Ricardian comparative advantage, emerges in a dynamic Heckscher-Ohlin-Samuelson model where goods are not differentiated by production location.

$$i_{mjt} = \left(\omega_{1j} h_{1jt}^{1-1/\sigma_{\mu 1}} + (1-\omega_{1j}) f_{1jt}^{1-1/\sigma_{\mu 1}}\right)^{\frac{1}{1-1/\sigma_{\mu 1}}}, \tag{2.7}$$

for $1 > \omega_{1j} > 0, \sigma_{\mu 1} > 0$, and $j = n, s$. The elasticity of substitution between home produced and imported primary goods is $\sigma_{\mu 1}$ and ω_{1j} is the weight reflecting home good bias.

The aggregation function for manufactured goods is also a CES function given by the following:

$$c_{jt} + i_{1jt} + i_{2jt} = \left(\omega_{2j} h_{2jt}^{1-1/\sigma_{\mu 2}} + (1-\omega_{2j}) f_{2jt}^{1-1/\sigma_{\mu 2}}\right)^{\frac{1}{1-1/\sigma_{\mu 2}}}, \tag{2.8}$$

for $1 > \omega_{2j} > 0$, $\sigma_{\mu 2} > 0$ and $j = n, s$. h_{2jt} denotes home produced manufactured goods and f_{2jt} denotes imported manufactured goods. The elasticity of substitution between home produced and imported manufactures is $\sigma_{\mu 2}$ and ω_{2j} is the weight reflecting home good bias.

2.1.5 Resource constraints

The model contains two non-reproducible factors labor and land. Labor is mobile between sectors, subject to adjustment costs. In particular, labor services (N_{ijt}^s) are described by the following dynamic relationship:

$$N_{ijt+1}^s = \phi_{Ni}\left(\frac{N_{ijt+1}}{N_{ijt}^s}\right) N_{ijt}^s, \tag{2.9}$$

for $i = 1, 2$ and $j = n, s$. I assume ϕ_{Ni} has properties similar to the capital adjustment cost functions (i.e. $\phi_{Ni}(x) > 0, \phi_{Ni}'(x) > 0$, and $\phi_{Ni}''(x) < 0$) although the actual cost of adjusting labor and capital will be different. Note, that like capital I assume that there are costs associated with bringing new workers *on-line*. Total hours are normalized to unity so that the agents face the following regional labor constraints:

$$1 - L_{jt} - \sum_{i=1,2} N_{ijt} = 0, \tag{2.10}$$

for $j = n, s$.

Land has a minor share in the value-added of the non-primary industries. The model reflects this by modeling non-primary value-added as a Cobb-Douglas function of capital and labor. Land is a assumed to be fixed throughout the analysis.

The only financial assets available to the Northern and Southern households are non-contingent one-period bonds b_{jt}. The price of these assets in terms of the numeraire good is p_{bt}. Note, throughout the paper I maintain Northern manufactured goods as the numeraire ($p_{2nt} = 1$). By allowing p_{ijt} to denote the price of region j's good i in terms of the numeraire good I can describe region j's representative household's intertemporal budget constraint as:

$$\sum_{i=1,2} p_{ijt} y_{ijt} + b_{jt} = p_{1jt} h_{1jt} + p_{2jt} h_{2jt} + p_{1kt} f_{1jt} + p_{2kt} f_{2jt} + p_{bt} b_{jt+1}, \tag{2.11}$$

for $j, k = n, s$ and $j \neq k$.

Each regional economy is also subject to the following sectoral resource constraints:

$$\begin{aligned} \text{Primary:} \quad & y_{1jt} = h_{1jt} + f_{1kt}, \\ \text{Manufacturing:} \quad & y_{2jt} = h_{2jt} + f_{2kt} \end{aligned} \tag{2.12}$$

for $j, k = n, s$ and $j \neq k$.

2.1.6 Driving processes

The model is driven by shocks to sectoral productivity. Following the real business cycle literature, I assume that the log of the sectoral productivity shock variables follows a multivariate autoregressive process described by the following:

$$\ln A_{t+1} = \rho \ln A_t + \xi_{t+1}, \tag{2.13}$$

where $A_t = [A_{1nt}\ A_{2nt}\ A_{1st}\ A_{2st}]'$, and ξ_t is an identically, independently distributed (*iid*) normal with mean zero and covariance matrix Ω.

2.1.7 Bond market equilibrium

In each region of the bond market economy the representative household's dynamic optimization problem is to maximize the expected lifetime utility described by (2.1) subject to the constraints given by equations (2.2)–(2.10) and (2.11). The competitive world equilibrium is described by the stochastic processes for consumption, leisure, labor effort, investment, output, capital, bonds and their associated prices which satisfy: the regional representative household's optimization problem; and the sectoral resource constraints given by (2.12), for $j = n, s$.

2.2 Complete markets economy

My characterization of the world equilibrium in complete markets model follows other open economy dynamic trade studies.[4] Researchers exploit the fact that the second welfare theorem applies in the complete markets setting, so the competitive equilibrium and Pareto optimum coincide. Using this fact the competitive world equilibrium is described by the stochastic processes for consumption, leisure, labor effort, investment, output and capital which satisfy the following optimization problem:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \pi \frac{\left(c_{nt}^{\theta_{cn}} L_{nt}^{1-\theta_{cn}}\right)^{1-\sigma}}{1-\sigma} + (1-\pi) \frac{\left(c_{st}^{\theta_{cs}} L_{st}^{1-\theta_{cs}}\right)^{1-\sigma}}{1-\sigma} \right\}, \tag{2.14}$$

subject to the constraints given by (2.2)–(2.12), for $0 < \pi < 1$ and $j = n, s$.

I use numerical techniques to solve for the dynamic equilibria of both models. Specifically, the log-linear approximation technique advanced in the real business cycle literature by King, Plosser and Rebelo (1988a,b,1990). A detailed description of the model solution algorithm of the bond and complete market models is provided in appendix B.

3 Calibration

If I had a large enough data set I could use cointegration or generalized method of moment techniques and the model's first order necessary conditions to estimate all the preference and production parameters in the model. Unfortunately, this requires more data than is currently at my disposal. Researchers working with multisector multicountry static computable general equilibrium models, such as Shoven and Whalley (1992) have adopted

[4]For examples of this research see the recent international business cycle surveys of Backus, Kehoe and Kydland 1995, and Baxter 1995.

an approach know as *calibration*. More recently this approach has been extended to dynamic models of international trade.[5]

Comprehensive North-South expenditure and output data is only available at the annual frequency. The model adopts a quarterly time interval for three reasons. First, an important feature of the model is its important trade in intermediate goods. Empirical evidence suggests that it takes some time to put these factors in place, but that this interval is less than one year. Second, by adopting a quarterly time interval I bring the model closer to existing international real business cycle models, which allows me to compare features of the model with earlier studies. Third, I can draw on the parameter set used in the earlier studies. Note, to compare the simulated model data with actual North-South data, which are at the annual frequency, I aggregate the quarterly model data to produce annual model data.

3.1 Preferences

Following King, Plosser and Rebelo (1988) I have a fairly general preference specification for aggregate consumption and leisure. First, I set the curvature parameter σ to 2. Second, θ_c is consistent with 20 percent of the agent's total time being devoted to market activity in the steady state. Finally, the average quarterly real interest rate is about 1.5 percent, which implies a Northern and Southern discount factor β of 0.9852.

3.2 Production

In general, capital share estimates tend to be much higher in the South data. Estimates on labor's share of value-added based on more reliable Northern data imply the following production parameters $\theta_1 = 0.25$ and $\theta_2 = 0.65$. Similarly, estimates based on the first-order condition for primary sector capital, and Northern data on sectoral value-added suggest land's share is roughly 35 percent of primary value-added, which suggests the following primary production parameter: $\alpha_1 = 0.35$.[6]

[5]See Backus, Kehoe and Kydland 1995, and Baxter 1995 for examples of calibrated international business cycle models.

[6]Capital's share is derived from: $\alpha_1 = s_{i1}\{1-\beta(1-\delta)\}/\beta\delta$, where s_{i1} is the ratio of primary investment to primary value-added.

The manufacturing production function described by (2.3) is motivated by the manufacturing cost function estimates in Ramey (1989). Ramey estimates production functions for durable manufacturing industries using quarterly US data. Her production function includes capital, labor and inventories of raw materials, goods-in-progress and finished goods. Combining her results with the theoretical results in Sato (1969) I find that the constant elasticity of substitution between intermediate inputs and the value-added component (σ_ε) is close to zero, which suggests manufacturing production is close to Leontief at the quarterly frequency. With an elasticity of 0.20 the production process is close to Leontief and well *in-line* with Ramey's quarterly estimates. The benchmark model's manufacturing costs shares are consistent with the values reported in the Northern and Southern input-output tables.

The quarterly capital depreciation rate is set at 3 percent, which is consistent with most quarterly real business cycle studies. Following Baxter and Crucini (1993) I set the capital adjustment cost function ϕ so that: its steady value is equal to the steady state ratio of investment to capital ($\phi(i/k) = i/k = \delta_k$); in steady state "Tobin's q" is unity ($1/\phi'(i/k) = 1$); and the elasticity of the sectoral investment-capital ratios with respect to their sectoral "Tobin's q" ($(\phi'/\phi'')/(i/k)$) are consistent with relative sectoral and aggregate investment volatility levels (I use US sectoral capital data to estimate relative investment volatilities). The sectoral labor adjustment cost functions are calibrated in a similar fashion. The primary sector has the highest capital and labor adjustment costs, which is consistent with the view that primary capital and labor inputs tend to be industry specific.

3.3 Trade

Roughly 85 percent of Northern trade is with other Northern economies, while 85 percent of Southern trade is with Northern economies. Therefore, elasticity estimates based on Southern data will be indicative of North-South substitution. I base the model's elasticities between home and foreign primary and manufactured goods on Dornbusch and Werner's (1994) estimates of these parameters from quarterly Mexican data. In particular, I assume that the North-Southern primary goods elasticity of substitution $\sigma_{\mu 1}$ is 1 and manufactured goods elasticity of substitution $\sigma_{\mu 2}$ is 0.50. I set the Southern home bias weights ω_{1s} and ω_{2s} so that they are consistent with estimates of the share of imports in total Southern primary and manufactured expenditure. The Northern home bias weights ω_{1n} and ω_{2n} are set so that the South's share of world primary and manufacturing are consistent with estimated shares.

