Product durability and trade volatility*

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February 2012

Abstract

One of the main causes behind the trade collapse of 2008-09 was a significant fall in the demand for durable goods. This paper develops a small country, overlapping generations model of international trade in which goods durability gives rise to a more than proportional fall in trade volumes, as observed in 2008-09. The model has three goods - two durable, traded goods and one non-durable, non-traded good and two factors of production. The durability of goods affects consumers' lifetime wealth and their optimal consumption bundle across goods and time periods. A uniform productivity shock reduces consumers' lifetime wealth inducing a re-optimisation away from durables. This gives rise to a more than proportional effect on international trade, provided the non-traded sector is sufficiently capital intensive. The elasticity of trade flows to GDP is found to be increasing in both the degree of durability and the size of the shock. The model thus provides microfoundations for the asymmetric shock to the demand for durable goods observed in recessions and clarifies the link between this endogenous shift in preferences and international trade flows. It also explains the observation that deeper downturns are associated with a higher elasticity of trade to GDP. Furthermore, the greater the degree of durability of traded goods, the larger is the share of domestically produced goods in consumption, for plausible factor intensities. This provides an alternative explanation for the home bias in consumption, and hence another explanation for Trefler's "missing trade".

Keywords: Trade in durable goods; 2008 trade collapse.

JEL codes: F11

*We extend our thanks to participants of the 2011 ETSG conference and seminar participants at the University of Oxford and the University of Sussex for useful comments and suggestions. Particular thanks go to Alan Winters, Peter Neary and Tony Venables. Any errors and omissions are ours.

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1 Introduction

The global financial crisis of 2008-09 led to a slowdown of economic growth in almost every developed economy, as well as a significant decline in global trade volumes in real terms. From an average growth rate of 8.4 percent per year between 2003 and 2007, export volumes grew by only 3 percent in 2008, fell by 10.7 percent in 2009 and grew 12.7 percent in 2010[1]. The trade collapse and recovery represent the largest percentage changes in trade volumes since the WTO data series began in 1950. Moreover, the collapse and recovery of trade volumes were far more pronounced than the fall and rise of world GDP, which grew at 1.5 percent in 2008, shrank by 2.3 percent in 2009, and grew by 4 percent in 2010.

The observation that trade fluctuates more than GDP is not unique to the 2008-09 recession. Freund (2009) estimates that the elasticity of trade volumes to world GDP increased from approximately 2 in the 1960s to over 3 after 1990 and is higher in global downturns[2], while Engel and Wang (2009) find international trade is about three times as volatile as GDP. Moreover, using IMF data we find the standard deviation of world GDP growth (at constant prices) between 1980 and 2010 is 1.43 percent, whereas that of trade volume growth is 4.65 percent over the same period, again confirming the larger volatility of international trade as compared with GDP.

The causes of the collapse and recovery of international trade in 2009 and 2010 are manifold. Essays in Baldwin (2009) and Baldwin and Evenett (2009) discuss the key explanations proposed, while several empirical papers examine the causes of the more-than-proportional collapse in trade volumes. Levchenko et al (2010) compare the contributions of three popular alternative explanations of the trade collapse: vertical production linkages, trade credit, and compositional effects on durables demand. They conclude the patterns of the trade collapse are consistent with vertical production linkages and durables demand playing important roles, but do not detect any impact of trade credit[3]. Figure 1 depicts the annual growth rate of US consumption of durables[4] and

[1] Reported figures are from the International Monetary Fund (IMF).

[2] Freund (2009) estimates that a global deceleration of 4.8 percent corresponds to a fall in international trade of 19 percent.

[3] Other authors, e.g.Chor and Manova (2011), find evidence suggesting credit conditions were an important channel in reducing trade volumes during the crisis. More generally, Amiti and Weinstein (2009) show the health of a bank providing trade finance influences firm export growth.

[4] "Consumer durable goods are tangible commodities purchased by consumers that can be used repeatedly or continuously over a period of 3 or more years (for example, motor vehicles)" (Bureau of Economic Analysis, 2009, pp.2-3).

non-durables in real terms, based on quarterly data from 2005 to 2011 from the Bureau of Economic Analysis (BEA). It shows both that consumption of durables is generally more volatile than non-durables consumption[5] and that the decline in the consumption of durable goods was far larger than that of non-durables in 2008-09[6].

To unpack the determinants of the trade collapse, Eaton et al (2011) develop a multi-sector model of production and trade, calibrated to global data from recent quarters. Of the four exogenous shocks considered[7], they find that shocks to manufacturing demand, especially for durable goods, account for the bulk of the decline in international trade. Similarly, Bems et al (2010) find that final demand shocks explain 70 percent of the trade collapse and that a large part of the impact occurs through durables. Using Belgian firm-level data, Behrens et al (2010) find the fall in global demand explains over half the fall in Belgian firm exports in 2008-09 and that trade in consumer durables and capital goods fell more severely than trade in other product categories.

On the theoretical side, Engel and Wang (2009) incorporate durable goods in an international real business cycle model, which they calibrate to observed characteristics of international trade to show the importance of durables trade for cyclicality[8]. While durable goods are commonly incorporated into macro models, many macro models simply *assume* the fraction of output that is traded, whereas this endogenously arises in our model. In addition, there is limited analysis of the role of product durability in the theoretical trade literature[9]. Comparative advantage models characterised by homothetic preferences and constant returns to scale technologies have the feature that trade flows respond proportionally to uniform productivity shocks; hence, they cannot explain the high elasticity of trade to GDP found in the empirical literature, nor that the elasticity is higher in periods of recession.

This paper embeds durability of traded goods and overlapping generations into an otherwise standard Heckscher-Ohlin, small-country framework with two traded sectors and one non-traded, non-durable sector, in order to explain the excess trade volatility phenomenon. All goods are

[5] The standard deviation of US durables consumption growth is 6.3 percent as compared to 2.1 percent for non-durables consumption growth over the period.

[6] Durables consumption fell by over 12 percent on an annualised basis in 2008-09, compared to a fall of 3 percent of non-durables consumption

[7] A shock to final demand, a shock to trade frictions, a productivity shock and a shock to trade deficits.

[8] The fall in GDP during the recession of 2008-09 has been associated with a greater-than-proportional decrease in the demand for consumer durables and business investment; see Wang (2010).

[9] Notably, Shimomura (1993) extends the Heckscher-Ohlin model to include durable and non-durable goods to show that different rates of time preference across countries constitute a basis for trade.

produced with constant returns to scale technologies using capital and labour and comparative advantage determines which of the two durable goods the country exports. While maintaining standard assumptions of homothetic preferences and technologies, overlapping generations of consumers maximise life-time utility by skewing their consumption towards durables when young, thereby generating future wealth. In turn, the stock of durables carried from the first year of life lowers demand for durable goods when consumers are old.

A one-period, unanticipated uniform productivity shock is introduced and the model re-solved with the shock, as well as during recovery from the shock. The shock reduces lifetime wealth, inducing a re-optimisation away from durables by both young and old in the economy, resulting in a more-than-proportional effect on the demand for durable goods. The model thus provides microfoundations for the asymmetric shock to the demand for durable goods identified by Levchenko et al (2010), Engel and Wang (2009), Eaton et al (2011) and illustrated in Figure 1. It also clarifies the link between the endogenous shift in preferences away from durables and international trade flows, showing that under plausible parameter values the shock induces a more than proportional effect on trade flows. Moreover, trade flows are found to overshoot their long run level in the period after the shock.

