Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
European Economic Review 48 (2004) 851–881
EUROPEAN ECONOMIC REVIEW
www.elsevier.com/locate/econbase

Public expenditure, international specialisation and agglomeration

Marius Brülhart[a,*], Federico Trionfetti[b,c]

[a] *Département d'économétrie et économie politique, Ecole des HEC, University of Lausanne, CH-1015 Lausanne, Switzerland*
[b] *CEPN-CNRS, University of Paris 13, F-93430 Paris, France*
[c] *CEPII, F-75015 Paris, France*

Received 9 May 2003; accepted 4 September 2003

Abstract

It is widely recognised that public-sector purchasers tend to favour domestic suppliers. We study the consequences of such home-biased public procurement on international specialisation. Using a general-equilibrium model with a monopolistically competitive sector, we find that a country will specialise in that sector if it has relatively large home-biased procurement (the "pull" effect). Furthermore, home-biased procurement can counter agglomeration forces in that sector and thereby attenuate the overall degree of international specialisation (the "spread" effect). Our empirical analysis, conducted on input–output data for the European Union, yields supporting evidence for the pull effect and some support for the spread effect.

JEL classification: H5; F1; R3; R15

Keywords: Public expenditure; International specialisation; Economic geography; European Union; Input–output analysis

1. Introduction

This study investigates the consequences of home-biased government procurement on the patterns and the intensity of international specialisation. By "home bias" we refer to governments' preference for domestic over foreign suppliers irrespective of cost and quality considerations. Discrimination by public purchasers in favour of local suppliers is a pervasive phenomenon, the motivations for which have been studied

* Corresponding author. Tel.: +41-21-692-3471; fax: +41-21-692-3305.
E-mail addresses: marius.brulhart@hec.unil.ch (M. Brülhart), trionfetti@seg.univ-paris13.fr (F. Trionfetti).

0014-2921/$ - see front matter
doi:10.1016/j.euroecorev.2003.09.002

extensively. In this paper we investigate the consequences of home-biased procurement on the location of manufacturing. First, we study whether and how public expenditure affects the location of industries across countries. For this purpose we extend the model of Helpman and Krugman (1985, Part III) to include home-biased public procurement. Our analysis yields the prediction that, *ceteris paribus*, a country will tend to specialise in the good for which it has relatively large home-biased procurement. We call this result the "pull effect". Our empirical investigation based on input–output data for EU countries in 1970–1985 supports this proposition: we find robust evidence of a "pull effect" of public expenditure on the location of manufacturing industries.

Our second focus is on the intensity of industrial concentration, i.e. on the "how much" rather than the "where" of industrial agglomeration. To study this question we extend the "new economic geography" model of Krugman and Venables (1995) to include home-biased procurement. We find that home-biased public expenditure, by acting as a dispersion force, reduces the likelihood that agglomeration forces prevail; and in the case that they prevail, public expenditure reduces the intensity of industrial agglomeration. We call this result the "spread effect". An analysis of this link in our EU input–output dataset confirms the presence of such a "spread effect" of public expenditure on the location of manufacturing industries.

Previous work on public procurement has followed two principal paths: one was to investigate the rationale for home bias, while the other was to study the consequences of home bias on international specialisation. The first body of research, reviewed in Mattoo (1996), took a partial equilibrium approach and explained the home bias through the political interplay between the tendering entity and domestic and foreign bidders. McAfee and McMillan (1989), for instance, focused on the design of the optimal procurement mechanism in a setting where each bidder is better informed about his own cost than either the government or other bidders. They find that, if the foreign firm's costs are lower in expectation than those of the home firm, the government can minimise its expected procurement costs by granting a preference margin to the home firm. The reason is that a discriminatory policy induces foreign firms to reveal their private information about their costs and to prevent the most efficient firms from bidding too high. Interestingly, in their model, it is the efficiency of government procurement that motivates the home bias. Conversely, in Branco (1994) and Vagstad (1995), the home bias in public procurement stems from the assumption that profits of domestic firms enter the objective function of government while those of foreign firms do not, and government discrimination against foreign bidders causes profits to shift from foreign to domestic firms. The model of Laffont and Tirole (1991) features bribes ("asymmetric collusion") as the channel through which domestic firms' profits enter the government's objective function. In Weichenrieder (2001), the home bias is motivated by the government's desire to attract capital-intensive production and thereby to increase local taxable capital. Naegelen and Mougeot (1998) have considered the efficiency argument and the profit-shifting argument in the same model and in a variety of informational settings. The optimal policy derived from this combined model results, once again, in a discriminatory procurement mechanism.

