Wealth Effects and Countercyclical Net Exports

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Abstract

Two-country, one-good business cycle models with Cobb-Douglas preferences predict procyclical net exports. The opposite is observed in the data. We show that introduction of preferences that eliminate wealth effects on labor supply remedies this discrepancy. It also improves the model's ability in matching cross-country correlations.

Keywords: Wealth Effects, GHH preferences, International Business Cycles

JEL Codes: E32, F41, G15

1 Introduction

A well-documented empirical fact is that net exports are countercyclical in most OECD countries. Ability to replicate this feature represents an important test for the business cycle models[1]. A two-country, one-good model with Cobb-Douglas preferences and capital adjustment cost fails to get comovement of net exports and output right. To remedy this discrepancy we depart from the standard preferences in favour of the specification proposed by Greenwood et al. (1988) (henceforth GHH). The distinctive feature of GHH preferences is that they eliminate wealth effect on labour

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[1]For instance, Kehoe and Perri's (2002) model with endogenously incomplete markets accounts for international comovement but it predicts procyclical net exports. They refer to this property as "the main failing of the model" (Kehoe and Perri 2002, p 926)

supply. GHH specification has been used successfully in small open economy models (Correia et al., 1995).

We consider an international business cycle model similar to Backus et al. (1992) augmented with GHH preferences. To curb counterfactually excessive volatility of investment in the complete market environment we incorporate capital adjustment cost described by Hayashi (1982). We show that under Cobb-Douglas preferences domestic absorption (DA) is less volatile than output. This contradicts the data and results in counterfactually procyclical net exports. Under GHH preferences, volatility of DA exceeds output volatility due to the absence of wealth effect on labor supply. As a result, the model predicts countercyclical net exports consistent with empirical evidence.

Our work is related to contributions of Devereux et al. (1992) and Raffo (2008). The former demonstrates that introduction of GHH preferences in a two-country model accounts for realistic consumption correlations provided that innovations to productivity are uncorrelated[2]. The latter shows that models with standard preferences and trade in imperfectly substitutable intermediate goods tend to predict countercyclical net exports. However, Raffo (2008) argues that this ability stems from the procyclical behaviour of terms of trade (TOT). He documents countercyclical net flow of goods in constant prices. Furthermore, he shows that a two-good model augmented with GHH preferences can account for this feature, while the model with standard preferences cannot. Unfortunately, the model with either preference structure predicts strongly procyclical TOT inconsistent with empirical evidence. Since changes in TOT affect cyclical behaviour of quantity aggregates, we focus on the model that abstracts from relative price movements.

2 The Model

The world consists of two countries: home and foreign. The same parameters describe technology and preferences in both countries. Foreign country variables are denoted by stars. The two countries produce a single good that can be either consumed or invested. Labor is immobile across countries. In each period t, the world economy experiences an event s_t drawn from the countable set of events, S. Agents have access to a complete set of state-contingent claims. A claim that sells internationally for $Q(s_{t+1})$ at time t, entitles the bearer to a unit of the consumption good at $t+1$ if the state s_{t+1} is realized.

The consumers in home country choose the plans for consumption c_t, investment i_t, hours worked

[2] Because their focus is different, Devereux et al (1992) do not consider a fully calibrated business cycle model.

l_t, and bond holdings $B(s_{t+1})$ to maximize expected utility

$$E_t\left[\sum_{t=0}^{\infty}\beta^t u(c_t, l_t)\right]$$

subject to the flow budget constraint

$$c_t + i_t + \sum_S Q(s_{t+1}) B(s_{t+1}) = r_t k_t + w_t l_t + B(s_t), \tag{1}$$

the equation of motion for capital

$$k_{t+1} = (1-\delta)k_t + \phi(i_t/k_t) k_t, \tag{2}$$

and the initial conditions $k_0, B(s_0)$. In the equations above β represents the discount factor, δ is the depreciation rate, r_t denotes real rental rate and w_t is the real wage. $E_t(\cdot)$ denotes expectation conditional on the information available at t. Capital adjustment cost function ϕ satisfies $\phi(\cdot) > 0$, $\phi'(\cdot) > 0$, and $\phi''(\cdot) < 0$.

Under GHH preferences the instantaneous utility function is

$$u(c, l) = \frac{1}{1-\sigma}\left(c - \chi\frac{l^{1+\eta}}{1+\eta}\right)^{1-\sigma},$$

where σ is the curvature parameter, χ determines relative importance of leisure, $1-l$, and consumption, c. The Frisch elasticity of labor supply is given by $1/\eta$. Under Cobb-Douglas preferences the period utility is

$$u(c, l) = \frac{[c^{\gamma}(1-l)^{1-\gamma}]^{1-\sigma}}{1-\sigma},$$

where γ determines the relative importance of leisure in the composite commodity.

