Industrial Structure and Monetary Policy in a Small Open Economy

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Abstract

In standard New Keynesian models, the size of the output expansion generated by aggregate demand shocks depends crucially on the elasticity of labor supply which is empirically quite small. In principle, this link can be broken in a multisectoral economy with differing degrees of price stickiness, so that the required increase in labor supply can come from other sectors. This paper reinterprets this line of reasoning in a small open economy with a traded and a non-traded sector. The latter is characterized by monopolistic competition and nominal price stickiness. The main findings of the paper are twofold. It is shown that, in fact, the size of the labor supply elasticity has no significant effect on the output response to a monetary policy shock. Yet, in this open economy framework the puzzle of the output response remains since they occur only for unrealistically high intertemporal substitution elasticities. Furthermore, it is shown that the current account response to an expansionary monetary shock crucially depends on the industrial structure of the money and not, as previously claimed, on consumption preferences alone. For reasonable model specifications the current acount moves into deficit.

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1 Introduction

This paper employs the New Open Economy Macroeconomics (NOEM) framework to revisit a central issues in the New Keynesian Economics by giving it a distinctive interpretation within the NOEM framework. As was pointed out by Lane (1999), the large majority of contributions in this literature assume a two-country world, the emphasis being firmly placed on analysis of the transmission mechanism of various kinds of shocks. There are far fewer contributions which specifically address issues that affect small open economies. I use a two-sectoral model with monopolistic competition and price stickiness to discuss the relationship between monetary policy, sectoral factor reallocation, and industrial structure.

I use the term industrial structure to describe, somewhat loosely, differences in the production structure as well as in the degree of competition across sectors. I differentiate between two modes of competition: perfect competition, where firms behave as price takers, and monopolistic competition, where firms choose their profit-maximizing price within certain boundaries. I do not attempt do give a justification for why these market constellations arise in the context of this model, an issue which is certainly beyond the reach of this paper. Instead, I impose this structure on the model and study its implications. Furthermore, the industrial structure is static in the sense that there is no entry nor exit, no changes in the technology nor in the pricing behavior. Besides differences in the degree of competition, I consider the relative size of the sectors as part of an economy's structure. For instance, economies with large non-traded sectors certainly react differently to both external and internal shocks than very open economies.

The potential relevance of the industrial structure has so far not figured prominently in the NOEM literature. Some contributions, such as Obstfeld and Rogoff (1995, 1996), Lane (1997, 1998), Hau (1998) and Cavallari (1998), study the effects of introducing non-traded goods, but their focus is mainly on the determination of nominal and real exchange rates and their respective volatilities[1]. Similarly, Betts and Devereux (1995, 1998) present models where some firms can engage in pricing-to-market behavior since both do-

[1]Specifically, Obstfeld and Rogoff (1995a) discuss a small open economy model with non-traded goods in an appendix to their 'Redux'-paper with the apparent intention to salvage their more elaborate two-country model which does not deliver the overshooting result.

mestic and foreign product markets are assumed to be effectively segmented. An alternative market structure is introduced by Bergin and Feenstra (1998) who study strategic pricing behavior, arising from translog consumer preferences, with an eye on explaining exchange rate persistence. In contrast, the model in this paper explicitly discusses the importance of the industrial structure with respect to the transmission of monetary policy shocks.

One of the main motivations for the model in this paper is a potentially problematic feature of the standard New Keynesian macro model as developed by Blanchard and Kiyotaki (1987)[2]. The central mechanism in this class of models is that an expansionary monetary shock has real effects since output becomes demand determined in the presence of menu costs. Firms are willing to satisfy the additional, artificially created demand virtually irrespective of their initial production choices. The crux of the matter is that in order to meet this demand firms have to raise their output which they can do by hiring new workers. In the standard model, the additional hirings have to come from previously idle workers who substitute out of leisure into market activities because of a perceived increase in the real wage. This line of reasoning, however, tends to break down when labor supply is perfectly inelastic. Consequently, a strong output effect of a monetary shock requires a fairly elastic labor supply. Yet, empirical evidence indicates that this is not the case. While this New Keynesian approach offers a plausible explanation of why money may not be neutral in the short run, the reliance on an unrealistically large labor supply response casts doubt on its empirical applicability.

The situation may be different, however, when the standard model is modified in the following way. Firms can hire new workers from the pool of previously idle ones, but they can also attract them from other firms. Suppose that there are two sectors in the economy, one that is characterized by the New Keynesian assumptions of monopolistic competition and price stickiness, while the other sector is perfectly competitive. As in the single-sector economy, a positive monetary surprise raises demand for the monopolistically produced goods, which can now be satisfied by additionally hiring workers away from the other sector above and beyond the new employees coming out of leisure. Even if aggregate labor supply were perfectly inelastic, the monopolistic sector could increase its production due to this sectoral labor reallocation effect. A multisectoral model thus disentangles

[2] This point is also made by Dixon and Hansen (1999).

the dependence of the New Keynesian mechanism from a preference-based labor supply schedule[3].

While an expansionary monetary policy shock raises output in the monopolistic sector, the effect on the competitive sector is less clear. The relative flow of workers out of the latter could conceivably depress production and consumption unless this is compensated by an increase in aggregate labor supply. In fact, Dixon and Hansen (1999) show that production in the competitive sector is decreasing in the money shock if aggregate labor supply is relatively inelastic. If, however, goods in these two sectors are gross substitutes (which holds for all commonly used utility functions such as CES), aggregate output definitely increases. This is precisely the hallmark of the New Keynesian approach. Since employment and production is inefficiently low if firms are monopolistically competitive, any demand results in a welfare improvement by inducing firms to produce more. Although production in the competitive sector may decline absolutely, this is not enough to overcompensate the aggregate demand effect on total output.

The previous discussion assumes a closed economy. If we suppose that the output of the monopolistically sector is non-traded, whereas that of the competitive sector is traded, we can modify the standard model in one more important respect. An open economy can borrow from or lend to the rest of world in order to smooth consumption. A monetary shock that depresses the traded sector in favor of the non-traded sector need not result in a decline in the consumption of the former. If production falls short of consumption, consumers may decide to incur debt which in effect allows them to move their consumption across time.

This paper therefore investigates the question how the aggregate labor supply interacts with the sectoral reallocation mechanism in an open economy, and how this modifies the discussion of the aggregate output effects of monetary shocks. The model in this paper thus improves upon the earlier literature by including an explicit industrial structure in combination with production in the traded sector as well as cross-sectoral labor mobility. Specifically, the dynamic behavior of the economy is enriched by considering

[3]To preempt any potential criticism of this argument, it should be pointed out that the sectoral reallocation mechanism only applies when factors can, in fact, move across sectors. If there are costs to changing employers, or a job change cannot take place within the period, but becomes only effective after some time, the strength of this argument diminishes. Nevertheless, the mere co-existence of a private labor supply schedule with sectoral reallocation suggests an important trade-off.

the following model characteristics: (i) The relative size of the sectors in the economy, as measured by their share parameters in the utility function. For instance, a larger non-traded sector, *ceteris paribus*, can be expected to require larger labor movements between sectors and from idle workers; (ii) the degree of monopolistic competition, as measured by the degree of heterogeneity among the not perfectly competitive sectors. Less competitive sectors tend to exhibit larger distortions and therefore, the effects of monetary policy shocks should be larger; (iii) the elasticity of labor supply. The higher this elasticity the more willing are workers to substitute away from leisure, which would imply a larger real response of the economy to shocks.

2 Description of the Model

The model presented in this paper is that of a small open economy which trades a single, homogenous consumption good with the rest of the world. The country has access to the international asset market by borrowing and lending in form of a real bond which pays a rate of interest in terms of units of the traded good. Being economically small within the world economy, the country takes the foreign price of the traded good as well as the interest rate on the bond as given. The economy additionally produces a non-traded good which, by definition, can only be consumed domestically.

The country can be thought of as being populated by a representative agent who derives utility from consuming the two goods and from enjoying leisure. Additionally, the agent values real money holdings because of the transaction services they provide. The agent is assumed to be the sole owner of the production technology, and he is consequently the recipient of any residual profits that may arise.