We depart from this line of research, which has focused on the *causes* of the home bias, by taking the home bias as exogenous and focusing on the *consequences* of this

practice on international specialisation in a general-equilibrium setting. In this respect, our study is closely related to a second line of inquiry on home-biased procurement, which, although initiated over 30 years ago, has remained relatively underexplored. This research programme links government procurement to international specialisation and is originally due to Baldwin (1970, 1984). His work shows that, in a Heckscher–Ohlin model, home bias in public expenditure is irrelevant for international specialisation. The reason is that home-biased government procurement crowds out private demand for domestic goods. Thus, the reduction in imports from the government is compensated by a corresponding increase in imports of the private economy. This somewhat counterintuitive result has been investigated further by Miyagiwa (1991), who demonstrated that Baldwin's "neutrality proposition" extends to a model of oligopoly with a homogeneous good.

Baldwin's analysis also established some cases in which neutrality does not hold. One case is where the government's domestic procurement requirement exceeds the undistorted free-trade level of domestic production. In this situation, government expenditure of course affects international specialisation. This configuration corresponds to the corner solution of the Heckscher–Ohlin model where one country is completely specialised and factor prices are no longer equalised. A variant of this configuration appears in the three-sector general-equilibrium model of Weichenrieder (2001), where governments are the sole buyers of an internationally traded homogenous good ("tanks"). In a country for which the undistorted free-trade equilibrium would imply zero production of tanks, domestic procurement of tanks obviously induces domestic production of tanks. Furthermore, Weichenrieder (2001) has shown that even for a country with positive tank production in the undistorted equilibrium and with domestic procurement that is smaller than free-trade domestic output, home-biased tank procurement can increase domestic production, because domestic procurement replaces exports less than one-for-one. Miyagiwa (1991) found that, in a partial-equilibrium oligopoly model with differentiated goods, home-biased procurement can affect domestic output as well. The reason is that when goods are differentiated, foreign and domestic goods are not perfect substitutes, and home-biased government demand does not therefore crowd out private demand for domestic goods entirely. Finally, Martin and Rogers (1995) showed that public expenditure on trade-facilitating infrastructure could substantially affect international specialisation in a general-equilibrium model with trade costs and monopolistic competition. This effect is the result of *what* the government purchases (i.e. trade-facilitating infrastructure) rather than *how* the government allocates its purchases (i.e. with or without home bias).

To our knowledge, ours is the first study of the impact of home-biased expenditure on international specialisation in a general-equilibrium model that features differentiated goods and imperfect competition, and the first to examine the effect of home-biased expenditure on industrial agglomeration. Specifically, we assume firm-level increasing returns and monopolistic competition in the differentiated-goods sector. We use the static version of this model to study the effect of home-biased expenditure on the specialisation of individual countries. A dynamic "new economic geography" version of the model with agglomeration and dispersion forces is then employed to study the consequences of the home bias on the intensity of industrial agglomeration across

countries. The econometric tests that complement our theoretical analysis constitute, to our knowledge, the first empirical investigation of the sectoral output effects of public expenditure in an international setting.