3.4 Driving processes

The model is driven by shocks to Northern and Southern sectoral productivity. With appropriate data on sectoral value-added, capital stocks, labor hours, intermediate inputs and estimates of $(\theta_{ij}, \alpha_{ij}, \omega_{ikj}\text{'}s)$ I can measure total factor productivity directly using the production functions described in section 3. There are three problems I face in taking this route. First, data on sectoral gross output and intermediate usage is not readily available across the group of countries under study. Second, sectoral capital stocks and labor hours are not readily available for developing non-fuel exporting countries. Third, when data are available they are at the annual frequency but not the quarterly frequency.

I overcome each of these problems in the following way. First, I solve the model using a log-linear technique. In the log-linear version of the model total factor productivity can be measured directly from value-added data A_{2jt},

$$\ln A_{2jt} = \ln y_{v2jt} - \theta_2 \ln N^s_{2jt} - (1-\theta_2) \ln k_{2jt} \qquad (3.15)$$

Second, annual sectoral capital stock and hours data are available for the United States. I make the strong assumption that estimates from US data will be indicative of the productivity structure in both the Northern and Southern regions. Using annual US data from 1948-85 the estimated within region multivariate driving process is given by the following:[7]

$$\rho_n^{US} = \begin{bmatrix} \begin{matrix} 0.87 \\ (0.09) \end{matrix} & 0 \\ 0 & \begin{matrix} 0.69 \\ (0.09) \end{matrix} \end{bmatrix} \text{ and } \Omega_n^{US} = \begin{bmatrix} 0.030^2 & \mathbf{0.130} \\ . & 0.015^2 \end{bmatrix}$$

where the values in parentheses are White robust t-statistics and the bold values in Ω_n^{US} indicate the correlation between innovations. I calibrate the Southern innovations so that the

[7] The off diagonal terms of ρ were not significantly different from zero in our initial regressions. Therefore, to rule-out spurious effects from poorly specified spillover terms we set the off-diagonal terms to be zero.

standard deviation of Southern primary and manufacturing value-added in the theoretical model are close to their data analogues.

My estimates of within region sectoral innovation correlations suggest that primary sector innovations are not correlated with the non-primary innovations. I assume that it is also the case that cross-region primary innovations are not correlated. Estimates of the correlation between US and a subset of Southern countries' manufactured good productivity innovations range from 0 to 0.70. I set the cross-region correlation of non-primary sector innovations to the mean of these estimates, 0.30.

Third, the estimated process describes the annual multivariate driving process, but the model has a quarterly frequency. I circumvent this problem by retaining the innovation correlation structure of the estimated annual process Ω^{US}, and assume the quarterly sectoral innovations are more persistent. In particular, I draw on estimates from quarterly data found in the real business cycle literature which suggest the autoregressive parameter of total factor productivity is 0.95. Using this approach the implied annual North-South productivity process from 100 simulations of length 80 quarters or 20 years is:

$$\rho^{sim} = \begin{bmatrix} 0.72 & . & \dots & 0 \\ . & 0.72 & & \vdots \\ \vdots & & 0.70 & . \\ 0 & \dots & . & 0.73 \end{bmatrix} \quad \text{and} \quad \Omega^{sim} = \begin{bmatrix} 0.026^2 & \mathbf{0.006} & \mathbf{0.015} & \mathbf{0.001} \\ . & 0.013^2 & \mathbf{0.005} & \mathbf{0.300} \\ . & . & 0.014^2 & \mathbf{0.013} \\ . & . & . & 0.011^2 \end{bmatrix}$$

where bold values in indicate within and across region innovation correlations.

The model's benchmark parameters are summarized in table 1. I use the model's first order conditions to calculate all remaining parameters and steady state shares. Actual aggregate expenditure and output shares are reported in table 2 along with their model analogues.

4 Model comparison

In this section I gauge the potential impact of increased North-South financial market integration by examining the behavior of key North-South model time series–output, consumption, investment, trade balance and terms of trade–under the bond and complete markets settings. I limit my discussion to the business cycle implications of financial integration. Business cycle frequencies are isolated in the model and actual data by applying a Hodrick and Prescott (1980) filter with a smoothing parameter of 10 (see Baxter and King 1995 for details). Following the real business cycle literature I describe North-South business cycles by various second moment properties of the filtered data.

4.1 Business cycle comovement

First, I turn my attention to North-South comovement. The defining characteristic of the North-South business cycle is the positive contemporaneous correlation between Northern and Southern gross domestic product (see the second column of table 3). Underlying this statistic is the strong positive contemporaneous comovement of Northern and Southern manufacturing value-added. In contrast to manufacturing value-added the contemporaneous correlations of all other North-South variables are not significantly different from zero. However, lagged Northern and current Southern data yield a completely different outcome. The third column of table 3 shows that this lead/lag relationship generates significant positive correlations between all non-primary Northern and Southern variables. With the obvious exception of manufactured output, these non-primary correlations greatly exceed the value of their contemporaneous correlations. Note, primary activity is poorly correlated across regions.

Data generated from the bond and complete markets models capture the basic features of North-South comovement. In particular, the model generates positive cross-region comovement of all the major macro-aggregates, while generating the pattern of cross-region sectoral correlations. Both models tend to overstate the contemporaneous correlation of Northern and Southern consumption and investment expenditure. The models differ significantly along four dimensions. First, the complete markets model generates lower North-South comovement of manufacturing activity. Second, the correlation between Northern and Southern labor hours is higher in the complete markets model. Third, the correlation of Northern and Southern investment is lower in the complete markets model. Finally, cross-region consumption correlations are lower in the complete markets model.

A popular explanation for why we observe a North-South business cycle is that shocks are transmitted from North to South through goods market trade. In particular, positive shocks to Northern activity increase the demand for the Southern exportable. This raises the relative price of the Southern exportable. Improvements in the South's terms of trade increase Southern real income and ultimately Southern consumption and production. A well-known North-South stylized fact in support of this is the strong positive correlation between Northern manufacturing output and real commodity prices (ratio of primary non-fuel commodity to manufactured goods prices) reported in table 4. A lesser known feature of the data is that real commodity prices are weakly negatively correlated with primary activity in both regions. Table 4 shows that data generated by the bond and complete market economies closely match the observed correlations between relative prices and activity in the North and South.

Finally, table 5 reveals that each of the regional economies displays a business cycle. In particular, consumption and investment are highly correlated with non-primary activity. In contrast, there is low coherence between primary activity and non-primary activity in both regional economies. Table 5 shows that data generated by the bond and complete market models match the data along all these avenues.

The bond and complete markets data differ along one important dimension. The correlation between domestic consumption expenditure and aggregate domestic production is higher in the complete markets case. This suggests that there is a stronger link between domestic activity and domestic consumption in the complete markets case.

4.2 Business cycle volatility

Table 6 reveals many common features in the cyclical volatility the North and South: consumption is less volatile than aggregate gross domestic product (GDP); investment is more volatile than GDP; and primary and manufacturing value-added is more volatile than aggregate GDP.

A central feature of the North-South debate is the cyclic behavior of the South's terms of trade. In an earlier paper Kouparitsas (1997b) I show that fluctuations in the terms of trade of Southern countries largely reflect movements in real commodity prices. Table 6 suggests that real commodity prices and the North-South terms of trade are considerably more volatile than Northern and Southern aggregate output.

Table 6 shows that the bond and complete markets versions of the model capture these features of North-South business cycles. In particular, the model captures the following features of the data: the pattern of sectoral output volatility; the pattern of consumption and investment volatility; the high volatility of relative prices; and the volatility of the ratio of Northern and Southern net exports to GDP. Data generated from the complete markets model differ significantly from the bond market data in two ways. First, the complete markets model generates smoother terms of trade and real commodity prices. Second, Southern consumption and investment expenditure are less volatile in the complete markets model.

5 North-South business cycle transmission

Following the theoretical work of Cole (1988, 1993) it is generally argued that by having a more diversified portfolio an agents wealth is less sensitive to fluctuations in domestic activity and more dependent on foreign economic fluctuations. This is expected to reduce the link between domestic production and consumption, while raising the correlation between domestic consumption and foreign output. Overall, risk-pooling is expected to lower the volatility of consumption, raise the variability of labor input, and raise the correlation between domestic and foreign consumption.

Recently, Baxter and Crucini (1995) and Kollman (1990) have extended Cole's two period endowment analysis by allowing for infinitely lived agents, endogenous production, capital accumulation and variable labor effort in a quantitative general equilibrium setting. They find weak quantitative support for this argument when their models are driven by stationary productivity shocks. Baxter and Crucini (1995) examine different productivity processes and find that the results are stronger if productivity shocks are permanent.

More recently Arvanitis and Mikkola (1996) have extended this class of models to include less than perfect substitutability between home and foreign goods. They find that a symmetric North-North model generates the opposite set of results when the elasticity of substitution between home and foreign goods is less than unity and productivity shocks are stationary. In particular, diversification leads to greater volatility of consumption and it lowers the cross-country consumption correlation. These results are stronger for lower elasticities of substitution. The main difference between the low-elasticity model and its antecedents is that the earlier models generate low terms of trade volatility, while the more recent model generates higher terms of trade volatility that is closer to that observed in the data.

Cole and Obstfeld (1991) argue that while the impact of diversification among industrial countries is small, this not likely to be the case for developing countries. My simulation results suggest that greater integration of North-South asset markets has an impact on the North-South business cycle. Specifically, I find that greater financial market integration (a) lowers Southern business cycle volatility and (b) weakens cross-region expenditure and output correlations. The remainder of this section explores the economic mechanisms that produce these results.

5.1 Basic intuition

In figure 1 I consider a simple static environment. The home country is endowed with a bundle (y_1, y_2). The relative price of good 1 is p_1/p_2. At these prices the home country's budget line passes through the endowment at point A and the optimal expenditure bundle is (e_1, e_2) at point B (where u is tangent to the budget line). Given these prices and endowments the home country is a net exporter of good 1 and a net importer of good 2. Now consider a shift in the relative price of good 1 from p_1/p_2 to p_1/p_2'. At these prices and the initial endowment, the home countries real income in terms of good 2 increases by R'. The optimal expenditure bundle is (e_1', e_2') at C (where u' is tangent to the new budget line).