The industrial structure is characterized by a fundamental, exogenously given dichotomy. The traded sector is comprised of a representative firm which operates a linear technology using labor as its only input. The market structure is therefore that of perfect competition: the firm takes prices in both the factor and product markets as given. The non-traded sector, on the other hand, is assumed to be monopolistically competitive. Preferences are such that the non-traded goods are imperfectly substitutable which gives the heterogeneous producers in that sector a certain modicum of market power. Furthermore, I assume that product prices in the non-traded sector are fixed in nominal terms for one period. Consequently, monetary shocks have real effects by design.

2.1 Consumer Optimization

The intertemporal utility function oft the representative agent is given as follows:

$$U_0 = \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{1-\sigma} C_t^{1-\sigma} + \frac{\chi}{1-\varepsilon} \left(\frac{M_t}{P_t} \right)^{1-\varepsilon} - \frac{\kappa}{\omega} l_t^{\omega} \right]. \tag{1}$$

Period utility is comprised of three additive components, viz. the utility value the consumer attaches to aggregate consumption C, real money balances $\frac{M}{P}$, and the disutility of work l. Respectively, $\sigma > 0$ is the coefficient of relative risk aversion (the inverse of the intertemporal substitution elasticity), $\varepsilon > 1$ is the partial interest elasticity of money demand, and $\omega > 1$, whereby $\omega - 1$ is the elasticity of the marginal disutility of work. $\chi, \kappa > 0$ are scale parameters. $0 < \beta < 1$ is the subjective discount factor.

The representative agent faces the following intertemporal budget constraint, expressed in nominal terms:

$$P_t C_t + M_t + p_{T,t} b_t + T_t = W_{T,t} l_{T,t} + W_{N,t} l_{N,t} + \pi_{T,t} + \pi_{N,t} + M_{t-1} + p_{T,t}(1+r) b_{t-1}. \tag{2}$$

The agents draws income from employment in the traded and the non-traded sector, l_T and l_N, paying a nominal wage W_T and W_N. Being the owner of the production technology he also is the recipient of residual profits in the two sectors, π_T and π_N. His wealth holdings are complemented by money balances carried over from the previous period and the nominal value of interest r and principal repayment of net foreign asset holdings b[4]. Period income is spent on aggregate consumption, whose price is P, paying lump-sum taxes T to the government, and augmenting wealth by holding money and net foreign assets. In choosing his labor supply, the agent also has to obey the following restriction:

$$l_{T,t} + l_{N,t} = l_t, \tag{3}$$

i.e. there are no barriers to allocating employment across sectors.

[4]Since the internationally traded bond is denominated in terms of the traded good it has to be valued using the money price p_T of the latter.

The representative consumer therefore maximizes the intertemporal utility function (1) subject to the constraints (2) and (3) by choosing sequences of $\{C_t, M_t, b_t, l_{T,t}, l_{N,t}\}_{t=0}^{\infty}$, while taking goods and factor prices, residual profits, the interest rate, and initial conditions M_{-1}, b_{-1} as given.

It follows immediately from the first order conditions that with free labor mobility sectoral nominal wages are equalized: $W_{T,t} = W_{N,t} \equiv W_t$. Own real factor returns, however, may differ across sectors. Total labor supply is determined by the real wage, evaluated in terms of the price index P, and aggregate consumption, the latter reflecting the fact that employment is wealth-dependent[5]:

$$\frac{W_t}{P_t} = \kappa l_t^{\omega-1} C_t^{\sigma}. \tag{4}$$

Note that changes in aggregate consumption shift the labor supply schedule by a factor of σ in percentage terms, i.e. more risk averse consumers require a higher real wage for any employment level so that the additional wage income serves as a buffer against adverse shocks. In other words, consumers cannot choose their labor input independently of the consumption smoothing motive[6].

The Euler-equation is slightly non-standard in that it contains an adjustment factor for relative sectoral price changes. The representative consumer has only access to a bond denominated in terms of the traded good, but desires to smooth aggregate consumption, as is evident from the utility function. In making an intertemporal consumption choice he therefore has to

[5] The assumption that $\omega > 1$ makes sure that the labor supply schedule is well-behaved and downward-sloping.

[6] It is a decidedly open empirical question whether aggregate wealth changes in the economy affect the labor supply. There is substantial disagreement in the literature to what extent consumers smooth leisure intertemporally (which is what this specification of period utility entails). In the choice of such a utility function this dissertation follows the convention in the NOEM literature to ensure comparability. Dixon and Hansen (1999), on the other hand, argue that "[...] *this kind of utility function excludes wealth effects in the labour supply*" (p. 1479). This statement is true only under their assumption of risk-neutrality which corresponds to $\sigma = 0$ in our case. It is shown later that this assumption leads to misleading results on the output effects of monetary shocks.

take account of relative price changes between the two individual goods[7]:

$$\frac{p_{T,t}}{C_t^\sigma P_t} = \beta(1+r)\frac{p_{T,t+1}}{C_{t+1}^\sigma P_{t+1}}. \tag{5}$$

Following Dornbusch (1983) it is instructive to introduce the consumption based real interest rate $1 + r^C$, which is the effective interest rate that consumers use to evaluate the trade-off between present and future consumption:

$$1 + r_t^C = (1+r)\frac{p_{T,t+1}}{p_{T,t}}\frac{P_t}{P_{t+1}}. \tag{6}$$

We can alternatively express the Euler-equation (5) as:

$$\frac{1}{C_t^\sigma} = \beta\left(1 + r_t^C\right)\frac{1}{C_{t+1}^\sigma}. \tag{7}$$

Note that this real interest rate now carries a time subscript. Changes in the aggregate price level, as well as in traded goods prices, alter the path of the real interest rate that is relevant for making consumption decisions. Consequently, the path of aggregate consumption need no longer be smooth. For instance, aggregate consumption is expected to rise if the consumption interest rate is larger than the exogenously given world interest rate r. r^C in turn increases if, say, the expected price of traded goods rises by more than the price level is expected to fall. Obviously, the behavior of aggregate consumption and of the price index depends on their composition in terms of the two goods.

Real money balances are chosen according to a standard Fisher-equation relating money holdings to the relevant transaction variable and expected inflation:

$$\frac{M_t}{P_t} = \chi^{\frac{1}{\varepsilon}} C_t^{\frac{\sigma}{\varepsilon}}\left[1 - \beta\left(\frac{C_t}{C_{t+1}}\right)^\sigma \frac{P_t}{P_{t+1}}\right]^{-\frac{1}{\varepsilon}}. \tag{8}$$

[7]The convenient assumption of an 'internationally traded bond denominated in terms of the traded good' is not completely innocuous. Conceivably, international investors, the proverbial rest of the world, could offer this small open economy a variety of assets with different denominations. For instance, bond issuers could promise a pay-off in terms of the non-traded good which, say, the borrower, then delivers in terms of its utility equivalent, that is in form of traded goods which can be exchanged for non-traded goods. Most contributions in the literature assume a traded goods denomination for analytical simplicity, and secondly, to capture the fact that a substantial part of international borrowing of LDC's is in fact tied to their exports. In order to ensure comparability with this literature, the model uses the same assumption.

Note that expected aggregate consumption growth as well as expected inflation reduce current real money demand. We can use the Euler-equation (5) to rewrite money demand in a more conventional form:

$$\frac{M_t}{P_t} = \chi^{\frac{1}{\varepsilon}} C_t^{\frac{\sigma}{\varepsilon}} \left(\frac{1+i_t}{i_t} \right)^{\frac{1}{\varepsilon}}, \tag{9}$$

where the nominal interest rate is defined as:

$$1 + i_t = (1+r) \frac{p_{T,t+1}}{p_{T,t}}. \tag{10}$$

The previous equations describe the intertemporal opportunities available to the small open economy. We now disaggregate the model further by assuming that aggregate consumption is a Cobb-Douglas composite of traded and non-traded goods with respective weights of γ and $1-\gamma$:

$$C = c_T^{\gamma} c_N^{1-\gamma}. \tag{11}$$

The choice of individual goods consumption can be interpreted as the second stage of a nested optimization problem in which the representative agent maximizes a consumption sub-utility function subject to the appropriate constraint[8]:

$$\begin{aligned} \max_{\{c_T, c_N\}} \quad & C = c_T^{\gamma} c_N^{1-\gamma} \\ \text{s.t.} \quad & p_T c_T + p_N c_N = PC \end{aligned} \tag{12}$$

Following Obstfeld and Rogoff (1996), P is the consumption-based price index, which is the minimum expenditure in money terms required to purchase one unit of C[9]. Defining the relative price of the non-traded good in terms

[8] Time subscripts are omitted for notational simplicity.