The analysis in this paper is of a positive nature, but it may also be informative for trade policy, since the issue of liberalisation of public procurement has been and continues to be on the agenda of the WTO and other international organisations. Policy makers have long recognised that home-biased procurement may affect industrial relocation. Liberalisation of public procurement has been the object of a number of EC Directives in the context of the implementation of the Single Market, as well as of the Government Procurement Agreement in the context of the WTO Uruguay Round. In its official assessment of the effects of the Single Market programme, the European Commission has for instance acknowledged that the liberalisation of public procurement may lead to "the rationalisation of Community production on a smaller number of sites" (Emerson et al., 1988, p. 53). As more conventional forms of protectionism are being whittled away, biased procurement thus receives increasing attention in international policy fora.

Our paper is structured as follows. In Section 2, we set out the theoretical model and derive three testable propositions. These propositions are tested empirically on input–output data for EU countries in Section 3. Section 4 concludes.

2. Theory

We explore the impact of home-biased public expenditure on international specialisation in two settings that have become benchmark models of the "new trade theory" and the "new economic geography". Our theoretical analysis confirms that Baldwin's neutrality proposition holds for the perfectly competitive sectors, but it shows that home-biased procurement does affect specialisation in increasing-returns monopolistically competitive sectors. We first use the "new trade theory" setting to investigate whether home-biased public expenditure can attract industrial activity to the home country, and then we turn to a "new economic geography" model to explore the impact of home-biased procurement on agglomeration and dispersion forces.

2.1. Public expenditure in a static model of international specialisation

In this section we extend the model developed in Helpman and Krugman (1985, Section 10.4) by introducing government demand. This allows us to investigate the effects of home-biased government procurement on international specialisation.

The basic structure of the model is as follows. We assume two homogeneous factors of production, generically labelled l and k; two countries, indexed by $i = 1, 2$; and three sectors: X, Y, and Z. Two sectors are perfectly competitive (Y and Z) and one is monopolistically competitive (X).[1] Sector Z will serve as numéraire. Production

[1] For maximum comparability of our findings with those of the relevant "home-market effect" literature, we work with a general equilibrium model, assuming that there is a sufficient number of goods to yield a factor-price equalisation set of full dimensionality. This is further explained below.

technologies differ across sectors but are identical across countries. Sectors Y and Z are subject to a linearly homogeneous production function and operate under perfect competition. The average and marginal cost functions associated with these technologies are $c_Y(w,r)$ and $c_Z(w,r)$, where the arguments are the remuneration to l and k. The X sector produces a differentiated commodity using a technology that requires a fixed cost $f(w,r)$ and a constant marginal cost $m(w,r)$. It is assumed that the functions $m(w,r)$ and $f(w,r)$ use factors in the same relative proportion. Thus, factor proportions in the X sector depend only on relative factor prices and not on the scale of firms. Since all X firms have identical costs and face the same demand, the optimal level of output is the same for all firms and is denoted by x. The average cost function of the X sector is $c_X(w,r) = m(w,r) + f(w,r)/x$. Demand functions for factors obtain from the cost functions through Shephard's lemma. We denote these demand functions as $l_s(w,r)$ and $k_s(w,r)$ with $S = X, Y, Z$. Further, we assume no factor intensity reversals. Finally, we adopt the standard assumption that goods Y and Z are traded internationally at zero costs while good X is traded internationally at a cost of the iceberg type. This means that for one unit of the X good shipped only a fraction $\tau \in (0,1]$ arrives at its destination.[2] The total number of X varieties produced in the world, denoted by N, is endogenously determined, and so is its distribution between countries. The number of X varieties produced in country i is n_i and we have $N \equiv n_1 + n_2$. The world's factor endowment is exogenous and denoted by L and K. Countries' factor endowments are exogenous, and $L_1 \equiv L - L_2$ and $K_1 \equiv K - K_2$. The equilibrium equations are:

$$p_S = c_S(w,r), \quad S = Y, Z, \tag{1}$$

$$p_X(1 - 1/\sigma) = m(w,r), \tag{2}$$

$$p_X = c_X(w,r,x), \tag{3}$$

$$l_Y(w,r)Y_i + l_X(w,r)xn_i + l_Z(w,r)Z_i = L_i, \quad i = 1,2, \tag{4a}$$

$$k_Y(w,r)Y_i + k_X(w,r)xn_i + k_Z(w,r)Z_i = K_i, \quad i = 1,2. \tag{4b}$$

Eqs. (1) and (2) express the usual condition that marginal revenue equal marginal cost in all sectors and countries. Eq. (3) states the zero profit condition in sector X in all countries. Eqs. (4a) and (4b) state the market clearing conditions for factors in all countries. These eight equations describe the supply side of the model.