Now let's say I alter the country's endowment bundle so that it is identical to the initial expenditure bundle (y_1'', y_2'')=(e_1, e_2). Given these prices and endowments the home country is neither a net exporter or net importer of good 1 or 2. Now consider the same shift in the relative price of good 1 from p_1/p_2 to p_1/p_2'. At these prices and endowment, the home countries real income in terms of good 2 increases by $R'' < R'$. The optimal expenditure bundle is (e_1'', e_2'') at D (where u'' is tangent to the new budget line).

These experiments highlight the essential difference between the bond and complete market models. In the incomplete setting the South has a production (endowment) bundle that is different from its expenditure bundle (i.e., the South exports primary raw materials and imports manufactured goods). Fluctuations in relative prices of primary and manufactured goods lead to large terms of trade fluctuations and movements in the real income of the South. In the complete markets setting the South has a smaller claim to world primary good output and a larger claim to world manufacturing output. Although its production bundle is unchanged its endowment is closer to its expenditure bundle. From my static example I know that in this setting relative price movements lead to smaller fluctuations in Southern real income (and wealth). Therefore, this part of the North-South business cycle transmission mechanism is weakened. It is replaced by a pure transfer of income from North to South (i.e., positive shocks to Northern activity add to the wealth of the South through the output pooling arrangement). In terms of the simple model the two environments are observationally equivalent if the pure income transfer shifts the budget line in the (y_1'', y_2'') case such that the new expenditure bundle is at C. This would require a transfer in terms of good 2 of $R' - R''$. Evidence presented in earlier tables and the figures below suggest that improvements in Southern real income following a positive shock to Northern activity are weaker in the complete markets case.

5.2 Response to a Northern Manufacturing shock

In figure 2 I plot the model's response to an unanticipated 1 percent increase in Northern manufacturing productivity in the bond economy. The increase in Northern manufacturing productivity increases the demand for all intermediate inputs. Capital and labor adjustment costs combined with an important fixed factor (land) limit the ability of primary sector activity to adjust in the short-run, so primary sector prices rise in response to increased demand. The lower panel shows that real commodity prices rise by almost 4 percent. The South is a net exporter of primary goods, so higher real commodity prices lead to an improvement in the South's terms of trade and real income. Northern and Southern households respond to their higher level of income by increasing their consumption of manufactured goods.

Northern producers respond to increased consumption and intermediate good demand by expanding production of primary goods. The Northern expansion is also reflected by greater capital investment. Northern agents substitute consumption and leisure in response to higher real wages. Northern and Southern manufactured goods are complements so part of the increased Southern consumption of manufactured goods is satisfied by imports and part is satisfied by increased domestic production. Finally, labor effort increases in response to higher real wages.

Figure 3 plots the model's response to an unanticipated 1 percent shock to Northern manufacturing productivity in the complete market economy. The higher level of Northern productivity again raises the demand for all manufactured inputs. Primary sector is slow to adjust in the short-run, so primary sector prices rise in response to increased demand. In the complete markets economy the North and South share their traded output, so the South has claim to a smaller share of world primary output. This leads to a considerably smaller increase in Southern real income than in the bond case. In contrast, the North has claim to a greater share of world primary output, which means that their real income rises by more than the bond market case. Lower real income in the South and higher real income in the North are reflected in weaker output and expenditure responses in the South and stronger output and expenditure responses in the North.

5.3 Dynamic Hicksian decomposition

To gain additional insight into the factors underlying the consumption and labor input responses to the Northern manufacturing shock I employ King's (1990) *Hicksian decomposition* methodology. Using King's method I decompose consumption and labor effort responses into: a wealth effect; interest rate effect; and real wage effect. These decomposition are plotted in figures 4 and 5, respectively. The wealth effect is computed as follows. First, compute the discounted present value of the change in utility caused by the altered time path of consumption and leisure (in response to the shock). Next, compute the constant consumption and leisure profiles that yield the same change in utility, using initial steady state wages and interest rates. The real interest rate effect is that part of the response due to changes in the interest rate alone, holding wealth and wage rates at their initial steady state levels. The wage effect is computed in a similar fashion holding constant wealth and interest rates at their initial levels.

The structure of North-South asset markets has little impact on the consumption path of the Northern economy. The Northern wealth effect is lower in the incomplete setting. Positive shocks to Northern manufacturing lead to a deterioration in the Northern terms of trade in both models. In support of my basic intuition the loss of real income and wealth due to the deterioration is smaller under the risk-sharing arrangement. In contrast to the North, the structure of North-South asset markets has a dramatic impact on the consumption path of the Southern economy. The sizable improvement in the South's terms of trade in the bond market leads to a significant positive wealth effect. Again, in support of my basic intuition risk-sharing leads to a smaller improvement in Southern real income and this is reflected by a smaller wealth effect in the complete markets economy.

Northern and Southern substitution effects from changes in the interest rate are virtually identical in the two models. This reflects the fact that changes in interest rates are similar in the models. In contrast, the paths of Northern and Southern real wages are quite different under the competing asset structures. Northern real wages are higher in the complete market model. Therefore, Northern agents are more willing to substitute consumption and leisure in the complete market setting, which leads to a higher consumption path in that economy. Southern real wages are higher in the bond market economy, so there is greater substitution of consumption and leisure in the South in that economy. Overall, the significantly higher path of the Southern consumption in the bond economy is driven by larger wealth and wage effects.

Labor responses mirror the consumption responses. Higher wage effects are offset by larger wealth effects in the complete market economy, so the paths for Northern labor input are similar in the two models. In contrast, Southern labor input responses are similar in the two models because the strong wage effect in the bond market economy is offset by a strong wealth effect.

6 Conclusion

This paper examines the business cycle implications of increased North-South trade in financial assets. I build a quantitative general equilibrium model of North-South trade and compare the models predictions under two asset market assumptions: a restricted setting in which asset trade is limited to a non-contingent one-period bond market; and a highly integrated setting in which agents have access to a complete contingent-claims market. The model predicts that greater asset market diversification leads to (a) lower Southern business cycle volatility and (b) lower cross-region output and consumption correlations.

These result emerge because the risk-pooling arrangement weakens the endogenous business cycle transmission mechanism present in the bond market economy. In both economies (bond and complete market) shocks to Northern activity produce large fluctuations in real commodity prices. In the bond market economy the South is a large net exporter of primary goods so the relative price movements result in large movements in Southern wealth. In the complete markets setting the North and South pool their traded output. Under this arrangement the South has claim to a smaller share of world primary activity than in the bond economy (i.e., the South is no longer a net exporter of primary goods). This means that even though shocks to Northern activity have a similar impact on real commodity prices the South experiences a smaller improvement in their real income. Hence, I find that as the Southern portfolio becomes more diversified Southern wealth is more sensitive to fluctuations in domestic activity and less dependent on foreign economic fluctuations. This strengthens the link between domestic production and consumption, while lowering the correlation between domestic consumption and foreign output (and consumption) in the South.

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A Data sources and definitions

This appendix describes the sources and definitions of the data underlying: tables 2–6; and the US sectoral productivity estimates of section 4.

A.1 Sources

The main data source is World Bank (1991). This data set provides time series on price levels, values and volumes of production, expenditure and trade for 178 countries covering the years from 1969 to 1988. I limit the dataset to the *market-based* economies that have the best data coverage. These 90 countries are listed in appendix C. The analysis focuses on trade between Northern and Southern non-fuel exporters. Non-fuel goods include non-fuel primary commodities and manufactured goods. The division of countries into fuel and non-fuel groups is based on World Bank (1992), World Tables, table 2. The distinction between a Northern and Southern economy is based on income levels. The North includes high income countries, while the South comprises low and middle income countries. The countries are classified by income according to World Bank (1992), World Tables, table 1.

Detailed trade and industry data used in calibrating the model comes from the following United Nations publications: National Accounts: Main Aggregates and Detailed Tables (1990a), National Accounts: Study of Input-Output Tables (1987), the Handbook of International Trade and Development Statistics (1992) (UNCTAD), and Yearbook of International Trade Statistics (1990b). In addition to US Department of Commerce (1984), Survey of Current Business.

A.2 Aggregation

A country's weight in a regional and world aggregate is based on the US$ value of their output, consumption, investment, exports and imports. The World Bank uses the Atlas method to construct comparable US$ series across countries. Specifically, let x_{jt} represent country j's real output, p_{jt} the US$ price of that output then country j's share of regional output at time t (α_{jt}) is given by the following:

$$\alpha_{jt} = \frac{p_{jt}x_{jt}}{\sum_j p_{jt}x_{jt}} \tag{A.1}$$

World Tables volume data is constructed by a Laspeyres index. Therefore, base year weights are sufficient for aggregation of volume data. Base years differ across countries, so I set the country weights to their sample average over 1969-1988. The regional and world quantity aggregate is given by:

$$x_t = \sum_j p_{jo}x_{jt} \tag{A.2}$$

where p_{jo} denotes base year prices and x_t is the regional aggregate at time t. Note that using the country weights explicitly and a log-linear approximation it follows that the log of the regional and world aggregates are given the following:

$$\ln x_t = \sum_j \alpha_{jo} \ln x_{jt} \tag{A.3}$$

where α_{jo} denotes the base year weight and $\ln x_t$ is the natural logarithm of regional aggregate at time t. The Hodrick and Prescott (1980) filtered log data in tables 1–4 are constructed using the latter method (A.3).

By virtue of the fact that quantities are constructed by Laspeyres index the World Tables price series are constructed by Paasche index. Our regional and world prices indices are also based on Paasche indices:

$$p_t = \frac{\sum_j p_{jt}x_{jt}}{\sum_j p_{jo}x_{jt}} \tag{A.4}$$

where p_t is the regional price index.

This paper is concerned with trade between the North and South. Roughly 85 percent of Southern trade involves trade with Northern economies, which suggests Southern trade data are indicative of North-South trade volumes and prices. Therefore, I describe the North-South terms of trade by the ratio of the aggregate Southern non-fuel exports price to aggregate Southern non-fuel import price. World non-fuel primary prices and manufactured goods prices are constructed from World Tables non-fuel primary and manufactured exports values and price indices. Individual country prices are weighted by their share of world exports.