The elasticity of trade flows to GDP is shown to be increasing in both the degree of durability of traded goods and the size of the shock. The model therefore provides an explanation for the observation that deeper downturns are associated with a higher elasticity of trade to GDP as found by Freund (2009). Furthermore, traded goods durability means that a country consumes a larger share of domestically-produced goods than would be predicted by the parameters of the utility function, thus providing an alternative explanation for the home bias in consumption (Krugman, 1980), and hence potentially another explanation for Trefler's missing trade (Trefler, 1995; see also Chung, 2003).

Three simplifying assumptions, for which there is empirical support, are made for computational tractability. First, the small country assumption, which implies exogenous prices. Empirically, Hall (2010) and Levchenko et al (2010) show that prices were sticky in the 2008 recession relative to quantities. Similarly, Gopinath et al (2011) show that prices fell by much less than trade volumes in the 2008-09 trade collapse. Furthermore, our computations using US data show that the annual growth rates of quantities decreased by much more than the annual growth rates of prices, between the period before the start of the crisis, in 2007Q2, and the height of the crisis, in 2009Q2, as depicted in Table 1.[10]

The second assumption that traded goods are durable whilst non-traded goods are non-durable is strong, but has empirical support from De Gregorio et al (1994), Engel and Wang (2008) and Erceg et al (2008), who show that durables represent a much larger share of international trade than of the domestic economy. According to Erceg et al (2008) consumer durables and capital goods constitute approximately 75 percent of US non-fuel imports and exports, but only 20 percent of the production share of the economy. Third, the unanticipated nature of the productivity shock may appear to be a strong assumption; however, the IMF's World Economic Outlook as late as October 2008 predicted world economic growth in 2009 to be 3.0 percent (IMF, 2008), well above the actual growth rate of -0.5 percent, suggesting that even the best forecasters were unable to anticipate the magnitude of the shock that hit the global economy.

The next section outlines the model. Section 3 analyses the impact of productivity shocks, while Section 4 concludes.

2 The model

Consider a small, open economy with three goods: two traded, durable goods, X and Y, and one non-traded, non-durable good, N. There is an infinite time horizon and in each period, τ, goods $j = \{X, Y, N\}$ are produced with Cobb-Douglas technologies using labour[11], L_j and capital, K_j, given by

$$X = \theta K_X^{\alpha} L_X^{1-\alpha} \tag{1}$$

$$Y = \theta K_Y^{\beta} L_Y^{1-\beta} \tag{2}$$

$$N = \theta K_N^{\nu} L_N^{1-\nu}, \tag{3}$$

where $\alpha, \beta, \nu \in (0,1)$ and productivity parameter θ is positive and identical across sectors for simplicity. Let $\beta > \alpha$, so Y is relatively capital intensive[12]. Assume prices of traded goods, P_X and

[10] For example, the annual growth rate of durable goods consumption in quantities fell from 5.63 percent in 2007Q2 to -10.42 percent in 2009Q2, which corresponds to the -16.05 percent shown in Table 1.

[11] Time subscripts are suppressed here to simplify the exposition of the model.

[12] The value of ν relative to β and α is important to the results of the model and is discussed in section 2.2.

P_Y, respectively, are quoted on world markets and $P_Y = 1$ and $P_X = p$. Further, $\overline{L}$ and $\overline{K}$ denote the economy's endowment of labour and capital, where these are supplied inelastically and always fully employed; w is the wage rate and r the rental rate. Suppose the economy is relatively capital abundant so good Y is exported and X imported, while parameter values are such that there is incomplete specialisation.

The factor market clearing conditions are

$$a_{LX}X + a_{LY}Y + a_{LN}N = \overline{L} \tag{4}$$

$$a_{KX}X + a_{KY}Y + a_{KN}N = \overline{K}, \tag{5}$$

where $\alpha_{i,j}$ denotes the unit factor requirement of input i into good j, which follow from cost minimisation and depend on relative factor prices and technological parameters.

Assume perfect competition so price equals unit cost in each sector:

$$a_{LX}w + a_{KX}r = p \tag{6}$$

$$a_{LY}w + a_{KY}r = 1 \tag{7}$$

$$a_{LN}w + a_{KN}r = P_N. \tag{8}$$

Solving for factor prices and P_N gives:

$$w = \theta \frac{\left[p\alpha^{\alpha}(1-\alpha)^{(1-\alpha)}\right]^{\frac{\beta}{\beta-\alpha}}}{\left[\beta^{\beta}(1-\beta)^{(1-\beta)}\right]^{\frac{\alpha}{\beta-\alpha}}} \; ; \quad r = \theta \frac{\left[\beta^{\beta}(1-\beta)^{(1-\beta)}\right]^{\frac{1-\alpha}{\beta-\alpha}}}{\left[p\alpha^{\alpha}(1-\alpha)^{(1-\alpha)}\right]^{\frac{1-\beta}{\beta-\alpha}}} \tag{9}$$

$$P_N = p^{\frac{\beta-\nu}{\beta-\alpha}} \frac{\left[\alpha^{\alpha}(1-\alpha)^{(1-\alpha)}\right]^{\frac{\beta-\nu}{\beta-\alpha}}\left[\beta^{\beta}(1-\beta)^{(1-\beta)}\right]^{\frac{\nu-\alpha}{\beta-\alpha}}}{\nu^{\nu}(1-\nu)^{(1-\nu)}}, \tag{10}$$

which depend on p and technological parameters. Moreover, national income, M, is the sum of all factor income, so $M = w\overline{L} + r\overline{K}$.

Let generations of consumers live for two time periods, $t = \{1, 2\}$. Consumers own labour and capital, which they supply inelastically in both time periods. Generations overlap such that in any τ half of consumers are in period 1, i.e. are 'young', while the rest are in period 2, i.e. are 'old'. For simplicity, let there be one young consumer and one old consumer, each of which owns $\frac{1}{2}\left(\overline{K}+\overline{L}\right)$. Consumers have identical, homothetic preferences and maximise their expected lifetime utility, given by

$$U = E_1 \sum_{t=1}^{2} \rho^{t-1} u_t, \tag{11}$$

where $\rho > 1$ is the subjective discount factor and u_t denotes consumers' instantaneous utility function

$$u_t = \gamma \log C_{N,t} + \frac{1-\gamma}{2} \log C_{X,t} + \frac{1-\gamma}{2} \log C_{Y,t}, \tag{12}$$

where $\gamma \in (0,1)$ and $C_{j,t}$ is consumption of good j in period t of the consumer's life. In period t of their lives, each consumer earns income m_t, where $m_t = \frac{M_t}{2} = \frac{1}{2}\left(w_t\overline{L} + r_t\overline{K}\right)$, and cannot borrow or lend.

Traded goods X and Y are durable, such that a fraction $d \in [0,1]$ of durable purchases by a consumer in period 1 endures and can be enjoyed in consumption in period 2. Hence d reflects the degree of durability of traded goods[13]. Durable goods last for two periods, there are no bequests of durables and no second hand market for durables.