Firms choose employment $l_t \geq 0$, and rent capital $k_t \geq 0$ to maximise profits $y_t - r_t k_t - w_t l_t$, subject to technological constraint

$$y_t = z_t k_t^{\alpha} l_t^{1-\alpha}.$$

The productivity shocks follows a stationary vector autoregressive process in logs:

$$\begin{bmatrix} \log(z_t) \\ \log(z_t^*) \end{bmatrix} = \begin{bmatrix} \rho & \nu \\ \nu & \rho \end{bmatrix}\begin{bmatrix} \log(z_{t-1}) \\ \log(z_{t-1}^*) \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix}.$$

Diagonal elements ρ of the transition matrix determine the degree of persistence in productivity within each country. Off-diagonal elements ν determine how quickly innovations originating in one country spill across national borders. The innovations to the productivity process $(\varepsilon_t\ \varepsilon_t^*)'$ are zero mean serially uncorrelated bivariate normal random variables.

Equilibrium is an allocation and prices that satisfy the usiual conditions. Given prices consumers maximize expected utility subject to (1), (2), the initial conditions and non-negativity constraints. Given prices firms maximize profits subject to technological and non-negativity constraints. Asset market clearing requires that $B(s_{t+1}) + B^*(s_{t+1}) = 0$, for all $t \geq 0$, and $s_{t+1} \in S$.

3 The Result

We solve the model numerically with parameterized expectation algorithm (PEA) developed by den Haan and Marcet (1990). A subset of model parameters is calibrated to match long-run averages in the US data as described in Cooley (1997). One period of time corresponds to one quarter. The quarterly depreciation rate δ is set to ensure that the steady-state investment-output ratio is 0.25 and the capital-output ratio is 10. Once δ is set, the discount factor β follows directly from the Euler equation in the steady state.[3] The coefficient that controls disutility from labor χ is set so that the agents spend 1/3 of their unit time endowment on market activities in the deterministic steady state.

Table 1: Parameter Values

Preferences	$\beta = 0.989, \sigma = 2, \eta = 1/1.43$
Technology	$\alpha = 0.36, \delta = 0.025$
Productivity shocks	$\rho = 0.95, \nu = 0, \sigma_\varepsilon = 0.007, \rho_\varepsilon = 0.25$

The rest of the parameter values reported in Table 1 are common to the international business cycle literature. The capital income share α, utility curvature σ, and parameters governing the stochastic process for productivity take the values found in Kehoe and Perri (2002). The Frisch elasticity of labor supply $1/\eta$ is set to 1.43, as in Correia et al. (1995) who incorporated GHH preferences in a small open economy setting. As in Raffo (2008) we keep the Frisch elasticity of labor supply ε_f constant across the models. The functional form for capital adjustment cost follows from Boldrin et al. (2001):

$$\phi(x) = \frac{\kappa_1}{1 - 1/\xi}(x)^{1-1/\xi} + \kappa_2,$$

[3] Given the values of α, δ and the steady-state capital-output ratio k_{ss}/y_{ss}, we compute the discount factor as $\beta = (\alpha(y_{ss}/k_{ss}) + 1 - \delta)^{-1}$.

where $\kappa_1 = \delta^{1/\xi}$, $\kappa_2 = \delta/(1-\xi)$, and ξ is the elasticity of investment with respect to Tobin's q. The restrictions $\phi(\delta) = \delta$ and $\phi'(\delta) = 1$ imposed on the constants κ_1 and κ_2 ensure that incorporation of the adjustment cost does not affect the deterministic steady state of the model. The elasticity ξ is set to match the observation that the standard deviation of investment is 2.88 times higher than that of output.

We now discuss the model's ability to match international business cycle statistics. In the data, the ratio of net exports to output (NX) is countercyclical for most OECD countries (Raffo, 2008). Table 2 shows that correlation of NX with output for the US ecenomy is −0.35. Consider the implications of the model for cyclical behaviour of NX. Impulse responses in Figure 1 suggest that the model will predict procyclical NX under Cobb-Douglas preferences and countercyclical NX under GHH preferences. Indeed, Table 2 reports that the correlation of NX with output is 0.40 under standard preferences (vs. −0.35 in the data), whereas it is −0.42 under GHH specification.

Table 2: Within Country Business Cycle Statistics

	St.dev %		St.dev relative to output			Correlation with Output			
	Y	NX	C	I	L	C	I	L	NX
Data	1.51	0.74	0.81	2.88	0.84	0.86	0.94	0.88	−0.35
Cobb-Douglas Preferences	1.31	0.25	0.36	2.88	0.48	0.84	0.97	0.96	0.40
GHH Prerefences	1.49	0.40	0.81	2.88	0.59	0.99	0.92	0.99	−0.42

Notes: In addition to comovement properties, the table reports (relative) volatility of cyclical components of output (Y), consumption (C), investment (I), hours worked (L) and net exports to output ratio (NX). Domestic statistics in the Data column correspond to the U.S. quarterly time series sample 1970:1-2008:2. The model's statistics are computed from a single simulation of 100.000 periods. All the statistics are based on logged (except for the net exports) and HP-filtered data with a smoothing parameter of 1600.