Northern net non-fuel exports to gross domestic product is defined as the ratio of value of Northern non-fuel exports in US$ minus the value of Northern non-fuel imports in US$ divided by the US$ value of Northern gross domestic product. Southern net non-fuel exports to gross domestic product is constructed in a similar fashion.

A.3 Sectoral, expenditure and trade classifications

World Bank World Tables sectoral classifications are based on International Standard Industry Classifications (ISIC). The sectoral World Tables data contain time series on agriculture, industrial, manufacturing and services value-added. Industrial includes manufacturing, mining and construction. I measure total gross domestic product as total gross domestic product at factor cost. Primary, manufacturing and service output are respectively agriculture, manufacturing and service value-added. Sectoral shares are based on World Tables sectoral data and table 6.3 of UNCTAD. For these calculations the primary sector includes (ISIC) agriculture and mining, manufacturing combines (ISIC) manufacturing and construction. North-South input-output shares are derived from the 1977 input-output tables of the United States and Chile. The input-output table for Chile is from United Nations (1987). The US input-output table is from US Department of Commerce (1984).

World Tables expenditure data includes private final consumption, public expenditure, fixed investment, changes in inventories, exports and imports. I ignore the government sector in our model and measure consumption as private final consumption. Investment is defined as fixed investment plus change in inventories. Expenditure shares are based on World Tables expenditure data and table 6.3 of UNCTAD. World Bank World Tables trade classifications are based on Standard International Trade Classifications (SITC). Primary non-fuels = SITC 0+1+2+4+68, and manufactured goods = SITC 5+6+7+8-68. Trade flows reported in table D1 are also based on SITC classifications. All other trade data is based on ISIC classifications.

A.4 US sectoral productivity data

United States sectoral data used in the construction of US sectoral productivity shocks is from Shapiro (1987a,b). These data include labor hours, capital stocks, total labor compensation (wages), and value-added for thirteen ISIC one-digit industries for the period 1948–1985. Primary, manufacturing and service sector labor hours, capital stocks, labor income and value-added are consistent with the World Bank World Table and model definitions of the previous subsection. See Shapiro (1987a,b) for further details.

B Model solution and linearization procedures

This appendix provides details of the model solution procedures used in this paper.

B.1 Model solution

The equilibrium of the economy described by (2.1)-(2.13) consists of a set of functions describing the behavior of endogenous variables such as consumption, investment, production, etc., as functions of the exogenous shocks to the model and the stocks of capital in place in each country. I follow Baxter and Crucini's (1995) approach to solving two-country models with restricted asset trade. First, I assume that the countries are small open economies that optimize in the face of an exogenous process for the world interest rate and commodity prices. Second, I describe the general equilibrium solution by bringing together the solutions of the two small open economy problems and imposing market clearing conditions for the asset and goods markets. In the general equilibrium interest rates and commodity prices are determined endogenously.

Partial small open economy problem A straight forward way to compute the solution for the small open economy is to solve the following Lagrangian problem:

$$
\begin{aligned}
\mathcal{L}_j = E_0 \textstyle\sum_{t=0}^{\infty} \quad & \beta^t \Big\{ \tfrac{1}{1-\sigma} \left(c_{jt}^{\theta_c} L_{jt}^{1-\theta_c} \right)^{1-\sigma} \\
& + \omega_{jt} \left[1 - L_t - \textstyle\sum_{i=1}^{2} N_{ijt} \right] \\
& + \textstyle\sum_{i=1}^{2} \zeta_{Nijt} \left[LN_{ijt+1}^{s} - N_{ijt}^{s} \right] \\
& + \textstyle\sum_{i=1}^{2} \lambda_{Nijt} \left[\phi_{Ni} \left(N_{ijt}/LN_{ijt}^{s} \right) LN_{ijt}^{s} - LN_{ijt+1}^{s} \right] \\
& + \textstyle\sum_{i=1}^{2} \zeta_{kijt} \left[k_{ijt} - k_{ijt}^{s} \right] \\
& + \textstyle\sum_{i=1}^{2} \lambda_{kijt} \left[(1-\delta_k) k_{ijt} + \phi_{ki} \left(i_{ijt}/k_{ijt} \right) k_{ijt} - k_{ijt+1} \right] \\
& + \zeta_{mjt} \left[m_{jt} - m_{jt}^{s} \right] \\
& + \lambda_{mjt} \left[i_{mjt} - m_{jt+1} \right] \\
& + \psi_{e1jt} \left[\left(\omega_{1j} h_{1jt}^{1-1/\sigma_{\mu 1}} + (1-\omega_{1j}) f_{1jt}^{1-1/\sigma_{\mu 1}} \right)^{\frac{1}{1-1/\sigma_{\mu 1}}} - i_{mjt} \right] \\
& + \psi_{e2jt} \left[\left(\omega_{2j} h_{2jt}^{1-1/\sigma_{\mu 2}} + (1-\omega_{2j}) f_{2jt}^{1-1/\sigma_{\mu 2}} \right)^{\frac{1}{1-1/\sigma_{\mu 2}}} - c_{jt} - i_{1jt} - i_{2jt} \right] \\
& + \zeta_{v2t} \left[A_{2jt} N_{2jt}^{s\theta_2} k_{2jt}^{s\alpha_2} - y_{v2jt} \right] \\
& + \lambda_{bjt} \left[\begin{array}{l} p_{1jt} A_{1jt} N_{1jt}^{s\theta_1} k_{1jt}^{s\alpha_1} + p_{2jt} \left\{ \omega_y y_{v2jt}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{jt}^{s1-1/\sigma_\varepsilon} \right\}^{\frac{1}{1-1/\sigma_\varepsilon}} \\ + b_{jt} - p_{1jt} h_{1jt} - p_{2jt} h_{2jt} - p_{1kt} f_{1jt} - p_{2kt} f_{2jt} - p_{bt} b_{jt+1} \end{array} \right] \Big\}
\end{aligned}
\tag{B.1}
$$

for $j = n, s$ and $k \neq j$. In programming this model, I found it convenient to introduce additional variables. In particular, I include capital services (k_{ijt}^{s}), intermediate good services (m_{2jt}^{s}), and lagged labor services (LN_{ijt}^{s}). The multipliers on the constraints in (B.1) have natural interpretations as utility denominated shadow prices. Specifically, ω_{jt} wage rate, ζ_{Nijt} value of marginal product of labor, λ_{Nijt} sector i value marginal product of existing labor, ζ_{kijt} sector i value marginal product of capital, λ_{kijt} sector i price of existing capital ζ_{v2jt} value marginal product of intermediate inputs, ζ_{v2t} value marginal product of value-added index, ψ_{e1jt} price of primary inputs, ψ_{e2jt} price of non-primary good expenditure,

λ_{bjt} price of Northern manufactured goods.

The first order necessary conditions for this Lagrangian problem are:

$$(c_{jt}) : \theta_c c_{jt}^{\theta_c(1-\sigma)-1} L_{jt}^{(1-\theta_c)(1-\sigma)} - \psi_{e2jt} = 0 \tag{B.2}$$

$$(L_{jt}) : (1-\theta_c) c_{jt}^{\theta_c(1-\sigma)} L_{jt}^{(1-\theta_c)(1-\sigma)-1} - \omega_{jt} = 0 \tag{B.3}$$

$$(N_{ijt}) : \lambda_{Nij} \phi'_{Ni}(N_{ijt}/LN_{ijt}^s) - \omega_{jt} = 0 \tag{B.4}$$

$$(N_{1jt}^s) : \theta_1 \lambda_{bjt} p_{1jt} A_{1jt} N_{1jt}^{s\theta_1 - 1} k_{1jt}^{s\alpha} - \zeta_{N1jt} = 0 \tag{B.5}$$

$$(N_{2jt}^s) : \theta_2 \zeta_{v2jt} A_{2jt} N_{2jt}^{s\theta_2 - 1} k_{2jt}^{s1-\theta_2} - \zeta_{N2jt} = 0 \tag{B.6}$$

$$(k_{1jt}^s) : \alpha_1 \lambda_{bjt} p_{1jt} A_{1jt} N_{1jt}^{s\theta_1} k_{1jt}^{s\alpha_1 - 1} - \zeta_{k1jt} = 0 \tag{B.7}$$

$$(k_{2jt}^s) : (1-\theta_2) \zeta_{v2jt} A_{2jt} N_{2jt}^{s\theta_2} k_{2jt}^{s-\theta_2} - \zeta_{k2jt} = 0 \tag{B.8}$$

$$(y_{v2jt}) : \lambda_{bjt} p_{2jt} \left(\omega_y y_{v2jt}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{jt}^{s1-1/\sigma_\varepsilon}\right)^{\frac{1}{1-1/\sigma_\varepsilon}-1} \omega_y y_{v2jt}^{-1/\sigma_\varepsilon} - \zeta_{v2jt} = 0 \tag{B.9}$$

$$(m_{jt}^s) : \lambda_{bjt} p_{2jt} \left(\omega_y y_{v2jt}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{jt}^{s1-1/\sigma_\varepsilon}\right)^{\frac{1}{1-1/\sigma_\varepsilon}-1} (1-\omega_y) m_{jt}^{s-1/\sigma_\varepsilon} - \zeta_{mjt} = 0 \tag{B.10}$$

$$(i_{ijt}) : \lambda_{kij} \phi'_{ki}(i_{ijt}/k_{ijt}^s) - \psi_{e2jt} = 0 \tag{B.11}$$

$$(i_{mjt}) : \lambda_{mj} - \psi_{e1jt} = 0 \tag{B.12}$$

$$(h_{1jt}) : \psi_{e1jt} \left(\omega_{1j} h_{1jt}^{1-1/\sigma_{\mu 1}} + (1-\omega_{1j}) f_{1jt}^{1-1/\sigma_{\mu 1}}\right)^{\frac{1}{1-1/\sigma_{\mu 1}}-1} \omega_{1j} h_{1jt}^{-1/\sigma_{\mu 1}} - \lambda_{bjt} p_{1jt} = 0 \tag{B.13}$$