Let us distinguish between consumption of durables, $C_{X,t}$, and purchases of durables, $D_{X,t}$. Period 1 consumption of durables exactly equals purchases made as there are no bequests, while consumption of durables in period 2 comprises the depreciated stock of durables from period 1 and additional purchases in period 2. Since good N is non-durable, consumption equals purchases in both periods. Hence:

$$C_{X,1} = D_{X,1} \; ; \quad C_{X,2} = dC_{X,1} + D_{X,2} \tag{13}$$

$$C_{Y,1} = D_{Y,1} \; ; \quad C_{Y,2} = dC_{Y,1} + D_{Y,2} \tag{14}$$

$$C_{N,1} = D_{N,1} \; ; \quad C_{N,2} = D_{N,2}. \tag{15}$$

[13] The mechanisms of the model continue to hold if the non-traded good is less durable than traded goods (rather then entirely non-durable), though effects are less pronounced. Moreover, symmetric durability of traded goods is maintained for simplicity; the key findings continue to hold if different degrees of durability are assumed, although the composition of demand and domestic production differs.

Consumers choose $C_{N,1}$, $C_{X,1}$, $C_{Y,1}$, $C_{N,2}$, $D_{X,2}$ and $D_{Y,2}$ to maximise

$$\begin{aligned} U &= \gamma \log C_{N,1} + \frac{1-\gamma}{2} \log C_{X,1} + \frac{1-\gamma}{2} \log C_{Y,1} \\ &+ \rho \left[\gamma \log C_{N,2} + \frac{1-\gamma}{2} \log \left(dC_{X,1} + D_{X,2} \right) + \frac{1-\gamma}{2} \log \left(dC_{Y,1} + D_{Y,2} \right) \right], \end{aligned} \tag{16}$$

subject to budget constraints

$$P_N C_{N,1} + pC_{X,1} + C_{Y,1} \leq m_1 \tag{17}$$

$$P_N C_{N,2} + pD_{X,2} + D_{Y,2} \leq m_2. \tag{18}$$

Let $\overline{C_j}$ denote aggregate demand for good j across both consumers. Further, impose the constraint that demand for non-traded goods equals domestic supply, $\overline{C_N} = N$. Let X_Y denote exports of good Y and M_X denote imports of X, where $X_Y = Y - \overline{C_Y}$ and $M_X = \overline{C_X} - X$; trade balances, so $pM_X = X_Y$.

2.1 Equilibrium without durability

As a benchmark we outline the equilibrium if all goods are non-durable. Since consumers cannot accumulate wealth in the form of durable goods and there is no borrowing or lending, the link between time periods is broken. The first order conditions with $d = 0$ give the standard result that consumers always allocate their income across goods in fixed proportions, according to the preference parameter γ. Hence aggregate expenditures are:

$$P_N \overline{C_N} = \gamma M \tag{19}$$

$$p\overline{C_X} = \overline{C_Y} = \frac{1-\gamma}{2} M, \tag{20}$$

which allow us to solve for equilibrium trade flows per period ,

$$pM_X = X_Y = \left(\frac{(1-\gamma)(1-\beta) + \gamma(1-\nu)}{(\beta - \alpha)} + \frac{1-\gamma}{2} \right) w\overline{K} - \left(\frac{(1-\gamma)(1-\beta) + \gamma(1-\nu)}{(\beta - \alpha)} + \frac{1-\gamma}{2} \right) r\overline{L}. \tag{21}$$

Since w and r are proportional to total factor productivity θ, it follows that trade flows are also proportional to θ in the non-durable case. Proposition 1 follows directly from equations (21) and (9).

Proposition 1 *If all goods are non-durable* $(d = 0)$*, then a fall in productivity gives rise to a proportional change in trade flows.*

2.2 Equilibrium with traded good durability

Now let traded goods have some degree of durability, so $d > 0$. First order conditions of the consumer's optimisation problem are given by equations (22) to (29), where ϕ and μ are the Lagrangean multipliers for budget constraints (17) and (18), respectively.

$$\frac{\gamma}{C_{N,1}} - \phi P_N = 0 \tag{22}$$

$$\rho\frac{\gamma}{C_{N,1}} - \mu P_N = 0 \tag{23}$$

$$\frac{1-\gamma}{2}\frac{1}{C_{X,1}} + \rho\frac{1-\gamma}{2}\frac{d}{dC_{X,1} + D_{X,2}} - \phi p = 0 \tag{24}$$

$$\frac{1-\gamma}{2}\frac{1}{C_{Y,1}} + \rho\frac{1-\gamma}{2}\frac{d}{dC_{Y,1} + D_{Y,2}} - \phi = 0 \tag{25}$$

$$\rho\frac{1-\gamma}{2}\frac{1}{dC_{X,1} + D_{X,2}} - \mu p = 0 \tag{26}$$

$$\rho\frac{1-\gamma}{2}\frac{1}{dC_{Y,1} + D_{Y,2}} - \mu = 0 \tag{27}$$

$$P_N C_{N,1} + pC_{X,1} + C_{Y,1} - m_1 = 0 \tag{28}$$

$$P_N C_{N,2} + pD_{X,2} + D_{Y,2} - m_2 = 0 \tag{29}$$

It follows that period 2 expenditures are:

$$pC_{X,2} = C_{Y,2} = \frac{1-\gamma}{2}\left(m_2 + dpC_{X,1} + dC_{Y,1}\right) \tag{30}$$

$$P_N C_{N,2} = \gamma\left(m_2 + dpC_{X,1} + dC_{Y,1}\right) \tag{31}$$

and $C_{X,1}$ and $C_{Y,1}$ satisfy

$$\frac{1-\gamma}{2pC_{X,1}} - \frac{\gamma}{m_1 - pC_{X,1} - C_{Y,1}} + \frac{d\rho}{2\left(m_2 + dpC_{X,1} + dC_{Y,1}\right)} = 0 \quad (32)$$

$$\frac{1-\gamma}{2C_{Y,1}} - \frac{\gamma}{m_1 - pC_{X,1} - C_{Y,1}} + \frac{d\rho}{2\left(m_2 + dpC_{X,1} + dC_{Y,1}\right)} = 0. \quad (33)$$

The durability of goods provides young consumers with a means of building period 2 wealth, which allows higher period 2 consumption of all goods. Equations (30) and (31) show that consumers' period 2 expenditure on goods is in fixed proportions of wealth. The durability of goods X and Y generates a tradeoff between period 1 and period 2 utility, such that consumers' optimal period 1 expenditure on each durable good exceeds $\frac{1-\gamma}{2}m_1$; by skewing consumption towards durable goods when young, consumers can achieve higher lifetime utility through the wealth effect.

In the absence of productivity shocks, income is constant over consumers' lifetime, so $m_1 = m_2 \equiv m = \frac{M}{2}$. We refer to the equilibrium under this constant income as the 'steady state'. Solving (32) and (33) yields

$$C_{Y,1} = pC_{X,1} = f(\gamma, d, \rho)\, m > \frac{1-\gamma}{2} m \quad (34)$$

$$P_N C_{N,1} = \left(1 - 2f(\gamma, d, \rho)\right) m < \gamma m \quad (35)$$

$$\text{where } f_\gamma(\cdot) < 0,\ f_d(\cdot) > 0,\ f_\rho(\cdot) > 0,$$

so consumers' period 1 expenditure on each durable good is a share $f(\gamma, d, \rho)$ of income[14]. Homotheticity of the utility function implies period 1 expenditure on each good is a constant share of income, but the share spent on durables is greater than when $d = 0$. Furthermore, $f(\gamma, d, \rho)$ is decreasing in γ and increasing in d and ρ. Intuitively, the greater the underlying preference for durable goods, then the greater the income share spent on durables in period 1. Also, the greater the degree of durability, the greater the wealth effect and so the greater the incentive to skew consumption towards durables. Furthermore, the greater is ρ, the more patient are consumers and thus the greater their willingness to sacrifice period 1 utility to build wealth[15] for period 2. Consider an example where $\rho = 0.95$ and $\gamma = 0.5$; if $d = 0.5$, then $C_{Y,1} = pC_{X,1} = 0.273\,12m > 0.25m$.