[9] Formally, the price index is found by solving:

$$\begin{aligned} & \min_{\{c_T, c_N\}} \{Z = p_T c_T + p_N c_N\} \\ & \text{s.t. } c_T^{\gamma} c_N^{1-\gamma} = C \end{aligned}$$

and setting $Z = PC = P$, so that $C = 1$.

of the traded good $s = \frac{p_N}{p_T}$, we can write[10]:

$$P = \frac{1}{\gamma_W} p_T^{\gamma} p_N^{1-\gamma} = \frac{1}{\gamma_W} p_T s^{1-\gamma}.^{11} \tag{13}$$

Individual demand functions are then given by:

$$c_T = \gamma \frac{PC}{p_T} = \left(\frac{\gamma}{1-\gamma} \right)^{1-\gamma} s^{1-\gamma} C, \tag{14}$$

$$c_N = (1-\gamma) \frac{PC}{p_N} = \left(\frac{1-\gamma}{\gamma} \right)^{\gamma} s^{-\gamma} C. \tag{15}$$

where we note that:

$$\frac{c_T}{c_N} = \frac{\gamma}{1-\gamma} s. \tag{16}$$

2.2 Production

We assume that there are two sectors in the economy which produce, respectively, a homogeneous traded good and an aggregate non-traded good. By definition, the former sector has access to the international goods market while the latter sector only sells to domestic consumers. Both sectors share the same pool of labor. Since workers are assumed to move freely across sectors firms have to pay identical real wages. Total factor productivities A_T and A_N, however, may vary between the two sectors. For simplicity it is also assumed that the production technologies are linear in labor input[12].The

[10]The definition of the consumption-based price index also allows us to rewrite the consumption-based real interest rate:

$$1 + r_t^C = (1+r) \left(\frac{s_t}{s_{t+1}} \right)^{1-\gamma}.$$

Other things being equal, an expected decrease in the relative price of non-traded goods raises the consumption interest rate by an elasticity factor of $1-\gamma$. An expected relative expansion of the non-traded sector thus increases the return on deferred traded goods consumption by lowering the former's price.

[11]$\gamma_W = \gamma^{\gamma}(1-\gamma)^{1-\gamma}$.

[12]Assuming technologies with a decreasing marginal product of labor adds curvature to the sectoral labor demand schedules, but does not alter the results for this models in a substantial way. See also Jeanne (1997) for more on this point.

representative firm in the traded goods sector solves a simple, single-period profit maximization problem:

$$\max_{\{l_T\}} \pi_T = p_T Y_T - W_T l_T$$
$$\text{s.t. } Y_T = A_T l_T \tag{17}$$

Using the equality of money wages across sectors which has been established from the first order conditions of the consumer's problem, we can derive the labor demand function in the traded sector, where we use aggregate consumption as the numeraire:

$$\frac{W_t}{P_t} = \frac{p_T}{P} A_T = \gamma_W \frac{A_T}{s^{1-\gamma}}. \tag{18}$$

Note that by virtue of constant returns to scale in production, the profit function of the firm in the traded sector is identically equal to zero.

The non-traded goods sector is characterized by the presence of monopolistically competitive firms which are distributed along the unit interval. Each of these firms faces a downward-sloping demand curve for its own output. The source of their market power stems from the consumers' preferences for diversity. This is represented by the now standard Dixit and Stiglitz (1977)-utility function in which heterogeneous consumption goods are imperfect substitutes. Consequently, consumers are reluctant to substitute away from individual goods which gives the heterogeneous producers some leeway in choosing the profit maximizing price.

The consumer's demand curve can be found by solving the standard utility maximization problem:

$$\max_{\{c_N(j)\}} \left[\int_0^1 c_N(j)^{\frac{\nu-1}{\nu}} dj \right]^{\frac{\nu}{\nu-1}} \tag{19}$$

$$\text{s.t. } \int_0^1 p_N(j) c_N(j) dj = p_N c_N. \tag{20}$$

$\nu > 1$ is the elasticity of substitution between any two of the heterogeneous goods. For $\nu \to \infty$, the $c_N(j)$ become perfect substitutes which, in the limit, results in the perfectly competitive situation. The inverse of this substitution elasticity can also be interpreted as the so-called Lerner index of deviations from the perfectly competitive scenario, whose values range between zero and one, the former indicating perfect competition[13]. Consumers take prices $p_N(j)$ as well as total nominal expenditure on the non-traded sector $p_N c_N$ as given[14]. The demand function for some good j is consequently:

$$p_N(j) = \left(\frac{c_N(j)}{c_N}\right)^{-1/\nu} p_N. \tag{21}$$

We can now formulate the problem a monopolistically competitive firm in the non-traded sector faces. The firm has access to a linear technology which uses labor as the only input. Workers are hired at a given wage rate $W_N(j)$. The firm maximizes profits by choosing the optimal price along the demand curve (21). Furthermore, the firm takes account of the fact that under the assumption of menu costs its output becomes demand determined. The firm is willing, within certain bounds, to supply whatever quantities of goods are demanded. To be able to do so, it hires workers irrespective of its labor demand curve.

We can thus describe the program of some firm j as follows:

$$\max_{\{l_N(j)\}} \pi_N(j) = p_N(j)Y_N(j) - W_N(j)l_N(j)$$

$$\text{s.t.} \qquad p_N(j) = \left(\frac{c_N(j)}{c_N}\right)^{-1/\nu} p_N,$$

$$Y_N(j) = A_N l_N(j), \tag{22}$$

$$Y_N(j) \leq Y_N(j)^D = c_N(j). \tag{23}$$

The first order condition implies that:

$$\frac{W_N(j)}{p_N(j)} = \left(1 - \frac{1}{\nu}\right) A_N. \tag{24}$$

If we assume that non-traded firms are homogeneous ex-post, i.e. they behave symmetrically and choose the same input and output prices, then we can rewrite the labor demand equation in this sector as before:

$$\frac{W_t}{P_t} = \frac{p_N}{P}\left(1 - \frac{1}{\nu}\right) A_N = \left(1 - \frac{1}{\nu}\right) \gamma_W A_N s^{\gamma}. \tag{25}$$

[13] See Dixon and Hansen (1999) for more on this point. Effectively, this is markup of price over marginal cost.

[14] Similarly to the previous subutility function for traded and non-traded goods c_N can be interpreted as a CES-aggregator while p_N is the corresponding consumption price index. Since firms are small they do not perceive their pricing decisions to have an effect on the sectoral price index.

Furthermore, it is easy to see that profits in the non-traded sector are:

$$\pi_N = \frac{1}{\nu} p_N Y_N > 0, \tag{26}$$

which disappear if $\nu \to \infty$.

2.3 Equilibrium

In order to complete the model specification we have to describe the behavior of the government with respect to monetary and fiscal policy. It is assumed initially that monetary policy consists of specifying a path for the money stock $\{M_t\}_{t=0}^{\infty}$. The government does not consume any resources and rebates any seigniorage revenue to the private sector, which implies the following government budget constraint:

$$M_t - M_{t-1} + T_t = 0. \tag{27}$$

We can use this equation, together with the requirement that $c_{N,t} = Y_{N,t}$, to derive the resource constraint for this small open economy. We substitute out sectoral profits by using (26) and $\pi_T = 0$, then use the definition $p_T c_T + p_N c_N = PC$ to get:

$$c_{T,t} + b_t = Y_{T,t} + (1 + r) b_{t-1}. \tag{28}$$

Any mismatch between domestic consumption and production of the traded good is reflected in the net accumulation of foreign assets. The current account is therefore simply:

$$ca_t = b_t - b_{t-1} = Y_{T,t} - c_{T,t} + r b_{t-1}.$$

Furthermore, we can define real GDP as the value-weighted sum of sectoral outputs:

$$Y_t = \frac{p_{T,t} Y_{T,t} + p_{N,t} Y_{N,t}}{P_t}. \tag{29}$$

The real exchange rate is next defined as the relative price of consumption baskets across countries when measured in the same currency. Specifically, we have:

$$rer_t = \frac{e_t P_t^*}{P_t} = \frac{const.}{s_t^{1-\gamma}}, \tag{30}$$

if we assume that the non-traded component of the foreign consumption price index remains constant.