$$(f_{1jt}): \psi_{e1jt}\left(\omega_{1j}h_{1jt}^{1-1/\sigma_{\mu1}} + (1-\omega_{1j})f_{1jt}^{1-1/\sigma_{\mu1}}\right)^{\frac{1}{1-1/\sigma_{\mu1}}-1}(1-\omega_{1j})f_{1jt}^{-1/\sigma_{\mu1}} - \lambda_{bjt}p_{1kt} = 0 \tag{B.14}$$

$$(h_{2jt}): \psi_{e2jt}\left(\omega_{2j}h_{2jt}^{1-1/\sigma_{\mu2}} + (1-\omega_{2j})f_{2jt}^{1-1/\sigma_{\mu2}}\right)^{\frac{1}{1-1/\sigma_{\mu2}}-1}\omega_{2j}h_{2jt}^{-1/\sigma_{\mu2}} - \lambda_{bjt}p_{2jt} = 0 \tag{B.15}$$

$$(f_{2jt}): \psi_{e2jt}\left(\omega_{2j}h_{2jt}^{1-1/\sigma_{\mu2}} + (1-\omega_{2j})f_{2jt}^{1-1/\sigma_{\mu2}}\right)^{\frac{1}{1-1/\sigma_{\mu2}}-1}(1-\omega_{2j})f_{2jt}^{-1/\sigma_{\mu2}} - \lambda_{bjt}p_{2kt} = 0 \tag{B.16}$$

$$(\omega_{jt}): 1 - L_t - \sum_{i=1}^{2} N_{ijt} = 0 \tag{B.17}$$

$$(\zeta_{Nijt}): LN_{ijt+1}^{s} - N_{ijt}^{s} = 0 \tag{B.18}$$

$$(\zeta_{kijt}): k_{ijt} - k_{ijt}^{s} = 0 \tag{B.19}$$

$$(\zeta_{mjt}): m_{jt} - m_{jt}^{s} = 0 \tag{B.20}$$

$$(\psi_{e1jt}): \left(\omega_{1j}h_{1jt}^{1-1/\sigma_{\mu1}} + (1-\omega_{1j})\, f_{1jt}^{1-1/\sigma_{\mu1}}\right)^{\frac{1}{1-1/\sigma_{\mu1}}} - i_{mjt} = 0 \tag{B.21}$$

$$(\psi_{e2jt}): \left(\omega_{2j}h_{2jt}^{1-1/\sigma_{\mu2}} + (1-\omega_{2j})\, f_{2jt}^{1-1/\sigma_{\mu2}}\right)^{\frac{1}{1-1/\sigma_{\mu2}}} - c_{2jt} - i_{1jt} - i_{2jt} = 0 \tag{B.22}$$

$$(\zeta_{v2t}): A_{2jt}N_{2jt}^{s\theta_2}k_{2jt}^{s\alpha_2} - y_{v2jt} = 0 \tag{B.23}$$

$$(LN_{ijt+1}^{s}): E_t\gamma_{Nij}(N_{ijt+1}/LN_{ijt+1}^{s})\beta\lambda_{Nijt+1} + \zeta_{Nijt} - \lambda_{Nijt} = 0 \tag{B.24}$$

$$(k_{ijt+1}): E_t\gamma_{ij}(i_{ijt+1}/k_{ijt+1})\beta\lambda_{kijt+1} + \beta E_t\zeta_{kijt+1} - \lambda_{kijt} = 0 \tag{B.25}$$

$$(m_{jt+1}) : \beta E_t \zeta_{mjt+1} - \lambda_{mjt} = 0 \tag{B.26}$$

$$(b_{jt+1}) : \beta E_t \lambda_{bt+1-} \lambda_{bt} p_{bt} = 0 \tag{B.27}$$

$$(\lambda_{Nijt}) : \phi_{Ni}\left(N_{ijt}/LN_{ijt}^{s}\right) LN_{ijt}^{s} - LN_{ijt+1}^{s} = 0 \tag{B.28}$$

$$(\lambda_{kijt}) : (1-\delta_k)k_{ijt} + \phi_{ki}\left(i_{ijt}/k_{ijt}\right) k_{ijt} - k_{ijt+1} = 0 \tag{B.29}$$

$$(\lambda_{mjt}) : i_{mjt} - m_{jt+1} = 0 \tag{B.30}$$

$$(\lambda_{bjt}) : \begin{array}{l} p_{1jt} A_{1jt} N_{1jt}^{s\theta_1} k_{1jt}^{s\alpha_1} + p_{2jt}\left\{\omega_y y_{v2jt}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{jt}^{s1-1/\sigma_\varepsilon}\right\}^{\frac{1}{1-1/\sigma_\varepsilon}} + b_{jt} \\ -p_{1jt}h_{1jt} - p_{2jt}h_{2jt} - p_{1kt}f_{1jt} - p_{2kt}f_{2jt} - p_{bt}b_{jt+1} = 0 \end{array} \tag{B.31}$$

$$E_0 \lim_{t\to\infty} \lambda_{kijt} k_{ijt+1} = 0 \tag{B.32}$$

$$E_0 \lim_{t\to\infty} \lambda_{bjt} b_{jt+1} = 0 \tag{B.33}$$

for $i = 1, 2$, $j = n, s$ and $k \neq j$, where $\gamma_{Nij}(z) \equiv [\phi_{Ni}(z) - z\phi_{Ni}'(z)]$ and $\gamma_{kij}(z) \equiv [\phi_{ki}(z) - z\phi_{ki}'(z) + (1-\delta_k)]$.

World general equilibrium In world general equilibrium, each of the regions faces the problem described above, but in general equilibrium the bond price (p_{bt}) and commodity prices (p_{ijt}'s) are endogenously determined. The the following constraints are imposed on the world general equilibrium. First, bond market clearing requires that:

$$(p_{bt}) : b_{nt} + b_{st} = 0 \tag{B.34}$$

since the bonds are in zero net supply in the world economy, while the efficiency conditions for b_{jt+1} yield the following condition:

$$(b_{nt+1}, b_{st+1}) : \beta E_t(\lambda_{bnt+1}/\lambda_{bnt}) = \beta E_t(\lambda_{bst+1}/\lambda_{bst}) = p_{bt} \tag{B.35}$$

Second, goods market clearing requires that:

$$(p_{1jt}) : y_{1jt} - h_{1jt} - f_{1kt} = 0 \tag{B.36}$$

$$(p_{2jt}) : y_{2jt} - h_{2jt} - f_{2kt} = 0 \tag{B.37}$$

for $j, k = n, s$ and $j \neq k$. I follow Baxter and Crucini's (1995) approach to computing the world general equilibrium. First, I drop one of the asset accumulation equations (B.31) since in a two region world only one of the asset stocks is independent. I drop the Northern region's asset accumulation equation. Second, I treat the Northern region's shadow price of Northern manufactured goods (λ_{bnt}) as an additional control variable. Third, I impose the equilibrium condition (B.35) by replacing p_{bt} with the expression $\beta E_t(\lambda_{bnt+1}/\lambda_{bnt})$ in the Southern accumulation equation for b_{st+1}:

$$(\lambda_{bst}) : \begin{array}{c} p_{1st} A_{1st} N_{1st}^{s\theta_1} k_{1st}^{s\alpha_1} + p_{2st} \left\{ \omega_y y_{v2st}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{st}^{s1-1/\sigma_\varepsilon} \right\}^{\frac{1}{1-1/\sigma_\varepsilon}} + b_{st} \\ -p_{1st} h_{1st} - p_{2st} h_{2st} - p_{1nt} f_{1st} - p_{2nt} f_{2st} - \beta E_t(\lambda_{bnt+1}/\lambda_{bnt}) b_{st+1} = 0 \end{array} \tag{B.38}$$

The world general equilibrium is described by the following system of equations: Northern {(B.2)-(B.26), (B.28)-(B.30), (B.36)-(B.37)}(note, $p_{2nt} = 1$, so (B.37) is the system's equation for λ_{bnt}); and Southern {(B.2)-(B.26), (B.28)-(B.30), (B.35)-(B.38)}.

B.2 Complete markets model

My characterization of the world equilibrium in the complete markets model follows other open economy trade studies. Researchers exploit the fact that the second welfare theorem applies in the complete markets setting, so the competitive equilibrium and Pareto optimum coincide. Thus a straightforward way to compute the solution for the complete markets economy is to solve the following Lagrangian problem:

$$
\begin{aligned}
\mathcal{L}_j = E_0 \textstyle\sum_{t=0}^{\infty} \beta^t \quad & \Big\{ \tfrac{\pi}{1-\sigma} \left(c_{nt}^{\theta_{cn}} L_{nt}^{1-\theta_{cn}} \right)^{1-\sigma} + \tfrac{1-\pi}{1-\sigma} \left(c_{st}^{\theta_{cs}} L_{st}^{1-\theta_{cs}} \right)^{1-\sigma} \\
& + \textstyle\sum_{j=n,s} \omega_{jt} \left[1 - L_{jt} - \sum_{i=1}^{2} N_{ijt} \right] \\
& + \textstyle\sum_{j=n,s} \sum_{i=1}^{2} \zeta_{Nijt} \left[LN_{ijt+1}^{s} - N_{ijt}^{s} \right] \\
& + \textstyle\sum_{j=n,s} \sum_{i=1}^{2} \lambda_{Nijt} \left[\phi_{Ni} \left(N_{ijt}/LN_{ijt}^{s} \right) LN_{ijt}^{s} - LN_{ijt+1}^{s} \right] \\
& + \textstyle\sum_{j=n,s} \sum_{i=1}^{2} \zeta_{kijt} \left[k_{ijt} - k_{ijt}^{s} \right] \\
& + \textstyle\sum_{j=n,s} \sum_{i=1}^{2} \lambda_{kijt} \left[(1-\delta) k_{ijt} + \phi_{ki} \left(i_{ijt}/k_{ijt} \right) k_{ijt} - k_{ijt+1} \right] \\
& + \textstyle\sum_{j=n,s} \zeta_{mjt} \left[m_{jt} - m_{jt}^{s} \right] \\
& + \textstyle\sum_{j=n,s} \lambda_{mjt} \left[i_{mjt} - m_{jt+1} \right] \\
& + \textstyle\sum_{j=n,s} \psi_{e1jt} \left[\left(\omega_{1j} h_{1jt}^{1-1/\sigma_{\mu 1}} + (1-\omega_{1j}) f_{1jt}^{1-1/\sigma_{\mu 1}} \right)^{\frac{1}{1-1/\sigma_{\mu 1}}} - i_{mjt} \right] \\
& + \textstyle\sum_{j=n,s} \psi_{e2jt} \left[\left(\omega_{2j} h_{2jt}^{1-1/\sigma_{\mu 2}} + (1-\omega_{2j}) f_{2jt}^{1-1/\sigma_{\mu 2}} \right)^{\frac{1}{1-1/\sigma_{\mu 2}}} - c_{jt} - i_{1jt} - i_{2jt} \right] \\
& + \textstyle\sum_{j=n,s} \zeta_{v2t} \left[A_{2jt} N_{2jt}^{s\theta_2} k_{2jt}^{s\alpha_2} - y_{v2jt} \right] \\
& + \textstyle\sum_{\substack{k,j=n,s \\ k \neq j}} \lambda_{bjt} p_{1jt} \left[A_{1jt} N_{1jt}^{s\theta_{1j}} k_{1jt}^{s\alpha_{1j}} - h_{1jt} - f_{1kt} \right] \\
& + \textstyle\sum_{\substack{k,j=n,s \\ k \neq j}} \lambda_{bjt} p_{2jt} \left[\left\{ \omega_y y_{v2jt}^{1-1/\sigma_\varepsilon} + (1-\omega_y) m_{jt}^{s1-1/\sigma_\varepsilon} \right\}^{\frac{1}{1-1/\sigma_\varepsilon}} - h_{2jt} - f_{2kt} \right] \Big\}
\end{aligned} \tag{B.39}
$$