[14] $f(\gamma, d, \rho) = \frac{1}{2d(2+\rho)}\left(d(1-\gamma) + \frac{1}{2}d\rho + \frac{1}{2}\left(8d + 4d\rho - 8d\gamma - 8d\rho\gamma + 4d^2 + 4d^2\rho - 8d^2\gamma - 4d^2\rho\gamma + d^2\rho^2 + 4d^2\gamma^2 + 4\right)^{\frac{1}{2}} - 1\right)$, for $d > 0$.

[15] If $\rho = 0$, the incentive to trade-off utility over periods 1 and 2 disappears and $f(\gamma, d, 0)$ collapses to $\frac{1-\gamma}{2}$.

Equations (30), (31) and (34) allows period 2 expenditure to be expressed as

$$D_{Y,2} = pD_{X,2} = \left(\frac{1-\gamma}{2} - \gamma d f(\gamma, d, \rho)\right) m < \frac{1-\gamma}{2} m \tag{36}$$

$$P_N C_{N,2} = \gamma \left(1 + 2d f(\gamma, d, \rho)\right) m > \gamma m. \tag{37}$$

The share of period 2 income spent on non-durable purchases is increasing in d, while durable purchases are declining in d. The (discounted) stock of durables from period 1 implies a lower demand for durables in period 2, even though total consumption of durables is a constant share $(1-\gamma)$ of period 2 wealth.

Equations (34) to (37) allow aggregate expenditure on durables and non-durables to be expressed as

$$p\overline{C_X} = \overline{C_Y} = \frac{1-\widehat{\gamma}(\gamma, d, \rho)}{2} M < \frac{1-\gamma}{2} M \tag{38}$$

$$P_N \overline{C_N} = \widehat{\gamma}(\gamma, d, \rho) M > \gamma M, \tag{39}$$

where $\widehat{\gamma}(\gamma, d, \rho) = \frac{1+\gamma}{2} - f(\gamma, d, \rho)(1-\gamma d)$ and $\widehat{\gamma}_\gamma(\cdot) > 0$, $\widehat{\gamma}_d(\cdot) > 0$ and $\widehat{\gamma}_\rho(\cdot) > 0$. Aggregate demand for traded durables is thus lower in equilibrium than if X and Y were non-durable. Intuitively, consumers derive more use from consumption of goods X and Y per unit when they are durable, since they generate a consumption stream in period 2. The aggregate share of income spent on durables is decreasing in d, and *vice versa* for non-durables. In fact, demand in the economy with durability $d > 0$ and preference parameter γ is identical to when $d = 0$ and the preference parameter is $\widehat{\gamma}$. Durability of goods thus endogenously shifts consumption away from durable goods in the aggregate, *as if* γ were higher. For example, if $\gamma = 0.5, \rho = 0.95$ and $d = 0.543\,37$, then $P_N\overline{C_N} = 0.55M$. Proposition 2 follows from equations (34) - (39) and $f(\gamma, d, \rho)$, and summarises these results.

Proposition 2 *The larger the degree of traded good durability, d, then:*

(i) the larger is the equilibrium share of income spent on durables by the young,

(ii) the smaller is the equilibrium share of income spent on durables by the old,

(iii) the smaller is the aggregate share of national income spent on durable goods.

The impact of durability on equilibrium trade flows is identical to that from increasing the preference parameter from γ to $\widehat{\gamma}$. Flam (1985) shows in a generalised model with two traded goods and one non-traded good that the impact on the trade share of an increased preference for the non-traded good depends on the factor intensities of the sectors. This is confirmed here, since from equation (21) it follows that

$$\frac{\partial X_Y}{\partial \gamma} = \frac{\partial \left(pM_X\right)}{\partial \gamma} = \frac{\beta + \alpha - 2\nu}{2\left(\beta - \alpha\right)} \left(w\overline{L} + r\overline{K}\right), \tag{40}$$

the implications of which are summarised by condition 1.

Condition 1 *If $\beta + \alpha - 2\nu < 0$, then trade flows are decreasing in the degree of durability, d.*

Condition 1 states that an increase in traded good durability lowers steady state trade flows through the impact of d on $\widehat{\gamma}\left(\gamma, d, \rho\right)$, provided the non-traded sector is not too labour intensive relative to the traded sectors[16]. The shift in aggregate demand towards the non–durable, non-traded good induces an expansion of domestic production N. If good N were very labour intensive, e.g. if $\beta > \alpha > \nu$, then a relatively large quantity of labour would need to be employed to generate this production increase, leaving the residual composition of available resources more capital abundant. This would necessitate an expansion of Y and contraction of X for factor markets to clear, increasing trade flows.

How plausible is it that condition 1 is satisfied? Non-traded goods are largely services. Although services are conventionally perceived as being labour intensive, some services are arguably more capital intensive than certain imports from developing countries. Cardi and Restout (2011) document that, across 13 OECD countries from 1970 to 2004, the capital share in the output of non-traded goods is similar to that in traded goods, and in some cases even exceeds the latter. They use the classification by De Gregorio et al (1994), who classify Agriculture, Mining, Manufacturing and Transportation as traded goods. Utilities, Construction, Wholesale and Retail Trade, Information and Communication, Finance and Real Estate, Professional Services, Education, Arts, Hotels and Restaurants, and Other Services are classified as non-traded goods. Using the same

[16] If the economy were instead relatively labour abundant, then trade flows would be decreasing in d if the non-tradable sector were not too capital intensive relative to the traded sectors.

classification, we construct Figure 2, using US data from 2000 to 2009[17]. It shows that the average fixed assets per full-time-equivalent employee is larger for non-traded sectors than for traded sectors[18], suggesting condition 1 is not implausible.

If condition 1 is satisfied, then the model points to an endogenous home bias in consumption arising from traded good durability and suggests a new explanation for Trefler's (1995) "missing trade". Consumers gain more 'use' out of traded goods the more durable they are, inducing an expansion in the share of domestically produced, non-durable goods in consumption and lowering steady state trade flows per period. Hence, a home bias can be generated with constant returns to scale technologies and homothetic preferences, without appealing to transport costs. Corollary 1 follows directly from Proposition 2 and condition 1.

Corollary 1 *If $\beta + \alpha - 2\nu < 0$ and $d > 0$, there is a home bias in consumption, which is increasing in d.*

3 Trade effects of a productivity shock

This section examines the impact of an unanticipated, uniform total factor productivity shock, for a single time period, on consumption decisions and trade flows, both in the period of the shock and in subsequent periods. In what follows superscripts denote the period in which the consumption takes place, while the digit subscript denotes whether the consumer is young or old in that period.

3.1 Trade flows in the shock period

Let T denote the shock period in which θ falls to $\lambda\theta$, where $\lambda \in (0, 1)$. From equations (9) and (10) it follows that factor prices w and r fall proportionally, while P_N is unchanged. National income thus falls to λM in period T and $m_T = \lambda m$. The shock is unanticipated and perceived temporary, so $E_{T-1}(m_T) = E_T(m_{T+1}) = m$.