In describing an equilibrium for this model economy we use the simplifying assumption that the ex-ante heterogeneous firms in the non-traded sector are identical ex post. This allows us to aggregate these firms into a single, representative, monopolistically competitive firm which nevertheless makes production decisions according to (25), that is by taking into account the downward-sloping demand curve. Equilibrium in this economy is given by the sequence of first order conditions from the consumer optimization problem (3), (4), (5), (8), and from the intratemporal consumption choice (13), (14), (15); then by the first order conditions from the firms in the two sectors (17), (18), (22), (25), and finally by the economy's resource constraint (28) in combination with a standard transversality condition which prevents net foreign indebtedness from rising too fast. The equilibrium can be considered indexed by the sequence of money supplies $\{M_t\}_{t=0}^{\infty}$ and the initial level of net foreign assets b_{-1} which I treat as a calibratable parameter[15].

2.3.1 Steady State

As a first step in analyzing the implications of the model we calculate a steady state allocation. However, it is possible to find an analytical solution for the steady state only for the case where the economy has no outstanding net foreign assets ($b_{-1} = 0$)[16]. The relative price of the non-traded good is be derived by combining sectoral labor demands:

$$s = \frac{\nu}{\nu - 1} \frac{A_T}{A_N}. \tag{31}$$

Assuming identical total factor productivity, the non-traded good commands a higher price than the traded, which suggests that output is inefficiently low. The more heterogeneous these goods are ($\nu \rightarrow 1$) the larger is the price differential. The implication, of course, is that policy actions that raise production in the non-traded sector have positive welfare effects[17]. This can

[15] The non-existence of a unique steady state is a well known problem in this class of models. None of the first-order conditions pins down the steady state value of outstanding debt.

[16] In this case, we can see from (28) that $c_T = Y_T$. For all other values of b, the current account equation is essentially non-linear.

[17] The standard remedy is to subsidize non-traded production by a factor of $1/\nu$, financed by lum-sum taxation.

also be seen by calculating the employment-ratio in both sectors:

$$\frac{l_N}{l_T} = \frac{(\nu - 1)}{\nu} \frac{(1 - \gamma)}{\gamma} < \frac{1 - \gamma}{\gamma}. \tag{32}$$

Another useful expression is the share of workers in the traded sector to total workforce[18]:

$$\frac{l_T}{l} = 1 - \frac{l_N}{l} = \frac{\gamma\nu}{\gamma\nu + (1 - \gamma)(\nu - 1)}, \tag{33}$$

Figure 1 depicts the traded labor share in total employment as a function of γ and ν.

The monopolistic distortion in the non-traded sector is significant only for small values of ν. As $\nu \to 1$ employment, and thus output, are severely reduced below their efficient level which is given by $1-\gamma$. For small values of ν the firms in the non-traded sector enjoy a large degree of pricing power which allows them to depress output. Other things being equal, workers have to seek employment in the traded sector whose output is artificially high. We can therefore expect to see larger welfare effects when non-traded goods are fairly heterogenous. Note also that $\frac{l_T}{l}$ tends towards γ as $\nu \to \infty$. If non-traded goods are perfect substitutes (the perfectly competitive case), then total labor supply is allocated across sectors according to their respective share in demand. The consumption share parameter γ can therefore be interpreted as a statistic for the relative size of the two sectors in the economy.

3 The Effects of Monetary Policy Shocks

We now proceed to analyze the effects of unexpected monetary expansion in the presence of nominal price stickiness and menu costs in the non-traded sector. Special emphasis is paid to the implications of a mixed industrial structure. The analysis builds on the contributions by Obstfeld and Rogoff (1996),

[18] For sake of completeness the steady state value of employment in the traded sector as a function of the structural parameters is given by:

$$\begin{aligned} l_N &= \left(\frac{\gamma_W}{\kappa}\right)^{\frac{1}{\sigma+\omega-1}} \left(\frac{1-\gamma}{\gamma}\right)^{\frac{\sigma\gamma}{\sigma+\omega-1}} * \\ &* \left(\frac{\gamma}{1-\gamma}\frac{\nu}{\nu-1} + 1\right)^{-\frac{\omega-1}{\sigma+\omega-1}} \left(\frac{\nu-1}{\nu}\right)^{\frac{1+\gamma(\sigma-1)}{\sigma+\omega-1}} \end{aligned}$$

where $\gamma_W = \gamma^\gamma (1-\gamma)^{1-\gamma}$.

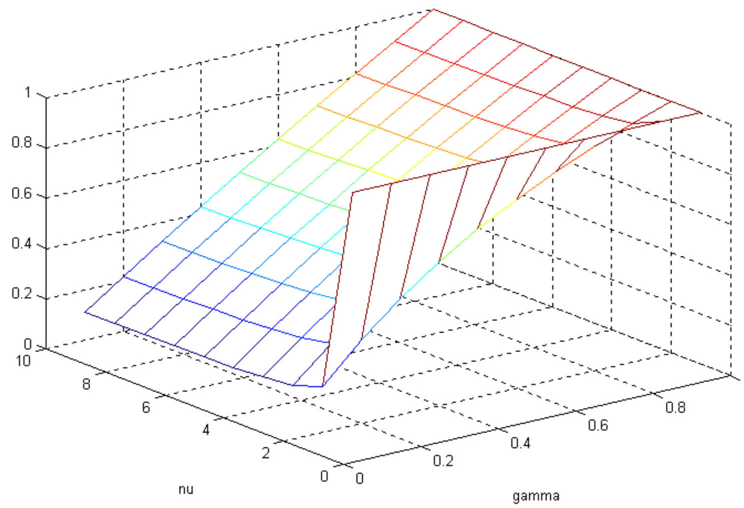

Figure 1: Employment Share in the Traded Sector

Lane (1997) and Cavallari (1998). However, these authors model traded output as endowment in the income stream of the representative agent, which abstracts from the importance of sectoral factor reallocation. The latter is studied by Dixon and Hansen (1999), albeit in a static, closed-economy framework.

3.1 Model Solution

Since exogenous shocks typically move the economy away from the steady state, this entails net foreign asset accumulation and current account imbalances. For $b_t \neq 0$, the model can no longer be solved analytically. We therefore proceed to log-linearize the equation system around the steady state, calculated earlier, for which $b = 0$. The solution of the model is further simplified by assuming that nominal prices in the non-traded sector are sticky for only one period. This effectively breaks down the infinite horizon problem into segments of two time periods each. Since prices adjust fully one period after the respective shock, there will be no further dynamics after that (until a new disturbance occurs); the economy thus reaches a new steady state indexed by possibly non-zero net foreign assets[19] [20]. Consequently, we can describe the equilibrium by two sets of equations: those valid in the short-run (denoted by a tilde), and those valid in the long-run (denoted by an overbar). The short and the long run are connected via the money demand-equation (8), via expected inflation, and the Euler-equation (5). It is convenient to solve first for the long-run variables as a function of net foreign assets and then to use this in determining the short-run.

The approximate labor supply-equation has the same form in the short- and in the long-run:

$$\left(\hat{W} - \hat{P}\right) = (\omega - 1)\hat{l} + \ \sigma\hat{C}, \tag{34}$$

where the caret '^' stands in for both '~' and '−'. Period money demands differ, however, since inflation is expected to be constant after the initial monetary expansion. We have:

$$\begin{aligned} \overline{M} - \widetilde{P} &= \frac{\sigma}{\varepsilon}\widetilde{C} + \frac{\beta}{1-\beta}\left(\widetilde{C} - \overline{C}\right) + \frac{\beta}{1-\beta}\frac{1}{\varepsilon}\left(\widetilde{P} - \overline{P}\right), &(35)\\ \overline{M} - \overline{P} &= \sigma\overline{C}. &(36) \end{aligned}$$

The Euler-equation can be approximated as:

$$\widetilde{p_T} - \sigma\widetilde{C} - \widetilde{P} = \overline{p_T} - \sigma\overline{C} - \overline{P}. \tag{37}$$

There is no long-run equivalent to this Euler-equation because consumption is expected to be constant after the initial period. The labor supply constraint is:

$$l_N\hat{l_N} + l_T\hat{l_T} \ = l\hat{l}. \tag{38}$$

The current account equation can be written approximately in the following way. Note that since net foreign assets can take on values of zero we cannot *log-linearize* b. Instead, we *linearize* b around its initial steady state ($b_0 = 0$) and denote the absolute deviation by db. This yields the short-run current account:

$$\widetilde{c}_T + \frac{db}{y_T} = \widetilde{Y}_T. \tag{39}$$

[19] There is a subtle, but potentially important problem associated with log-linearization in this model.