The first order necessary conditions for this Lagrangian problem are

$$
(c_{nt}) : \pi \theta_{cn} c_{nt}^{\theta_{cn}(1-\sigma)-1} L_{nt}^{(1-\theta_{cn})(1-\sigma)} - \psi_{e2nt} = 0 \tag{B.40}
$$

$$
(c_{st}) : (1-\pi) \theta_{cs} c_{st}^{\theta_{cs}(1-\sigma)-1} L_{st}^{(1-\theta_{cs})(1-\sigma)} - \psi_{e2st} = 0 \tag{B.41}
$$

$$(L_{nt}) : \pi\theta_{cn}(1-\sigma)c_{nt}^{\theta_{cn}(1-\sigma)}L_{nt}^{(1-\theta_{cn})(1-\sigma)-1} - \omega_{nt} = 0 \tag{B.42}$$

$$(L_{st}) : (1-\pi)\theta_{cs}(1-\sigma)c_{st}^{\theta_{cs}(1-\sigma)}L_{st}^{(1-\theta_{cs})(1-\sigma)-1} - \omega_{st} = 0 \tag{B.43}$$

(B.5–B.26), (B.28–B.30), B.32 and (B.36–B.37) for $i = 1, 2$, $j = n, s$ and $k \neq j$.

B.3 Log-linearization and state space solution

The procedure described above yields a dynamic system of equations that can be linearized and solved using the method advanced in the real business cycle literature by King, Plosser and Rebelo (1988, 1990). I briefly summarize their methodology. First, linearization of the non-linear system is achieved by a first-order Taylor series approximation at the model's steady state. This yields a linear system where the arguments are percentage deviations from steady state, $\hat{x}_t = (x_t - \bar{x})/\bar{x}$ where $\bar{x}$ is the steady state value of x. For small percentage deviations $\hat{x}_t \simeq \ln(x_t) - \ln(\bar{x})$, which conveniently allows the model data to be compared to logged actual data. Second, the resulting linear system is solved using standard linear systems theory (see King, et al. for details).

C. Country lists

C.1 Northern and Southern regions

C.1.1 Southern countries

Low-income countries

Benin
Burkina Faso
Central African Republic
Egypt
Ethiopia
Gambia, The
Ghana
Guyana
Haiti
Honduras
India
Kenya
Lesotho
Madagascar
Malawi
Mali
Mauritania
Nepal
Niger
Pakistan
Rwanda
Sierra Leone
Somalia
Sudan
Tanzania
Togo
Uganda
Zaire
Zambia

Middle-income countries

Argentina
Barbados
Bolivia
Botswana
Brazil
Cameroon
Chile
Colombia
Costa Rica
Dominican Republic
Ecuador
El Salvador
Fiji
Greece
Guatemala
Jamaica
Jordan
Korea, Republic of
Malaysia
Malta
Mauritius
Mexico
Morocco
Nicaragua
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Portugal
Senegal
South Africa
Syrian Arab Republic
Thailand
Tunisia
Turkey
Uruguay
Zimbabwe

C.1.2. Northern Countries

Australia
Austria
Canada
Cyprus
Denmark
Finland
France
Germany
Hong Kong
Iceland
Ireland
Israel
Italy
Japan
Netherlands
New Zealand
Norway
Singapore
Spain
Sweden
Switzerland
United Kingdom
United States

Table 1: Benchmark parameters

Parameter	North	South	Global
Preferences			
β			0.98
σ			2.00
θ_c consistent with market time N:			0.20
Production			
δ			0.025
Primary sector			
θ_1			0.25
α_1			0.35
$(i/k)/(\phi_k'/\phi_k'')$			-0.70
$(N/N^s)/(\phi_N'/\phi_N'')$			-50.00
Manufacturing sector			
σ_ε			0.20
θ_2			0.65
ω_y consistent with value-added cost share:			0.90
$(i/k)/(\phi_k'/\phi_k'')$			-0.10
$(N/N^s)/(\phi_N'/\phi_N'')$			-0.0001
Trade			
Primary			
$\sigma_{\mu 1}$			1.00
ω_1 consistent with imports/(total domestic usuage) share:	0.40	0.11	
Manufacturing			
$\sigma_{\mu 2}$			0.50
ω_2 consistent with imports/(total domestic usuage) share:	0.03	0.34	

Table 2: Actual and model steady state shares

Variable	North Data	North Model	South Data	South Model
Production-Domestic share				
Output gross domestic product	1.00	1.00	1.00	1.00
Primary value-added	0.08	0.07	0.26	0.27
Manufacturing value-added	0.92	0.93	0.74	0.73
Production-World share				
Output gross domestic product	0.84	0.85	0.16	0.15
Primary value-added	0.48	0.53	0.52	0.47
Manufacturing value-added	0.87	0.86	0.13	0.14
Labor-Sectoral share				
Primary		0.03		0.13
Manufacturing		0.97		0.87
Investment-Sectoral share				
Primary		0.06		0.25
Manufacturing		0.94		0.75
Expenditure-Share of GDP				
Consumption	0.75	0.78	0.77	0.80
Investment	0.25	0.22	0.24	0.20
Exports	0.04	0.07	0.15	0.34
Imports	0.04	0.07	0.17	0.34
Trade-Export shares				
Primary	0.20	0.03	0.58	0.58
Manufacturing	0.80	0.97	0.42	0.42

Notes: Author's calculations based on data from World Bank (1991) and United Nations (1992), Tables 6.3 and 6.4.

Table 3: Asset market structure and business cycle correlations

Variable	Correlation with same variable in South at t+j j= -1	j= 0	j= +1
Northern variable at t	**Data (1969-1988)**		
Gross Domestic Product (GDP)	-0.27	0.44	0.68
	(0.21)	(0.14)	(0.13)
Primary Output	0.18	-0.07	-0.17
	(0.23)	(0.21)	(0.22)
Manufacturing Output	-0.38	0.52	0.58
	(0.19)	(0.12)	(0.17)
Consumption	-0.25	0.09	0.74
	(0.25)	(0.20)	(0.12)
Investment	-0.27	0.18	0.49
	(0.17)	(0.17)	(0.19)
	Bond market model		
Gross Domestic Product (GDP)	0.22	0.52	0.05
Primary Output	-0.05	-0.07	0.03
Manufacturing Output	0.19	0.52	0.03
Consumption	0.24	0.75	0.11
Investment	0.21	0.74	0.09
Labor Hours	-0.07	0.51	0.21
	Complete markets model		
Gross Domestic Product (GDP)	0.21	0.47	0.04
Primary Output	-0.07	-0.07	0.06
Manufacturing Output	0.16	0.45	0.04
Consumption	0.20	0.45	0.04
Investment	0.20	0.60	0.06
Labor Hours	-0.05	0.73	0.23

Notes: Items in the data section report the author's calculations based on data from World Bank (1991). Values in parentheses are GMM standard errors using a QS kernel. The remaining sections report averages over 100 simulations of 80 quarters (20 years) for the bond and complete markets models respectively. Actual and model data are Hodrick and Prescott (1980) filtered with a smoothing parameter of 10. Quantities are logged prior to filtering. See appendix A for a detailed description of the data and appendix C for a listing of countries by region.

Table 4: International Correlations

Correlation with:	Northern NX / GDP	Northern Terms of Trade	World Real Commodity Prices
	Data (1969-1988)		
Northern			
GDP	-0.65	-0.23	0.50
	(0.20)	(0.20)	(0.20)
Primary	0.14	0.20	-0.20
	(0.21)	(0.15)	(0.17)
Manufacturing	-0.61	-0.40	0.49
	(0.17)	(0.16)	(0.15)
NX / GDP		0.10	-0.31
		(0.24)	(0.23)
	Bond market economy		
Northern			
GDP	-0.47	-0.55	0.36
Primary	0.47	0.31	-0.56
Manufacturing	-0.55	-0.61	0.45
NX / GDP		0.96	-0.96
	Complete market economy		
Northern			
GDP	-0.49	-0.52	0.35
Primary	0.45	0.30	-0.57
Manufacturing	-0.57	-0.59	0.43
NX / GDP		0.96	-0.95

Correlation with:	Southern NX / GDP	Southern Terms of Trade	World Real Commodity Prices
	Data (1969-1988)		
Southern			
GDP	-0.37	0.11	0.07
	(0.24)	(0.18)	(0.22)
Primary	-0.39	0.02	-0.32
	(0.21)	(0.21)	(0.25)
Manufacturing	-0.29	0.27	0.19
	(0.27)	(0.21)	(0.27)
NX / GDP		0.28	0.40
		(0.23)	(0.22)
	Bond market economy		
Southern			
GDP	0.04	0.05	0.12
Primary	-0.12	-0.26	-0.18
Manufacturing	0.10	0.18	0.22
NX / GDP		0.96	0.96
	Complete market economy		
Southern			
GDP	-0.03	-0.03	0.05
Primary	-0.08	-0.29	-0.16
Manufacturing	0.00	0.10	0.13
NX / GDP		0.96	0.95

Notes: tems in the data section report the author's calculations based on data from World Bank (1991). Values in parentheses are GMM standard errors using a QS kernel. The remaining sections report averages over 100 simulations of 80 quarters (20 years) for the bond and complete markets models respectively. Actual and model data are Hodrick and Prescott (1980) filtered with a smoothing parameter of 10. Real commodity prices = ratio of world non-fuel commodity prices to world manufactured goods prices. Terms of trade = ratio of non-fuel export prices to non-fuel mport prices. Quantity and price ratios are logged prior to filtering. See appendix A for a detailed description of the data and appendix C for a listing of countries by region.