Substituting $m_2 = \lambda m$ and (34) into (30) and (31) gives period T expenditure levels for the old

[17] We also find the classification developed by De Gregorio et al (1994) still applies to more recent data. That is, with all industries listed above classified as 'traded' or 'non-traded', all US 'traded' industries have trade shares greater than 30 percent, while all 'non-traded' industries have trade shares of less than 10 percent.

[18] There is wide variation in capital-labour ratios within both traded and non-traded sectors. For example, Mining, Utilities, Communication and Finance and Real Estate have above-average capital-labour ratios.

consumer:

$$pD_{X,2}^{T} = D_{Y,2}^{T} = \max\left[\left(\frac{1-\gamma}{2} - \frac{\gamma df(\gamma,d,\rho)}{\lambda}\right)\lambda m, 0\right] < \lambda D_{Y,2} = \lambda p D_{X,2} \quad (41)$$

$$P_N C_{N,2}^{T} = \min\left[\gamma\left(1 + \frac{2df(\gamma,d,\rho)}{\lambda}\right)\lambda m, \lambda m\right] > \lambda P_N C_{N,2}. \quad (42)$$

Let $\widehat{\lambda}(\gamma,d,\rho)$ denote the threshold value of λ below which durable purchases of the old consumer fall to zero in the shock period[19]. Assume $\widehat{\lambda}(\gamma,d,\rho) < \lambda < 1$ so $pD_{X,2}^{T} = D_{Y,2}^{T} > 0$. Equations (41) and (42) imply the fall in demand for durables by the old generation is more than proportional to the productivity shock, due to carrying a relatively large stock of durables from $T-1$.

Substituting $m_1 = \lambda m$ and $m_2 = m$ into (32) and (33) gives period T expenditure levels for the young consumer:

$$C_{Y,1}^{T} = pC_{X,1}^{T} = g(\gamma,d,\rho,\lambda)\lambda m < \lambda C_{Y,1} = \lambda p C_{X,1} \quad (43)$$

$$P_N C_{N,1}^{T} = (1 - 2g(\gamma,d,\rho,\lambda))\lambda m > \lambda P_N C_{N,1} \quad (44)$$

where $g_{\gamma}(\cdot) < 0$, $g_d(\cdot) > 0$, $g_{\rho}(\cdot) > 0$ and $g_{\lambda}(\cdot) > 0$,

where expenditure on each durable good is a share $g(\gamma,d,\rho,\lambda)$ of income[20]. The fall in demand for durables by the young generation is *also* more than proportional to the productivity shock. This arises because income is uneven over the consumer's lifetime. A lower period 1 income reduces the incentive to skew consumption towards durables in period 1, as the sacrifice in period 1 utility from doing so is larger.

Aggregate period T expenditure on each good is thus

$$p\overline{C_{X,T}} = \overline{C_{Y,T}} = \frac{1-\widehat{\gamma}_T(\gamma,d,\rho,\lambda)}{2}\lambda M < \frac{1-\widehat{\gamma}(\gamma,d,\rho)}{2}\lambda M \quad (45)$$

$$P_N\overline{C_{N,T}} = \widehat{\gamma}_T(\gamma,d,\rho,\lambda)\lambda M > \widehat{\gamma}(\gamma,d,\rho)\lambda M, \quad (46)$$

[19] $\widehat{\lambda}(\gamma,d,\rho)$ is increasing in d and ρ and decreasing in γ, since these raise and lower the consumer's period 1 durable consumption, respectively, through $f(\gamma,d,\rho)$. For example, if $\rho = 0.95$, $\gamma = 0.5$ and $d = 0.54337$, then from $f(\gamma,d,\rho)$ and equation (41) it follows that $\widehat{\lambda} = 0.29843$.

[20] $g(\gamma,d,\rho,\lambda) = \frac{1}{2\lambda d(2+\rho)} \times$
$\left(d\lambda(1-\gamma) + \frac{1}{2}d\rho\lambda + \frac{1}{2}\left(8d\lambda + 4d\rho\lambda - 8d\lambda\gamma - 8d\rho\lambda\gamma + 4d\lambda^2 + 4d^2\rho\lambda^2 - 8d^2\lambda^2\gamma - 4d^2\rho\lambda^2\gamma + d^2\rho^2\lambda^2 + 4d^2\lambda^2\gamma^2 + 4\right)^{\frac{1}{2}} - 1\right)$, for $d > 0$.

where $\widehat{\gamma}_T(\gamma, d, \rho, \lambda) = \frac{1+\gamma}{2} - g(\gamma, d, \rho, \lambda) + \frac{\gamma d f(\gamma,d,\rho)}{\lambda}$ and is increasing in γ, d, ρ and decreasing in λ. Since both young and old optimise away from durables, it follows that for given d, a shock λ induces a smaller fraction of national income λM to be spent on durables[21].

Since $w_T = \lambda w$ and $r_T = \lambda r$, trade flows in T are:

$$pM_X^T = X_Y^T = \lambda \left(\frac{(1-\widehat{\gamma}_T)(1-\beta) + \widehat{\gamma}_T(1-\nu)}{(\beta-\alpha)} + \frac{1-\widehat{\gamma}_T}{2} \right) r\overline{K} \\ - \lambda \left(\frac{(1-\widehat{\gamma}_T)\beta + \widehat{\gamma}_T \nu}{(\beta-\alpha)} - \frac{1-\widehat{\gamma}_T}{2} \right) w\overline{L} < \lambda p M_X = \lambda X_Y. \tag{47}$$

Trade flows are scaled down by λ, then lowered further by the preference shift from $\widehat{\gamma}$ to $\widehat{\gamma}_T(\gamma, d, \rho, \lambda)$, if $\beta + \alpha - 2\nu < 0$, giving rise to a more than proportional overall decline in trade. Proposition 3 follows from equations (41) to (47) and condition 1.

Proposition 3 *If $\beta + \alpha - 2\nu < 0$ and $d > 0$, then an unanticipated fall in productivity for one period gives rise to a more than proportional decline in trade flows in that period.*

Consider again the example where $\alpha = \frac{1}{3}$, $\beta = \frac{2}{3}$, $\nu = \frac{3}{5}$, $\gamma = \frac{1}{2}$, $d = 0.543\,37$, $\rho = 0.95$, $p = \theta = 1$, $\overline{K} = 900$ and $\overline{L} = 600$, for which $\widehat{\gamma} = 0.55$ and steady state trade flows are $67.5 \times 2^{\frac{2}{3}}$. If $\lambda = 0.5$, then $\widehat{\gamma}_T(\lambda = 0.5) = 0.635 > \widehat{\gamma}$ and trade flows fall more than proportionally to $27.4 \times 2^{\frac{2}{3}}$.