[20] This segmentation can also be applied to models with longer periods of rigidity. The essential insight is to distinguish between the "short run" and the "long run" no matter how long they are. This point is demonstrated by Corsetti and Pesenti (1998).

The term $\frac{db}{y_T}$ is therefore the change in net foreign assets as a percentage of traded output. In the long-run, the current account remains balanced; there are no more shocks that provide incentives for the agents to move consumption across time, and we have:

$$\overline{c}_T = \overline{Y}_T + r\frac{db}{y_T}. \tag{40}$$

The equations governing consumption allocations, (14), (15), (16), and the price index (13) are log-linearized, respectively, as follows:

$$\begin{aligned} \hat{c}_T &= (1-\gamma)\hat{s} + \hat{C}, & (41)\\ \hat{c}_N &= -\gamma\hat{s} + \hat{C}, & (42)\\ \hat{c}_T - \hat{c}_N &= \hat{s}, & (43)\\ \hat{P} &= \hat{p}_T + (1-\gamma)\hat{s}. & (44) \end{aligned}$$

Labor demand in the traded sector is governed by:

$$\left(\hat{W} - \hat{P}\right) = \hat{A}_T - (1-\gamma)\hat{s}, \tag{45}$$

whereas for the non-traded sector we have in the long-run:

$$\left(\overline{W} - \overline{P}\right) = \overline{A}_N + \gamma\overline{s}. \tag{46}$$

The crucial step in the solution of the model is now to notice that in the short-run, employment, and output, in the non-traded sector is no longer governed by (25). With the assumption that output is determined in the presence of menu costs, firms hire as many workers as the labor supply (both from previously idle workers and from the traded sector) allows and the increased demand warrants. The system of equations is completed by:

$$\widetilde{s} = -\widetilde{p}_T, \tag{47}$$

which is derived from the definition of the relative price of non-traded goods using the assumption that prices in this sector are fixed in the short run, i.e. $\widetilde{p}_N = 0$.

We now proceed by solving for the long-run variables as functions of net foreign assets $\frac{db}{y_T}$. Combining (18) and (25) yields:

$$\overline{s} = \overline{A}_T - \overline{A}_N. \tag{48}$$

The relative price of non-traded goods does not depend on monetary shocks, as does the real exchange rate. We can then deduce immediately the effect on the real wage in the long run:

$$\left(\overline{W} - \overline{P}\right) = \overline{A}_W. \tag{49}$$

Defining $\delta_0 = \frac{\omega-1}{\sigma+\omega-1}\frac{l_T}{l}$, where $0 < \delta_0 \leq 1$, we have:

$$\overline{C} = \overline{c}_T = \overline{c}_N = \delta_0 r \frac{db}{y_T}, \tag{50}$$

and

$$\bar{l}_T = (\delta_0 - 1) r \frac{db}{y_T}, \tag{51}$$

$$\bar{l} = -\frac{\sigma}{\omega - 1}\delta_0 r \frac{db}{y_T}. \tag{52}$$

There are two observations to make here. First, although monetary policy has long-run effects via the current account, the quantitative impact is fairly small since $\frac{db}{y_T}$ enters with the real interest rate which is typically of an order of a few percentage points. This effect is likely to be larger, however in a two-country framework where the terms of trade as an additional channel of sectoral and international income and wealth redistribution. Secondly, employment and output in the traded sector move in the opposite direction of those in the non-traded sector. For instance, while a first period current account deficit ($\frac{db}{y_T} < 0$) requires lower consumption, traded output has to be higher due to the need for a trade surplus in order to service foreign debt. Total employment increases unambiguously[21]. The employment effect depends inversely on the parameter ω which measures the unwillingness of agents to work.The next step is to solve the short-run equation system by using the

[21]Note that if $\sigma = 0$ agents do not smooth leisure intertemporally so that employment does not change in the long-run. This is similar to the scenario detailed in Dixon and Hansen (1999).

previously derived expressions to substitute out the long-run variables in the money demand and Euler equations. We have:

$$\widetilde{p}_T = \eta_0 \overline{M} - \eta_1 r \frac{db}{y_T}, \tag{53}$$

where

$$\eta_0 = \frac{\varepsilon(1-\beta)+\beta}{(1-\gamma+\gamma\varepsilon)(1-\beta)+\beta} > 0, \tag{54}$$

$$\eta_1 = \frac{\sigma\delta_0}{(1-\gamma+\gamma\varepsilon)(1-\beta)+\beta} > 0. \tag{55}$$

Note that when $\varepsilon = 1$, the parameters reduce to $\eta_0 = 1$ and $\eta_1 = \sigma\delta_0$, respectively. We can now use this expression in the current account equation (39) together with (38) and (38) to get the final solution for net foreign asset accumulation as a function of the monetary expansion:

$$\frac{db}{y_T} = \frac{\left(\frac{1-\gamma}{\sigma} + \gamma - \frac{l_T}{l}\right)\eta_0}{\left(\frac{1-\gamma}{\sigma} + \gamma - \frac{l_T}{l}\right)\eta_1 r - (1+r)\frac{l_T}{l}} \overline{M} = \psi_0 \overline{M}. \tag{56}$$

Since all endogenous variables can be expressed as functions of the short run current account, the remaining model solution is standard. We will present the solutions for other variables as we go along in the discussion of the model.

3.2 The Mechanics of the Model

We now discuss the mechanics of the model by focusing on the example of an unexpected, one-time, permanent increase in the money supply which raises the domestic currency price of the traded good one-for-one. Since prices are completely sticky in the non-traded sector, the relative price of non-tradeables falls. Assuming gross-substitutability (which holds for the Cobb-Douglas utility function) non-traded consumption expands relative to traded goods consumption. From (39), we can see that the latter can only increase if aggregate consumption rises by enough to compensate the relative price effect. This, however, depends on the strength of the wealth effect from the monetary shock. As equation (34) shows, this is directly related to the labor supply response.

The decline in its relative price thus reallocates demand towards the traded good, but there is also another factor at play. This idea was formalized by Blanchard and Kiyotaki (1987) who build on ideas first presented in Akerlof and Yellen (1985). The monopolistically competitive firms in the non-traded sector are assumed to be subject to 'menu costs'. That is, if they want to change their product prices they have to incur some fixed cost in literal meaning of having to pay for printing new menus. For large enough costs, this prevents firms from changing their prices at all, which become effectively sticky. But since firms face a downward-sloping demand curve they can alter the optimal production point by varying labor inputs without having to worry about rising input costs. The important point that Akerlof and Yellen (1985) make is that the profit function is nearly flat in a neighborhood around the maximum. Firms can therefore hire more workers and increase their revenue without having to forego too much profit. Output thus becomes demand determined; firms are willing to supply goods at nearly any price.

In order to understand the mechanism behind the sectoral reallocation of labor, we discuss first the logic underlying the similar, yet much simpler models employed by Cavallari (1998) and Lane (1997). Both authors assume that the supply of traded goods is exogenous and fixed. All labor supply changes therefore affect only the non-traded sector. It is well known in the literature that the direction of the current account response depends on the sign of the difference between the intertemporal elasticity of substitution $1/\sigma$ and the intratemporal substitution elasticity in consumption[22]. When this difference is negative, goods are said to be substitutes in consumption, and complements else. For instance, with Cobb-Douglas utility $\sigma > 1$ implies that an increase in non-traded consumption lowers traded consumption. In this case, the representative consumer is more concerned about a smooth path of aggregate consumption than a balanced consumption profile within each period. He incurs a current account surplus in order to be able to balance higher future traded consumption against the expected decline in non-traded output in the next period. Since the domestic supply of traded goods is exogenous, it is only the decline in consumption that contributes to the surplus[23].

[22] Cavallari (1998) assumes Cobb-Douglas preferences, as does the model in this chapter, so that the intratemporal elasticity is unity. Lane (1997) works with a CES-utility function, but this does not change the substantive nature of the results since a varying intratemporal elasticity just scales the behavior of the current account with respect to the intertemporal elasticity.