To understand the intuition for this result, notice that introduction of GHH preferences increases relative volatility of consumption bringing it closed to the data (see Figure 1 and Table 2). From national income identity it follows that

$$NX_t = (Y_t - C_t - I_t)/Y_t = 1 - DA_t/Y_t.$$

Since relative volatility of investment is calibrated to match the data, increased relative volatility of consumption translates into higher relative volatility of DA. As shown in Figure 2, in the aftermath positive shock both DA and output jump. Under Cobb-Douglas preference, the increase in output exceeds the increase in DA, which elevates NX. Under GHH specification, an increase in DA exceed that of output. The latter results in a fall in NX depicted in Fig 1.

[Figure 1 and Figure 2 about here]

Why GHH specification increases consumption volatility? The answer lies in the ability of GHH preferences to eliminate wealth effect on labor supply. Consider the intratemporal optimality condition that controls labor supply. It equates marginal rate of substitution between consumption and leisure with the real wage. Under GHH specification it reads as follows

$$\chi l_t^{\eta} = w.$$

The marginal rate of substitution between consumption and leisure under GHH specification is independent of consumption, while under standard preferences it is not. A positive productivity shock raises both consumption and wages. Under Cobb-Douglas preferences the substitution effect compels agents to increase hours worked while wealth effect makes them reduce hours. Under GHH preferences only the substitution effect is present. As a result, hours become more volatile (see Table 2). Since households strive to smoothen marginal utility, increased volatility of hours worked is matched by increased volatility of consumption.

Table 3: International Comovements

	Cross-Country Correlations of			
	Output (Y)	Consumption (C)	Investment (I)	Employment (L)
Data	0.56	0.46	0.43	0.31
Cobb-Douglas Preferences	0.01	0.90	−0.21	−0.49
GHH Prerefences	0.21	0.48	−0.42	0.21

Notes: The statistics in the 'Data' column are calculated from U.S. data and aggregated data for 15 European countries. The sample consists of quarterly time series covering the period of 1970:1-2008:2. The model's statistics are computed from a single simulation of 100,000 periods. All the statistics are based on logged (except for net exports) and HP-filtered data with a smoothing parameter of 1600.

Introduction of GHH preferences improves the model's ability to match cross-country correlations.[4] Table 3 shows that the model predicts realistic international consumption correlation (0.48 vs.

[4] Some of the mechanisms through which GHH preferences improve the model's predictions for international comovements is discussed by Devereux et al (1992). However, they do not report simulations from a calibrated two-country model with correlated innovations to productivity.

0.46 in the data). Absence of wealth effects on labor supply is responsible for positive comovement of employment. Contemporaneoulsly correlated innovations to productivity induce comovement in real wages and therefore in hours worked (0.21 vs. 0.31 in the data). The latter translates into positive cross-country correlation of output levels. The main discrepancy that remains is negative correlation of investment while it is positive in the data.

4 Conclusion

Predictions of the international business cycle models with complete markets disagree with the data along several dimensions. We show that introduction of preferences that eliminate wealth effect on labour supply helps to reconcile the model's prediction with the data. In particular, by increasing volatility of domestic absorption relative to output, GHH preferences allow the model to account for countercyclical behavior of net exports. At the same time, such departure from Cobb-Douglas preferences improves international comovement properties of the model.

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Figure 1:
Responses of net exports and consumption to a one-standard-deviation productivity shock

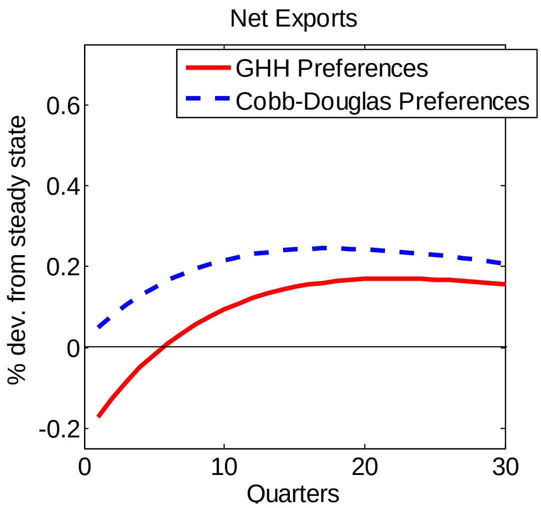

Figure 2:
Responses of domestic absorption and output to a one-standard-deviation productivity shock