3.2 The elasticity of trade to the shock

A corollary of Proposition 3 is that the elasticity of trade to the productivity shock exceeds 1, if $\beta + \alpha - 2\nu < 0$ and $d > 0$. The elasticity of exports to the shock, and thus to GDP, follows from equation (47) and can be expressed as[22]:,

$$\begin{aligned} \varepsilon_{X,T} &\equiv \frac{\partial X_Y^T}{\partial M_T} \frac{M_T}{X_Y^T} = \frac{\partial X_Y^T}{\partial \lambda} \frac{\lambda}{X_Y^T} \\ &= 1 + \frac{-\frac{\partial \widehat{\gamma}_T(\gamma,d,\rho,\lambda)}{\partial \lambda} \lambda (2\nu - \beta - \alpha)\left(r\overline{K} + w\overline{L}\right)}{2r\overline{K} - \left[\beta + \alpha + \widehat{\gamma}_T(2\nu - \beta - \alpha)\right]\left(r\overline{K} + w\overline{L}\right)} > 1, \end{aligned} \tag{48}$$

where $\varepsilon_{X,T}$ is decreasing in λ and $\overline{K}$ and increasing in d, γ, $\overline{L}$, and ρ. The elasticity of trade to GDP is thus greater the larger the degree of durability and the larger the shock. Returning to the

[21] The share of national income spent on durables is the average of the shares of the young and old consumers.

[22] Note $\varepsilon_{X,T} \equiv \frac{\partial X_Y^T}{\partial M_T} \frac{M_T}{X_Y^T} = \frac{\partial X_Y^T}{\partial \lambda} \frac{\partial \lambda}{\partial M_T} \frac{M_T}{X_Y^T} = \frac{\partial X_Y^T}{\partial \lambda} \frac{1}{M} \frac{\lambda M}{X_Y^T} = \frac{\partial X_Y^T}{\partial \lambda} \frac{\lambda}{X_Y^T}$.

example where $\alpha = \frac{1}{3}$, $\beta = \frac{2}{3}$, $\nu = \frac{3}{5}$, $\gamma = \frac{1}{2}$, $d = 0.543\,37$, $\rho = 0.95$, $p = \theta = 1$, $\overline{K} = 900$, $\overline{L} = 600$, the elasticity is 1.46 if $\lambda = 0.5$ but rises to 1.62 if $\lambda = 0.4$. Figure 3 depicts the relationship between trade elasticity and the degree of durability for these parameter values under the two different shocks.

The model thus describes a mechanism that explains the observation that deeper downturns are associated with a higher elasticity of trade to GDP. Moreover, it does so under standard Heckscher-Ohlin assumptions of homothetic preferences and production functions.

3.3 Trade flows after the shock

In $T+1$, productivity is restored to θ and so the factor prices and national income are w, r, and M. The young consumer in period $T+1$ expects constant income m over his life, so demands goods according to equations (34) and (35). The old consumer in $T+1$ has a low stock of durables from T relative to the steady state, which induces higher durable purchases in $T+1$ relative to the steady state. Substituting $m_2 = m$ and (43) into (30) and (31) gives durable purchases of the old consumer in $T+1$:

$$pD_{X,2}^{T+1} = D_{Y,2}^{T+1} = \left(\frac{1-\gamma}{2} - \gamma d\lambda g\left(\gamma, d, \rho, \lambda\right)\right) m > D_{Y,2} = pD_{X,2} \tag{49}$$

$$P_N C_{N,2}^{T+1} = \gamma\left(1 + 2\lambda d g\left(\gamma, d, \rho, \lambda\right)\right) m < P_N C_{N,2}. \tag{50}$$

The old generation spends a larger share of income on durables than in the steady state, while the young generation spends exactly the same share as in the steady state. Aggregate period $T+1$ expenditure on each good is thus

$$p\overline{C_{X,T+1}} = \overline{C_{Y,T+1}} = \frac{1-\widehat{\gamma}_{T+1}\left(\gamma, d, \rho, \lambda\right)}{2} M > \frac{1-\widehat{\gamma}\left(\gamma, d, \rho\right)}{2} M \tag{51}$$

$$P_N\overline{C_{N,T+1}} = \widehat{\gamma}_{T+1}\left(\gamma, d, \rho, \lambda\right) M < \widehat{\gamma}\left(\gamma, d, \rho\right) M, \tag{52}$$

where $\widehat{\gamma}_{T+1}(\gamma, d, \rho, \lambda) = \frac{1+\gamma}{2} - f(\gamma, d, \rho) + \gamma d\lambda g(\gamma, d, \rho, \lambda)$ and is increasing in γ, d, ρ and λ. Trade flows in $T+1$ are:

$$pM_X^{T+1} = X_Y^{T+1} = \left(\frac{\left(1-\widehat{\gamma}_{T+1}\right)(1-\beta) + \widehat{\gamma}_{T+1}(1-\nu)}{(\beta-\alpha)} + \frac{1-\widehat{\gamma}_{T+1}}{2} \right) rK \tag{53}$$
$$- \left(\frac{\left(1-\widehat{\gamma}_{T+1}\right)\beta + \widehat{\gamma}_{T+1}\nu}{(\beta-\alpha)} - \frac{1-\widehat{\gamma}_{T+1}}{2} \right) w\overline{L} > pM_X = X_Y$$

If $\beta + \alpha - 2\nu < 0$, then the decrease to $\widehat{\gamma}_{T+1}(\gamma, d, \rho, \lambda)$ causes trade flows to overshoot the steady state level. Finally, in period $T+2$, the steady state is restored. Proposition 4 follows from equations (49) to (53) and condition 1.

Proposition 4 *If $\beta + \alpha - 2\nu < 0$ and $d > 0$, then trade flows overshoot the steady state level before returning to it in the two periods following an unanticipated, one period fall in productivity.*

Returning to our numerical example, if $\lambda = 0.5$ then $\widehat{\gamma}_{T+1} = 0.511\,26 < \widehat{\gamma}$. Trade flows are computed from equation (53) to be $73.311 \times 2^{\frac{2}{3}}$, larger than steady state trade flows at $67.5 \times 2^{\frac{2}{3}}$. Figure 4 illustrates the time path of durables and non-durables consumption, and of trade flows and GDP, for these parameter values. It shows that durables consumption falls proportionally more than non-durables consumption and then overshoots in the recovery phase. Overshooting occurs because the shock induces fewer durables purchases by the young in T, resulting in a smaller stock of durables in old age, which in turn stimulates more purchases of durables in $T+1$ than in the steady state; correspondingly, purchases of non-durables undershoot their long-run level. This time path appears broadly consistent with Figure 1. Moreover, the time path of durables consumption exactly matches that of trade flows in Figure 4, since non-durables are non-tradeable. The greater volatility of trade flows relative to GDP is thus driven by the endogenous shift in consumer preferences in the shock year and recovery phase.

4 Conclusions

There is systematic evidence that trade flows are more volatile than GDP, with the trade collapse of 2008 a striking example of this. Moreover, the observed large decline in demand for durable goods has been posited as key to explaining the trade collapse. While durable goods are commonly incorporated into macro models, there is relatively limited analysis of the role of product durability in the theoretical trade literature. Comparative advantage models characterised by homothetic preferences and constant returns to scale technologies have the feature that trade flows change in proportion with uniform productivity shocks. This paper shows that by embedding durability of traded goods into an otherwise standard Heckscher-Ohlin framework with two traded sectors and one non-traded, non-durable sector, it is possible to explain the excess trade volatility phenomenon, and generate results that are consistent with the patterns observed surrounding the trade collapse and recovery. Moreover, the minimal model that generates a more-than-proportional trade effect does not rely on non-standard assumptions, such as non-homothetic preferences, or on savings and investment or borrowing and lending.