[23] Based on this line of reasoning, Lane (1997) somewhat testily makes the claim that this simple model without capital accumulation is able to match the data in the sense

In this simplified version of the model the dynamic behavior in terms of direction therefore amounts to a comparison of substitution elasticities in consumption only, while the quantitative impact is linked again to the labor supply elasticity. The wealth effect in question therefore refers to size of the change in aggregate consumption.

The behavior of the model with endogenous traded output is substantially different. The short-run behavior of the current account is a function of the change in the money supply: $\frac{db}{y_T} = \psi_0 \overline{M}$. The sign of the response coefficient ψ_0 can be shown to depend on the structural parameters in the following way. Label the numerator and the denominator in the above coefficient respectively:

$$\zeta = \left(\frac{1-\gamma}{\sigma} + \gamma - \frac{l_T}{l} \right) \eta_0, \text{ and} \tag{57}$$

$$\xi = \zeta \eta_1 r - (1+r) \frac{l_T}{l}. \tag{58}$$

It is easy to show that:

$$\sigma \lesseqqgtr \nu \frac{l}{l_T} \Longleftrightarrow \zeta \gtreqqless 0, \tag{59}$$

since $\eta_0 > 0$ always. We now have to determine the sign of ξ over the parameter space. Note that if $\zeta < 0$, then $\xi < 0$ automatically, and the ratio of the two coefficients $\psi_0 = \frac{\zeta}{\xi} > 0$. Similarly, for $\sigma = \nu \frac{l}{l_T}, \psi_0 = 0$. What happens in the case when $\sigma < \nu \frac{l}{l_T}$, which implies that $\zeta > 0$? It can be easily shown that there is no parameter combination such that $\xi > 0$. We can therefore divide the parameter space in such a way that the elasticity of the current account response with respect to the monetary shock ψ_0 is monotonic and increasing in σ. We thus have:

$$\psi_0 \gtrless 0 \Leftrightarrow \sigma \gtrless \nu \frac{l}{l_T} = 1 + \frac{\nu - 1}{\gamma}. \tag{60}$$

The current account improves in response to an expansionary monetary policy shock when the parameter of relative risk aversion (the inverse of the

that domestic expansions typically lead to current account deficits. The standard NOEM model, for instance Obstfeld and Rogoff (1995a), as well as the open economy version of the IS-LM model, predict surpluses on account of a terms of trade effect. Intertemporal current account models that include investment, on the other hand, exhibit current account deficits due to the inflow of foreign investment attracted by a rising marginal product of capital.

intertemporal substitution elasticity) σ is well above unity. In fact, for reasonable parameter combinations a current account surplus requires a fairly low intertemporal substitution elasticity, that is very risk averse consumers.

If γ, the size of the traded sector, is small, then an expansion of non-traded output requires a large increase in its labor input which is supplied by workers moving across sectors. Consequently, traded output plummets and the economy would run a current account deficit unless consumers are sufficiently risk averse (or unwilling to substitute intertemporally) that demand for the traded good actually declines.

Interestingly, the parameter determining the elasticity of the labor supply ω does not influence the *direction* of the current account response. Intuitively, it might have been reasonable to assume that a more elastic employment response from idle workers would relieve the pressure to contract from the traded sector. Other things being equal, a smaller ω could have implied that the representative agent need be less risk averse for a current account surplus to arise. Why does this line of reasoning not apply? The answer is that workers face no costs in moving across sectors whereas moving in and out of employment entails opportunity costs of not enjoying leisure. Total labor supply thus varies mainly because of the consumption smoothing behavior.

Even more interesting, however, is that the *quantitative* effect on the current account response is negligible. Figure 2[24] depicts the value of ψ_0 plotted against ω and γ[25]. The coefficient shows clear variation in γ: a small traded sector cannot keep up with the loss of workers to the non-traded firms and the increase in consumption demand, the consequence being a deficit. Small increases in γ at these levels, however, would result in comparatively smaller initial deficits. Once the sign switch occurs, from a deficit to a surplus as predicted by (60), the current account response to an expansionary monetary shock as a function of the relative size of the traded sector does not vary much. Note, however, that as the size of the non-traded sector tends towards zero ($\gamma \to 1$) the effect of monetary policy on the economy vanishes. Thus, there appears to be a threshold size of the traded sector beyond which monetary disturbances barely register in the balance of payments. Consequently, open economies that are well integrated into the world economy should be

[24] Canonical parameter values used in this and all following simulations are: $\beta = 0.98$, $\gamma = 0.5$, $\varepsilon = 1$, $\nu = 2$, $r = 0.02$, $\sigma = 3$.

[25] A similar graph applies for combinations of ω and σ. Note also that the partial interest elasticity of money demand ε mereley tilts the response profile. The substitution elasticity within the non-traded sector ν offers similar predictions as the relative labor share.

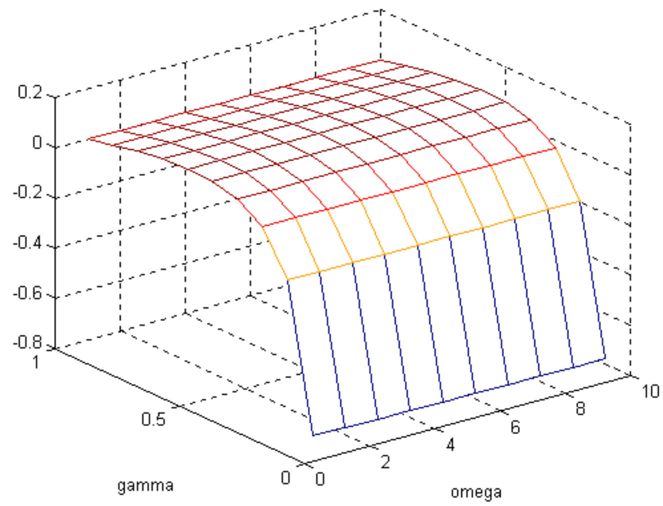

Figure 2: Current Account Response Coefficient

expected to exhibit a smaller degree of current account fluctuations than relatively closed ones. Furthermore, across the parameter space, the current account coefficient shows virtually no change for different values of the labor supply elasticity ω.

The remarkable result transpires that the labor supply elasticity plays virtually no role in the determination of the current account in response to monetary shocks. Since net asset accumulation determines the wealth position of the economy, the path of the variables in the long run is not affected by this parameter. This result also requires a reinterpretation of the intuition behind the current account response in Lane (1997) and Cavallari (1998). As discussed before, they argue that the behavior of the current account depends on whether traded and non-traded goods are substitutes or complements in consumption. The analysis in this paper modifies that argument - which is based on preferences - by another dimension, that is, the industrial structure. *Ceteris paribus*, countries with an extensive non-traded sector that is characterized by a high degree of competition tend to incur current account deficits in times of monetary expansions. Contrary to an analysis such as Tille (1998) who studies differences in cross-country and cross-sectoral substitution elasticities as determinants of terms of trade movements and current account changes, the model in this paper shifts the discussion towards industry structure and sector size. A simple comparison of consumption elasticities is thus augmented and superseded by a discussion of industrial structure.

We now proceed with our discussion of the model mechanics. Suppose for the sake of argument that the parameter constellation is such that a positive money shock induces a deficit. As was discussed before, the required expansion of non-traded sector employment could stem from either leisure or from workers leaving the traded sector. We look first at the aggregate employment effect. Total labor supply in the short run is given by:

$$\widetilde{l} = -\frac{\sigma}{\omega - 1}\overline{C} = -\frac{\sigma}{\sigma + \omega - 1}\frac{l_T}{l}r\frac{db}{y_T}. \tag{61}$$

A monetary expansion that worsens the current account reduces long-run consumption, but has a positive effect on the labor supply. The simple explanation is that the initial deficit reduces the economy's wealth so that the representative agent has to work more to maintain his standard of living and to cover the interest payments on his foreign debt. As shown in Figure 2, the labor supply elasticity has virtually no effect on the size of the current account. Since wealth effects are of the order of the interest rate r, it can then be safely argued that ω plays no significant quantitative role in determining aggregate labor supply[26].Consequently, the increase in non-traded output derives almost exclusively from workers leaving the other sector. How does this labor reallocation come about? The model utilizes the assumption that when prices are sticky output becomes demand determined: Firms are willing to increase their production at (nearly) all cost. The corresponding analytical part to this logical reasoning is that the labor demand equation (25) is suspended for one period. However, there exists a *notional* real wage whose movements steer labor flows across sectors[27]. Note that the real wage can be determined from labor demand in the traded sector:

$$\widetilde{W} - \widetilde{P} = (1 - \gamma)\widetilde{p}_T, \tag{62}$$

[26] Qualitatively, a rise in ω makes the labor supply more inelastic, so that aggregate employment varies less.