Table 5: Regional business cycles

Correlation with:	Northern Pri	Northern Man	Northern Con	Northern Inv	Correlation with:	Southern Pri	Southern Man	Southern Con	Southern Inv
		Data (1969-1988)					**Data (1969-1988)**		
Northern					**Southern**				
GDP	0.04	0.95	0.84	0.96	**GDP**	0.11	0.76	0.76	0.89
	(0.31)	(0.02)	(0.10)	(0.02)		(0.26)	(0.12)	(0.19)	(0.20)
Primary		0.01	-0.15	0.00	**Primary**		-0.46	0.07	0.25
		(0.26)	(0.25)	(0.29)			(0.21)	(0.18)	(0.29)
Manufacturing			0.80	0.89	**Manufacturing**			0.75	0.72
			(0.14)	(0.06)				(0.20)	(0.25)
Consumption				0.82	**Consumption**				0.57
				(0.10)					(0.21)
		Bond market economy					**Bond market economy**		
Northern					**Southern**				
GDP	0.42	0.99	0.99	0.98	**GDP**	0.54	0.91	0.77	0.84
Primary		0.32	0.40	0.48	**Primary**		0.17	0.16	0.22
Manufacturing			0.98	0.97	**Manufacturing**			0.84	0.89
Consumption				0.96	**Consumption**				0.95
		Complete market economy					**Complete market economy**		
Northern					**Southern**				
GDP	0.42	0.99	0.98	0.99	**GDP**	0.54	0.91	0.91	0.92
Primary		0.32	0.33	0.45	**Primary**		0.17	0.20	0.26
Manufacturing			0.99	0.98	**Manufacturing**			0.99	0.97
Consumption				0.95	**Consumption**				0.95

Notes: Items in the data section report the author's calculations based on data from World Bank (1991). Values in parentheses are GMM standard errors using a Ç kernel. The remaining sections report averages over 100 simulations of 80 quarters (20 years) for the bond and complete markets models respectively. Actual and model data are Hodrick and Prescott (1980) filtered with a smoothing parameter of 10. Quantities are logged prior to filtering. See appendix A for a detailed description of the data and appendix C for a listing of countries by region.

Table 6: Asset market structure and business cycle volatility

Variable	Percentage Standard Deviation from trend: Data (1969-1988)	Model: Bond	Model: Complete	Ratio of Complete/ Bond
Northern				
Gross Domestic Product (GDP)	1.38 (0.25)	1.41	1.41	1.00
Primary Output	2.62 (0.51)	2.59	2.58	1.00
Manufacturing Output	1.43 (0.22)	1.44	1.44	1.00
Consumption	1.02 (0.17)	0.77	0.83	1.08
Investment	3.38 (0.65)	3.45	3.54	1.02
Labor Hours		0.54	0.55	1.01
Non-Fuel Net Exports / GDP	0.22 (0.05)	0.18	0.22	1.23
Southern				
Gross Domestic Product (GDP)	0.78 (0.18)	1.00	1.00	1.00
Primary Output	1.46 (0.21)	1.49	1.51	1.02
Manufacturing Output	1.10 (0.16)	1.16	1.15	0.99
Consumption	0.71 (0.11)	0.86	0.68	0.79
Investment	2.53 (0.54)	2.94	2.60	0.88
Labor Hours		0.46	0.43	0.94
Non-Fuel Net Exports/ GDP	0.67 (0.12)	0.91	1.12	1.23
Non-Fuel Terms of Trade (px/pm)	4.74 (0.60)	4.63	3.74	0.81
Real Commodity Prices (p1/p2)	6.98 (1.08)	6.74	6.58	0.98

Notes: tems in the data column report the author's calculations based on data from World Bank (1991). Values in parenthese are GMM standard errors using a QS kernel. The remaining columns report averages over 100 simulations of 80 quarters (20 years) for the bond and complete markets models respectively. Actual and model data are Hodrick and Prescott (1980) filtered with a smoothing parameter of 10. Real commodity prices = ratio of world non-fuel commodity prices to world manufactured goods prices. Terms of trade = ratio of non-fuel export prices to non-fuel import prices. Quantity and price ratios are logged prior to filtering. See appendix A for a detailed description of the data and appendix C for a listing of countries by region.

Figure 1: The effects of a terms of trade improvement in a simple static model

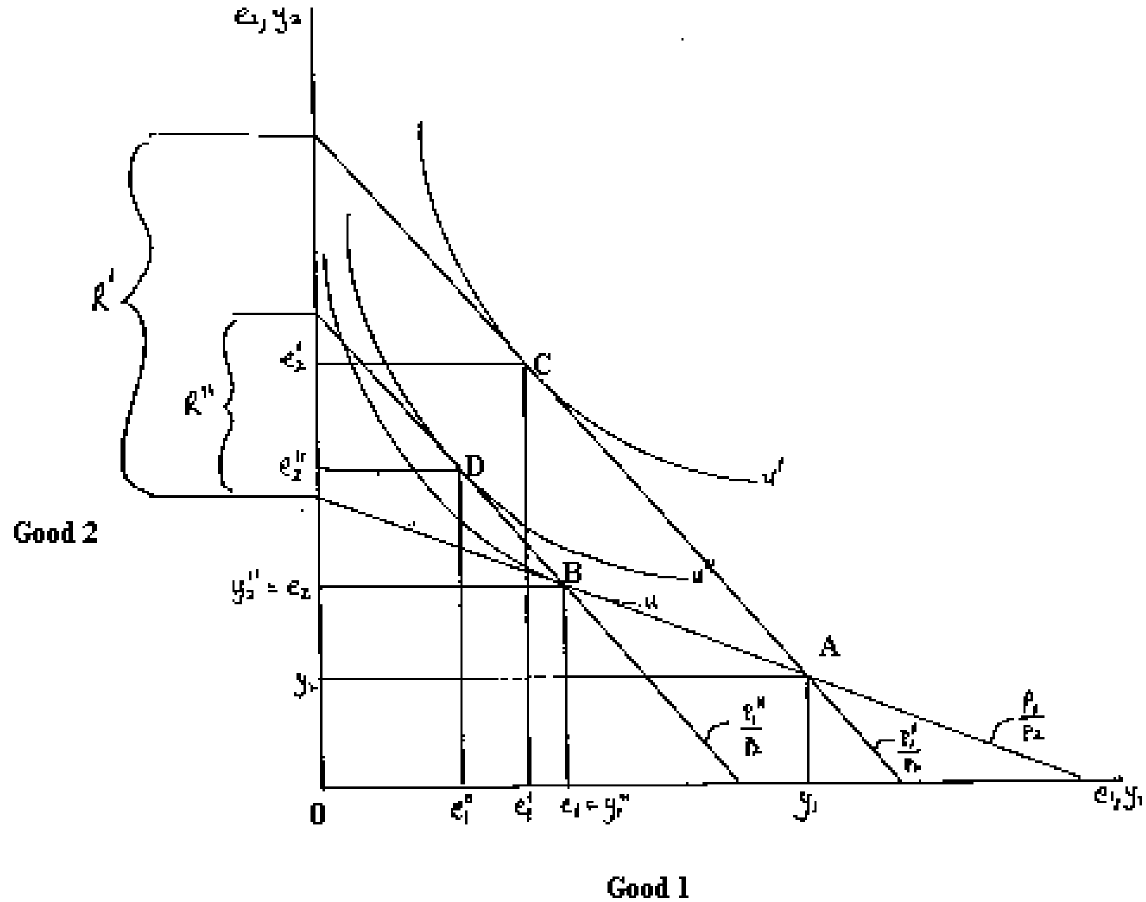

Figure 2: The effects of a 1% shock to Northern manufacturing productivity (Bond)