Overlapping generations of consumers who generate future wealth through the purchase of durables are shown to maximise life-time utility by skewing their consumption towards durables when young. In turn, the stock of durables carried from the first year of life lowers demand for durable goods when consumers are old. The aggregate effect is that durability of traded goods endogenously shifts preferences away from traded goods towards non-traded goods in the economy. Provided the non-durable sector is sufficiently capital intensive, embedding durability in the model gives rise to an endogenous increase in the share of domestically produced goods in consumption. The model thus offers an alternative explanation for the home bias phenomenon, as well as for Trefler's "missing trade", that does not hinge on the presence of transport costs or increasing returns.

Shocking the equilibrium with a one period, unanticipated uniform decline in productivity induces a re-optimisation away from durables by both young and old in the economy. For the young it is due to a reduced willingness to trade-off utility in youth for utility in later life when period 1 income is shocked. For the old it is the large stock of durables carried forward from youth, which explains the fall in durable purchases. The aggregate effect is a more than proportional decline in international trade, provided the non-traded sector is sufficiently capital intensive. Furthermore, the elasticity of trade flows with respect to GDP is found to be increasing both in the degree of durability and the size of the shock. Thus the model provides microfoundations for the asymmetric shock to the demand for durable goods observed in recessions and clarifies the link between this endogenous shift in preferences and international trade flows. It also offers an explanation for the observation that deeper downturns are associated with a higher elasticity of trade to GDP.

The model clearly has its limitations. While it offers one mechanism for understanding trade volatility, it does not address other factors thought to have contributed to the trade collapse such as vertical production linkages. Moreover, the emphasis is on demand for consumer durables, and does not consider demand for capital goods. The small economy assumption makes the model tractable, but limits the analysis to the effects of a domestic shock while prices are kept constant. Furthermore, the only intertemporal link in the model is the stock of durable goods that are carried forward; consumers are unable to borrow or lend. Examining how access to capital markets may affect trade volatility in this framework is an interesting avenue for future research. Finally, the only determinant of international trade considered is comparative advantage. An examination of trade models based on economies of scale or with heterogeneous firms may provide further mechanisms for understanding the determinants of trade volatility.

References

[1] Amiti, Mary and Weinstein, David E. (2009), "Exports and financial shocks", NBER Working Paper No. 15556.

[2] Baldwin, Richard (2009), *The great trade collapse: Causes, consequences and prospects*, CEPR and VoxEU.

[3] Baldwin, Richard and Evenett, Simon (2009), The collapse of global trade, murky protectionism, and the crisis: Recommendations for the G20, CEPR and VoxEU.

[4] Behrens, Kristian, Corcos, Gregory and Mion, Giordano (2010), "Trade crisis? What trade crisis?" National Bank of Belgium Working Paper No. 195.

[5] Bems, Rudolfs, Johnson, Robert C. and Yi, Kei-Mu (2010), "Demand spillovers and the collapse of trade in the global recession", IMF Economic Review, 58 (2): 295–326.

[6] Bureau of Economic Analysis (2009), *Concepts and Methods of the U.S. National Income and Product Accounts*, U.S. Department of Commerce.

[7] Cardi, Olivier and Restout, Romain (2011), "Fiscal shocks in a two-sector open economy", HAL Working Paper 2011-03.

[8] Chor, Davin and Manova, Kalina (2011), "Off the cliff and back? Credit conditions and international trade during the global financial crisis", forthcoming, *Journal of International Economics*.

[9] Chung, Chul (2003), "Factor content of trade: Nonhomothetic preferences and 'missing trade"', mimeo, Georgia Institute of Technology.

[10] De Gregorio, Jose, Giovannini, Alberto and Wolf, Holger C. (1994), "International evidence on tradables and nontradables inflation", *European Economic Review* 38(6): 1225-1244.

[11] Eaton, Jonathan, Kortum, Samuel, Neiman, Brent and Romalis, John (2011), "Trade and the global recession", NBER Working Paper No. 16666.

[12] Engel, Charles and Wang, Jian (2009), "International trade in durable goods: Understanding volatility, cyclicality, and elasticities", *Journal of International Economics* 83(1): 37-52.

[13] Erceg, Christopher J., Guerrieri, Luca and Gust, Christopher (2008), "Trade adjustment and the composition of trade", *Journal of Economic Dynamics and Control* 32(8): 2622-2650.

[14] Flam, Harry (1985). "A Heckscher-Ohlin analysis of the law of declining international trade", *Canadian Journal of Economics*, 18 (3): 605-615.

[15] Freund, Caroline (2009), "The trade response to global downturns: Historical Evidence", World Bank Policy Research Working Paper No. 5015

[16] Gopinath, Gita, Itskhoki, Oleg and Neiman, Brent (2011), "Trade prices and the global trade collapse of 2008-2009", mimeo, Princeton University.

[17] Hall, Robert E. (2010), "Fiscal stimulus", *Daedalus* 139(4): 83-94.

[18] IMF (2008), *World Economic Outlook October 2008: Financial Stress, Downturns, and Recoveries*, International Monetary Fund, Washington D.C.

[19] Krugman, Paul R. (1980), "Scale economies, product differentiation, and the pattern of trade", *American Economic Review* 70(5): 950-959.

[20] Levchenko, Andrei A., Lewis, Logan T. and Tesar, Linda L. (2010), "The collapse of international trade during the 2008-2009 crisis: In search of the smoking gun", IMF Economic Review 58(2): 214-253.

[21] Shimomura, Koji (1993), "Durable consumption goods and the pattern of international trade," Chapter 5 in Herberg, Horst and Long, Ngo Van, eds., *Trade, Welfare, and Economic Policies: Essays in Honor of Murray C. Kemp*, Ann Arbor: Michigan University Press, 103-119.

[22] Trefler, Daniel (1995), "The case of the missing trade and other mysteries", *American Economic Review* 85(5): 1029-1046.

[23] Wang, Jian (2010), "Durable goods and the collapse of global trade", *Economic Letter: Insights from the Federal Reserve Bank of Dallas* 5(2): 1-8.

Figures and tables

	Quantities	Prices
Durable goods	-16.05%	0.21%
Nondurable goods excluding fuel	-6.65%	1.57%
Services	-3.90%	-1.86%

Table 1: Change in the annual percentage growth rate in quantities and prices for US consumption between 2007Q2 and 2009Q2 (source: BEA).

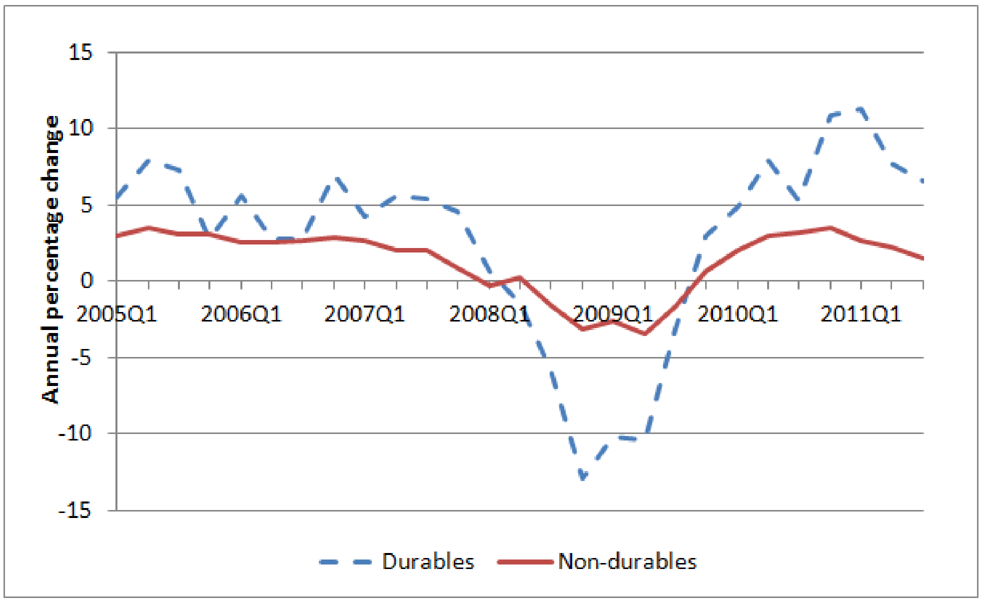

Figure 1: Annual growth rate of real US durables and non-durables consumption, 2005-2011 (source: BEA).