[27] The assumption that (25) is suspended just implies that firms are off the demand curve derived from profit maximisation. As was argued before, firms abandon the optimal pricing choice when confronted with menu costs. Equilibrium employment is nevertheless determined by the intersection of labor supply and the notional labor demand schedule.

or alternatively:

$$\widetilde{W} = \widetilde{p}_T. \tag{63}$$

The monetary shock temporarily raises the real wage (and the nominal wage) because of the demand-driven expansion of non-traded production. Firms attract workers by offering them a higher wage. Traded goods producers have to go along so as not to lose too many workers. Equilibrium is maintained when the some worker is indifferent between working in either sector because traded firms are willing to match notional wage offers from the firms in the non-traded sector..

We now try to determine how the sectors are affected individually. It is instructive to express the short-run solutions as functions of long-run consumption, which by itself depends on the current account and proxies for the wealth effect derived from net foreign asset holdings. Using $\overline{C} = \frac{\omega-1}{\sigma+\omega-1}\frac{l_T}{l}r\frac{db}{y_T}$ and maintaining the assumption that $\sigma < 1 + \frac{\nu-1}{\gamma}$, i.e. the economy runs a deficit, we find:

$$\widetilde{C} = \frac{1-\gamma}{\sigma}\widetilde{p}_T + \overline{C}. \tag{64}$$

Since the price of the traded good rises unambiguously, the monetary expansion has a positive effect on current consumption which is only slightly dampened by the expected future decline in $\overline{C}$. Similarly, we find that:

$$\widetilde{c}_N = \left(\gamma + \frac{1-\gamma}{\sigma}\right)\widetilde{p}_T + \overline{C}, \text{ and} \tag{65}$$

$$\widetilde{c}_T = (1-\gamma)\frac{1-\sigma}{\sigma}\widetilde{p}_T + \overline{C}. \tag{66}$$

As expected, non-traded consumption, as well as labor input and output, increase by a factor of γ more than aggregate consumption. More interestingly, we find that traded consumption would definitely decline for $\sigma > 1$. Abstracting from the wealth effect, the qualitative behavior of traded goods consumption thus depends only on the intertemporal substitution elasticity. This result is reminiscent of Cavallari (1998) and Lane (1997). If goods are complements in consumption ($\sigma < 1$), then traded and non-traded consumption rise unisono. The additional expenditure on traded goods is financed by borrowing from abroad. If goods are substitutes, then traded goods consumption declines. This does not, however, imply an automatic trade surplus because of the change in sectoral output. This point is illustrated in the fol-

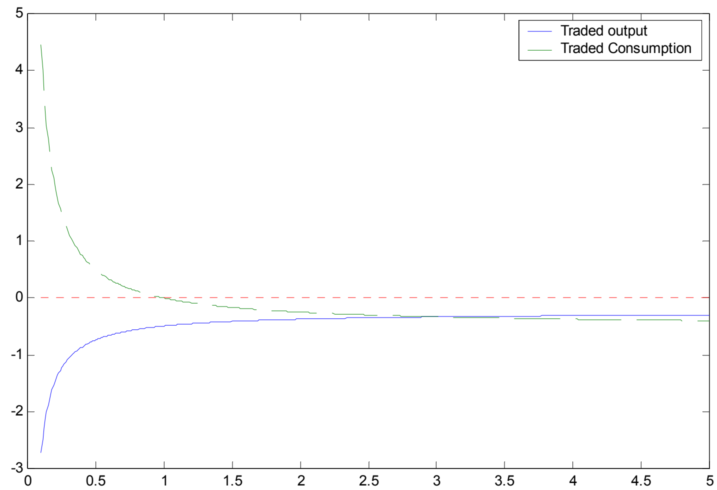

Figure 3: Traded Output and Consumption Response Coefficients

lowing figure[28].

Figure 3 plots the response coefficients on consumption and production in the traded sector against σ. The initial consumption response is positive for intertemporal substitution elasticities above unity. Traded employment on the other hand declines irrespective of the parameter values chosen. Note that for small values of σ the expansion in the non-traded sector is fairly strong so that there is a marked employment decline in the traded sector which becomes less pronounced as σ increases.

This result differs significantly from the scenario in a closed economy for which it could be expected that a strong labor supply response would com-

[28] Traded employment is given by:

$$\widetilde{l}_T = (1 + r\delta_0)\psi_0\overline{M} + (1-\gamma)\frac{1-\sigma}{\sigma}\widetilde{p}_T,$$

which is a complicated function of the structural parameters. There appears to be an interesting trade-off in the determination of employment: the parameter space can be divided in three sections where $\sigma < 1$, $1 < \sigma < 1 + \frac{\nu-1}{\gamma}$, and $\sigma > 1 + \frac{\nu-1}{\gamma}$, so that sectoral reallocation and intertemporal substitution effects either alternatively dominate or work in the same direction. Tedious algebra, however, shows that the pull of the non-traded sector always compensates for intertemporal substitution.

pensate the outflow of workers from the traded sector. I have shown, however, that the wealth effect is negligible for the behavior of leisure. Consequently, total employment does not change markedly in response to a monetary shock and output in the traded sector unambiguously. The economy thus exhibits a bias towards current account deficits which is only counteracted at lower intertemporal substitution elasticities when consumption declines even more than production does. In a way, this just reflects the ability of an open economy to engage in intertemporal trade. Since the traded good can always be imported, the output loss from allocating workers to the other sector is not as problematic as it would be for a closed economy. However, this raises the question to what extent aggregate output actually increases. Furthermore, for a relatively wide range of parameter combinations the economy accumulates foreign debt.

In order to investigate these issues I derive the approximate short-run response of GDP to a monetary shock:

$$\widetilde{Y} = \frac{Y_T}{Y_T + sY_N}\widetilde{Y}_T + \frac{sY_N}{Y_T + sY_N}\widetilde{Y}_N - \left[\frac{sY_N}{Y_T + sY_N} - (1-\gamma)\right]\widetilde{p}_T, \tag{67}$$

which simplifies to $\widetilde{Y} = \gamma\widetilde{Y}_T + (1-\gamma)\widetilde{Y}_N$ when we assume that $A_T = A_N = 1$. Figure 4 depicts the GDP response coefficient as a function of σ. A monetary expansion leads to an increase in aggregate output for all possible parameter values. The value of the coefficient, however, declines sharply as the consumers become more and more risk averse.

Figure 4 also gives an interpretation of the finding by Dixon and Hansen (1999) that in a closed economy model with a mixed industrial structure, similar to the one employed in this paper, monetary disturbances result in aggregate output responses that are substantially larger than those for standard New Keynesian models containing only one sector. It has been argued in the introduction that a short-coming of this approach is the dependence on a high labor supply elasticity to generate quantitatively important real effects. Dixon and Hansen (1999) similarly use their finding to suggest that the sectoral reallocation mechanism breaks this causal chain.