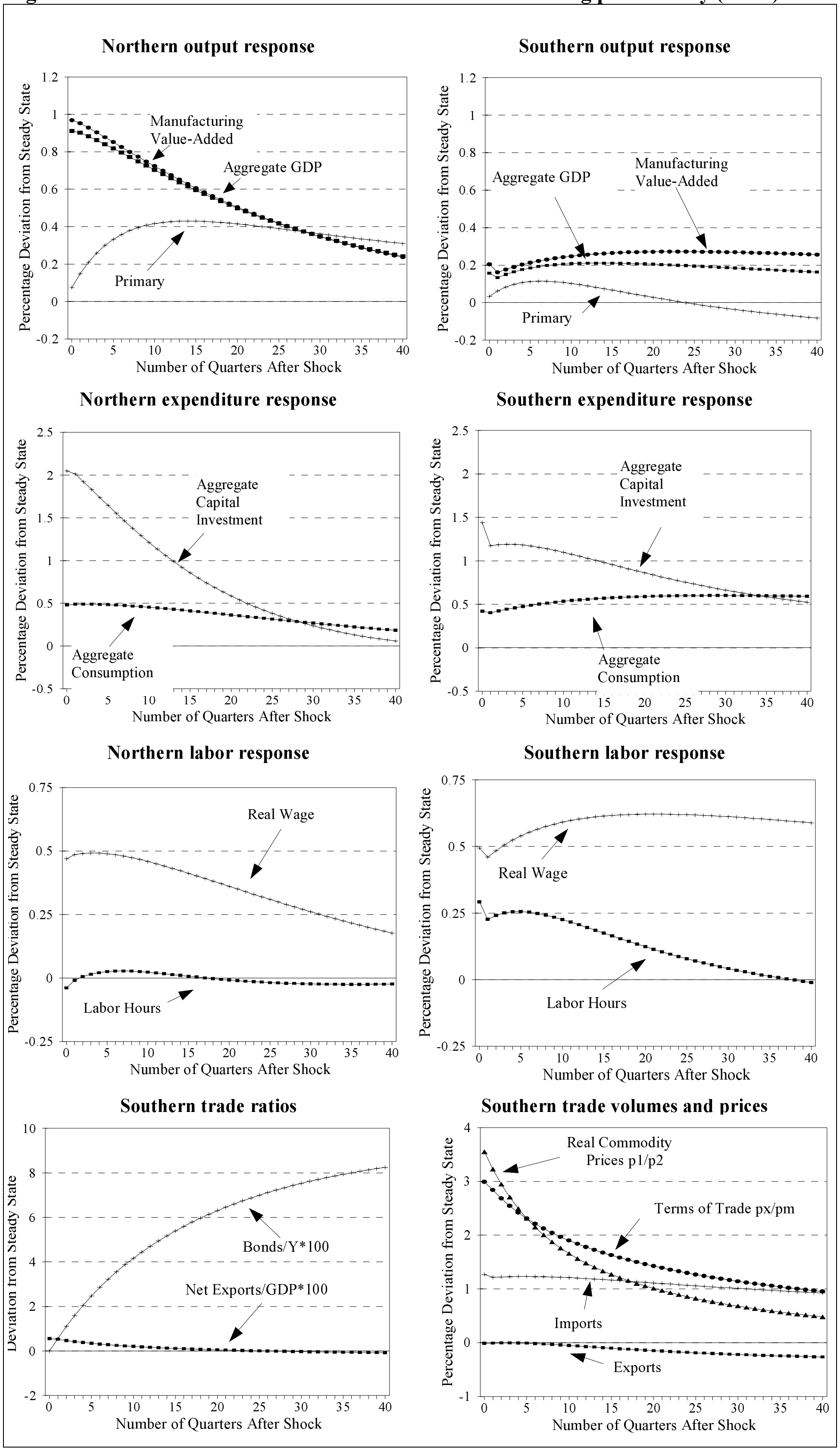

Figure 3: The effects of a 1% shock to Northern manufacturing productivity (Complete)

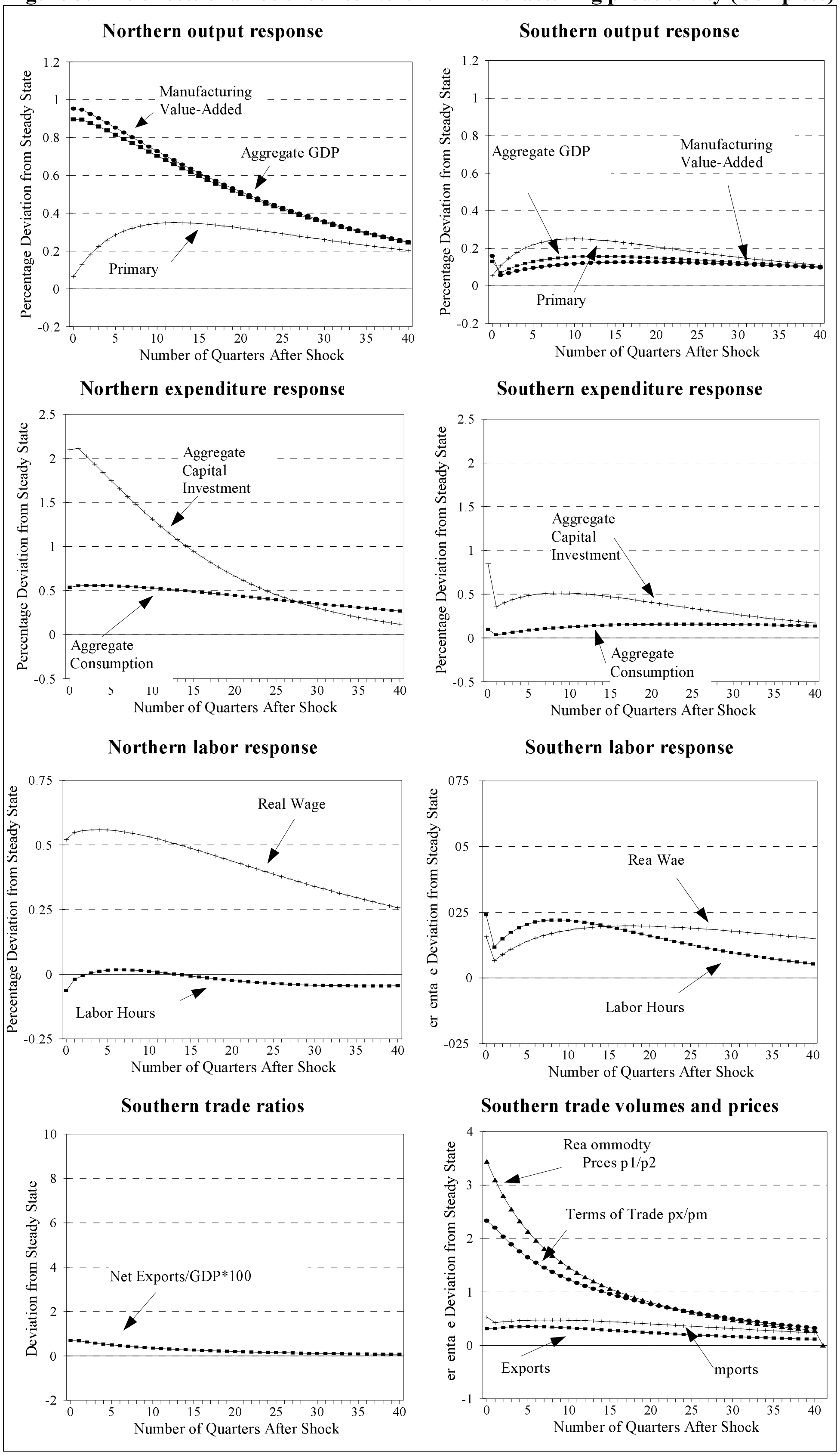

Figure 4: Hicksian decomposition of consumption - Northern productivity shock

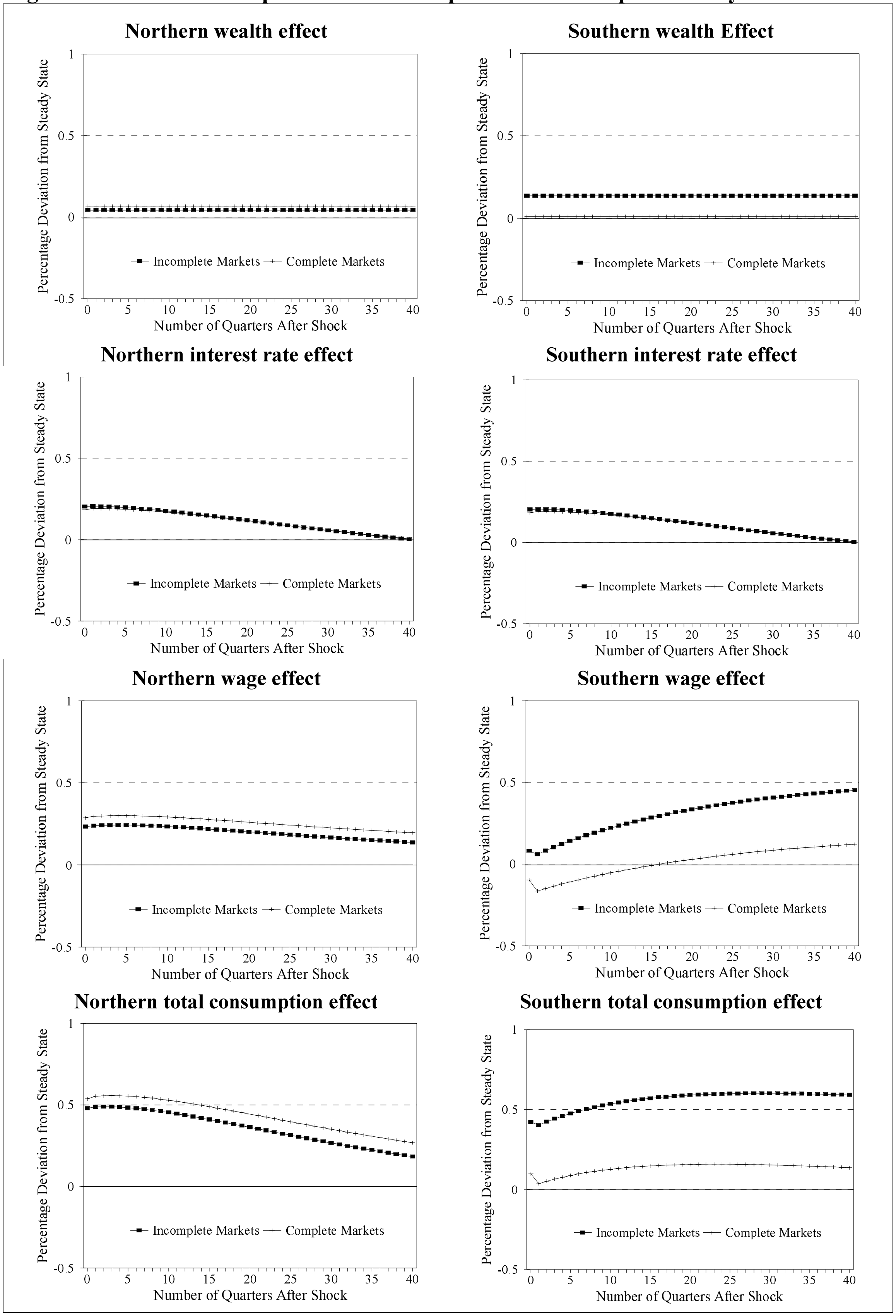

Figure 5: Hicksian decomposition of labor - Northern productivity shock