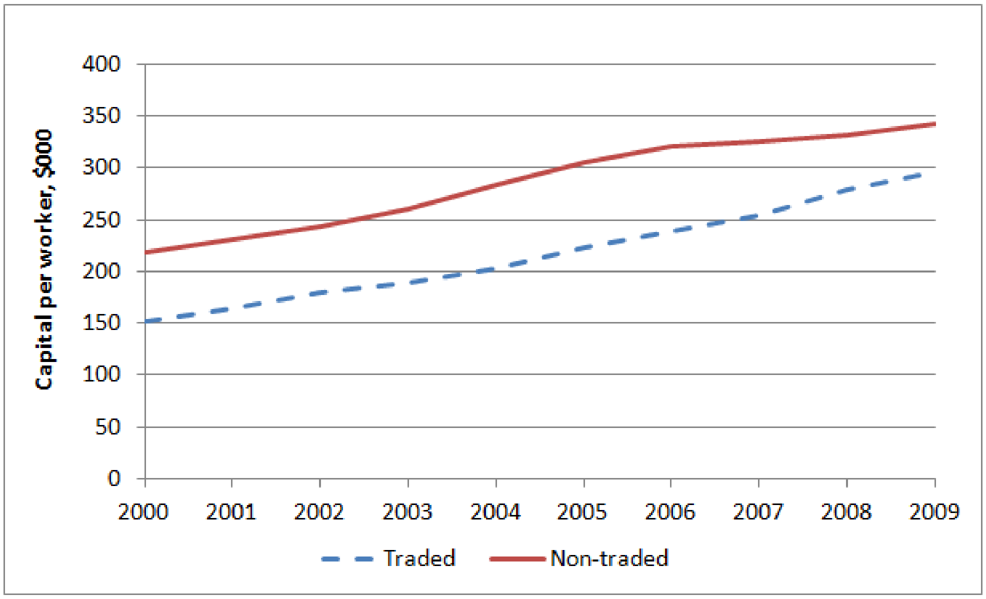

Figure 2: Capital-labour ratio in traded and non-traded sectors for the US (source: BEA).

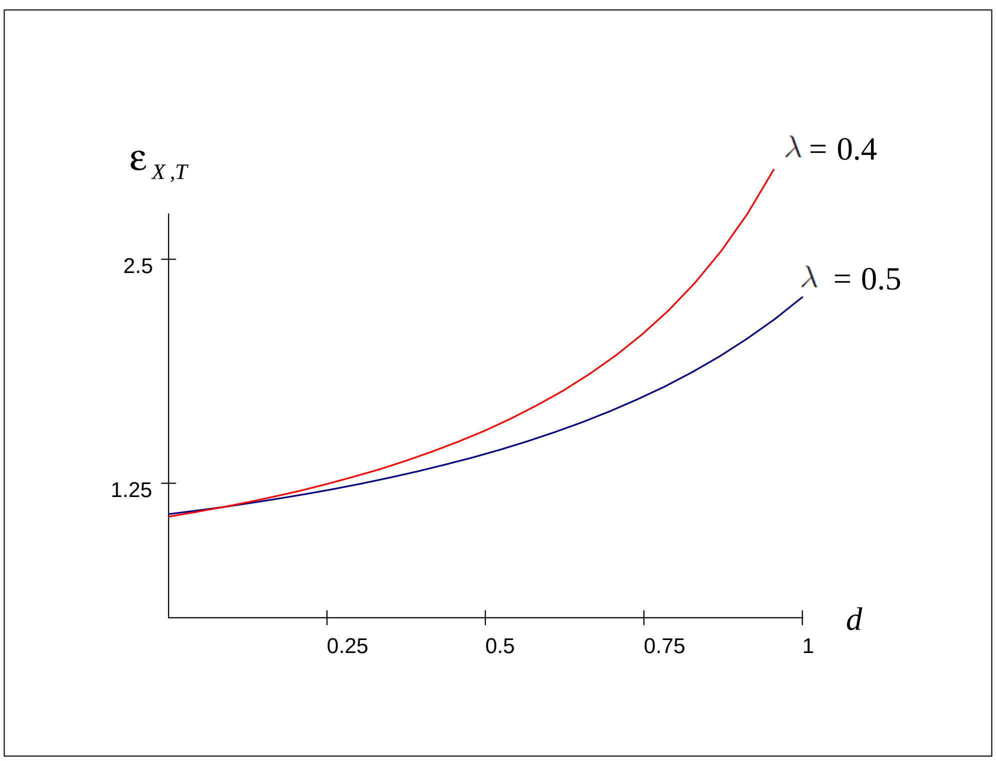

Figure 3: Trade elasticity and the degree of durability under two productivity shocks.

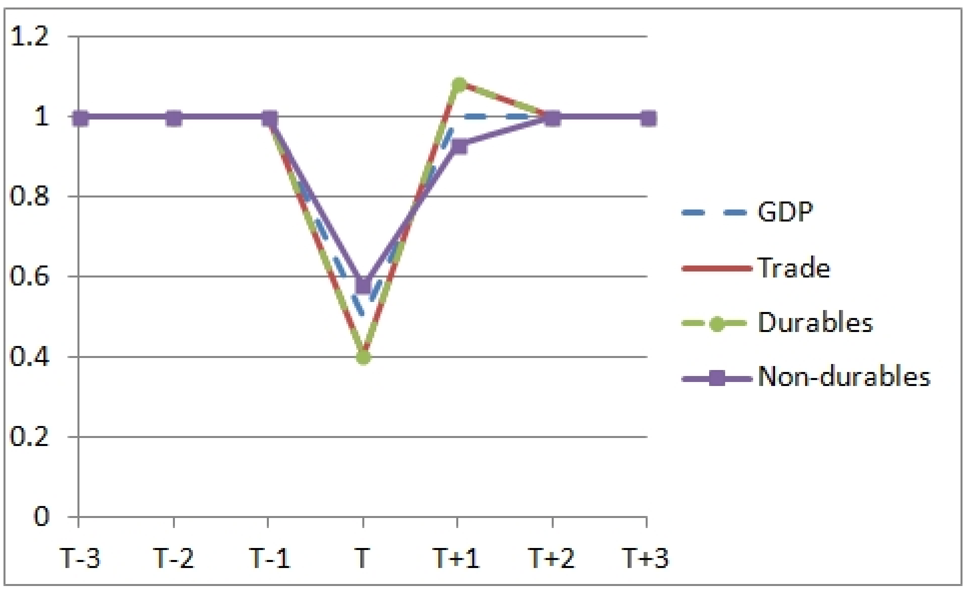

Figure 4: The time path of durable and non-durable consumption, trade flows and GDP relative to the steady state.