However, my findings cast a critical light on their argument. I have shown that the labor supply elasticity has no qualitative impact on the variables of interest. Furthermore, changes in this parameter are quantitatively of second order. As Figure 4 shows, however, the GDP response increases with higher values of the intertemporal substitution elasticity. Consumers would be less

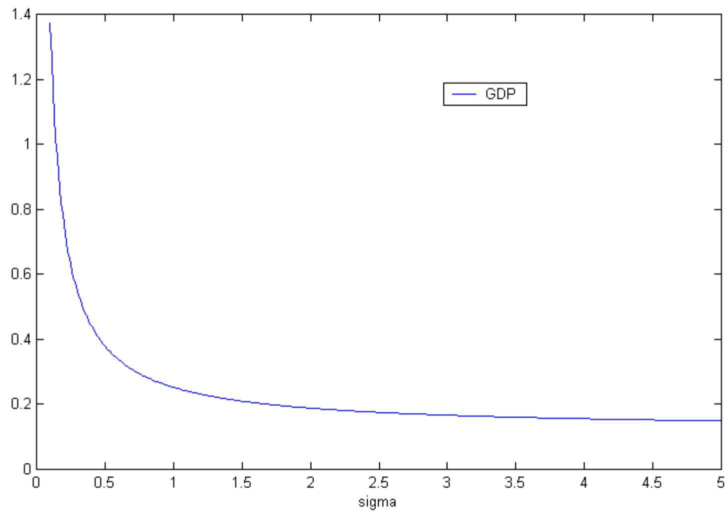

Figure 4: GDP Response Coefficient

concerned with a smooth consumption path. Instead, the expansionary monetary shock provides opportunity to raise production drastically. Although this is mainly achieved by increasing labor input in the non-traded sector at the expense of the traded sector (note the sharp decline in traded output in Figure 3 as $\sigma \to 0$), the expansion of the latter more than compensates for the contraction of the former. Dixon and Hansen (1999) use a static, closed economy model that assumes risk-neutral agents, which corresponds to a value $\sigma = 0$. This finding therefore calls into question their assertion that a multisectoral, New Keynesian model generates a large enough output response even without assuming a high labor supply elasticity. I conclude that the argument made by Dixon and Hansen (1999) applies only to the static, risk-averse case.

To conclude the analysis of the model, I briefly discuss the behavior of the exchange rate. The specific dynamic response pattern of the nominal exchange rate, labeled 'overshooting' following the contribution by Dornbusch (1976), is considered the hallmark of the price rigidity approach in open economy macroeconomics. By comparing the short-run and the long-run solutions of the nominal price of the traded good we can see immediately that $\widetilde{p}_T = \overline{p}_T$. That is, there is no overshooting, the exchange rate jumps immediately to its long-run level. Overshooting only occurs if $\varepsilon > 1$. The exchange rate actually undershoots for $\varepsilon < 1$. It is interesting to note here that the question of overshooting is not a characteristic of sticky-price models per se - in fact, price stickiness is only a necessary condition. Thus, overshooting is purely an issue of the specification of the money demand function[29] which considerably weakens the case for an explanation of exchange rate volatility based on price stickiness[30]. Additionally, quick inspection of the behavior of the real exchange rate reveals the following. In the long run the real exchange rate returns to its initial level. The short run real exchange rate is given by:

$$\widetilde{rer} = -(1-\gamma)\widetilde{s} = (1-\gamma)\widetilde{p}_T. \tag{68}$$

The real exchange rate thus shares the characteristics of the nominal exchange rate. A monetary expansion leads to both a nominal and real appreciation in the short-run. From a time series perspective the nominal and real exchange rates would be perfectly correlated while the latter shows a volatility measured in terms of the standard deviation that is smaller by a factor of $1-\gamma$. Similarly to other models of this class, there is no clear-cut prediction regarding the likely correlation of the real exchange rate with the current account when we consider money shocks alone. As we have seen, the direction of the current account response is determined by the industrial structure while the behavior of the exchange rate is unambiguous.

We finally discuss quickly the behavior of the model in the long run, which is virtually the mirror image of the short run. Continuing the example of an initial deficit from before, the accumulated foreign debt requires trade balance surpluses to cover interest payments on the debt[31]. The economy has to reduce consumption and/or increase production of the traded good. However, compared to the short-run effects deviations from the initial steady

[29] This point has already been made by Corsetti and Pesenti (1998), albeit in a two-country model with a different industrial structure. In simpler models with non-traded goods, the ambiguity of the overshooting result does not appear.

[30] In all fairness to the sticky price approach, models with different industrial structures or pricing behavior do not suffer from this shortcoming. For instance, Betts and Devereux (1995) show that when producers face segmented product markets at home and abroad they engage in pricing-to-market behavior which in combination with price rigidity can make foreign currency denominated export prices impervious to domestic monetary shocks, thereby amplifying exchange rate fluctuations. The authors in fact show that the volatility of the nominal exchange rate is an increasing function of the number of pricing-to-market producers.

[31] The current account, the change in net foreign debt, is balanced from this time on.

state in the long-run are only of second order. The monetary shock changes the net foreign asset position of the economy permanently, but this affects real variables only in terms of interest payments. Note that although the real wage does not increase in the long run total labor supply rises because the representative agent desires to jointly smooth consumption and leisure. The additional workers exclusively enter the traded sector which also attracts resources from the non-traded firms. Traded output and consumption move in opposite directions to jointly generate a trade balance surplus which is enough to cover foreign interest payments.

As shown before, the size of the long-run responses is mainly governed by the coefficient $\delta_0 = \frac{\omega-1}{\sigma+\omega-1}\frac{l_T}{l} = \frac{\omega-1}{\sigma+\omega-1}\frac{\gamma\nu}{\gamma+\nu-1}$. Similarly to the short-run response, the more inelastic the labor supply is (a larger ω), the larger is the long-run response of consumption. Again, because of the non-separability of consumption and leisure, aggregate consumption varies inversely with total employment. From the coefficient on $\bar{l}$ it can also be seen that as $\omega \to \infty$ labor becomes perfectly inelastic. All variation in sectoral input is then generated by reallocation of labor. Note also that in terms of relative movements in $\overline{C}$ and $\bar{l}$ the intertemporal substitution elasticity $1/\sigma$ plays a similar role as ω.When the agent becomes less and less willing to substitute consumption intertemporally ($\sigma \to \infty$), $\overline{C}$ will tend towards zero (i.e. consumption does not change with respect to the initial steady state) while $\bar{l}$ becomes more volatile. Risk-neutral consumers, on the other hand (for $\sigma \to 0$), smooth their intertemporal utility by varying aggregate consumption and leaving leisure unchanged.

4 Conclusion

In this paper I developed a model illuminating the interaction of the industrial structure with monetary policy shocks in the determination of the current account. In particular, I discuss the economic logic behind the sectoral labor reallocation mechanism and show how this alters the transmission of shocks. I thus interpret the distinction between a traded and a non-traded sector, which is prevalent in international trade theory, as industrial structure, whereby the former sector is characterized by monopolistic competition, and the latter is perfectly competitive. This modeling assumptions then allows to derive two main results.

It is commonly argued that in small open economy models with no capital the direction of the current account response to monetary shocks depends on preferences only, that is on whether consumption goods are substitutes or complements. I demonstrate, however, that this regularity does not apply in a model with an explicit industrial structure. The crucial determinants for the behavior of the current account are the degree to which competition differs across sectors and their relative sizes. Although the preference structure is not uninformative in predicting the current account it is nearly of secondary importance compared to the industrial structure. I find that, all other things being equal, countries with large non-traded sectors that are not heavily monopolized are more prone to incur deficits.

Secondly, I reevaluate the claim made against the standard New Keynesian model that it has to rely on unrealistically high labor supply elasticities in order to generate sizable real effects. The argument is made that in a multi-sectoral economy sectors that are expanding relative to others do not depend on the pool of previously idle workers since cross-sectoral flows of workers can substitute for movements of labor in and out of the workforce. My analysis shows that the labor supply elasticity has no significant qualitative nor quantitative impact on the economy. However, I also argue that the case in favor of the sectoral reallocation mechanism is overstated. Large aggregate output responses only occur for comparatively high intertemporal substitution elasticities. Within the generally accepted range of parameter values, the size of the output response is far smaller than otherwise claimed.

Naturally, the economy presented here is very specific in a variety of aspects, and the robustness of the findings has to be established against modifications of the model. A prime candidate is the perfect mobility of labor across sectors which enjoys an advantage over movements between work and leisure since it carries no costs. Imposing reallocation costs is therefore likely to weaken the importance of this mechanism, but this could be weighed against a specification of the labor supply schedule that does not depend on aggregate wealth effects. An important extension would be to introduce a different monetary policy rule that takes into account, for instance, sectoral inflation rates as well as changes in output. Similarly, the sectoral reallocation mechanism could be evaluated in the light of different types of shocks, such as sectoral productivity shocks or shocks arising from abroad. Finally, since the discussion in this paper is of a qualitative nature only, it might be useful to get sense of the actual importance of the findings by calibrating and simulating the model, and to compare to the data.

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