[2] Free trade in the perfectly competitive sectors is an assumption of convenience which has the additional attraction here of assuring comparability with related studies. However, we have shown elsewhere that the impact of home-biased expenditure on international specialisation ("pull effect") obtains also if we assume positive trade costs in all sectors (Brülhart and Trionfetti, 2002).

To close the model, we need to describe the demand side in its two components, private and public. Households in both countries are assumed to have homothetic preferences. Specifically, we assume Dixit–Stiglitz preferences (i.e., a nested Cobb–Douglas–CES utility function) with Cobb–Douglas expenditure shares υ_{si} $(S = X, Y, Z)$ and $\sum_S \upsilon_{Si} = 1$, and with an elasticity of substitution of the CES sub-utility equal to the constant $\sigma \in (1, \infty)$. Households are taxed in a lump-sum fashion. Homothetic preferences assure that the distribution of taxation among households does not affect aggregate demand. Maximisation of utility subject to the budget constraint yields households' demand functions. Aggregating across households gives demand functions for the differentiated good. Country i's private demand for each variety produced in i is $p_X^{-\sigma} P_i^{1-\sigma} \upsilon_{Xi} I_i^d$ and for each variety produced in j is $\tau^\sigma p_X^{-\sigma} P_i^{1-\sigma} \upsilon_{Xi} I_i^d$. The price index $P_i = (n_i p_X^{1-\sigma} + n_j \tau^{\sigma-1} p_X^{1-\sigma})^{1/(1-\sigma)}$ is the price index applicable to country i, $I_i^d = (1-\delta_i) I_i$ is households' disposable income, δ_i is a taxation parameter, and I_i is the inner product between the vector of factor endowments and the vector of factor prices (households have claims on k). Since profits are zero, I_i is national income. For future reference, we define private expenditure on the X good in i as $E_{Xi}^P \equiv \upsilon_{Xi}(1 - \delta_i) I_i$.

Governments purchase goods that they use for their subsistence. The balanced budget requirement assures that expenditure equals tax collection. Tax revenue amounts to $\delta_i I_i$ and is allocated among goods according to the parameter γ_{Si} $(S = X, Y, Z)$ with $\sum_S \gamma_{Si} = 1$. Government i's expenditure on X goods is then $E_{Xi}^G \equiv \gamma_{Xi} \delta_i I_i$.[3]

Following Baldwin (1970, 1984) and Miyagiwa (1991), we introduce an exogenously determined parameter that represents governments' bias in favour of domestically produced goods: $\phi_i \in [0, 1]$. Specifically, a proportion ϕ_i of government i's purchases is reserved to domestic producers. The remainder of government expenditure is allocated efficiently among suppliers from both countries. A large ϕ_i therefore means a strong home bias. This simple assumption can represent two widely used discriminatory practices: (1) the outright exclusion of foreign bidders from domestic public tenders and (2) a domestic-content requirement imposed on foreign firms.[4] For clarity of exposition we shall say that government i's procurement is "fully liberalised" if $\phi_i = 0$, "home-biased" if $\phi_i \in (0, 1]$, and "wholly home-biased" if $\phi_i = 1$. Note that our assumption that home bias appears only in public expenditure and not in private expenditure is one of pure convenience. In fact, all our results would carry through if we allowed both sources of expenditure to exhibit home bias, as long as the home bias of public-sector purchasers exceeds that of private agents.[5]

[3] Following Baldwin (1974, 1980) and Miyagiwa (1991), we leave the government's expenditure share and the taxation parameter exogenous. The same expenditure shares would result from the assumption that governments produce a public good according to a Cobb–Douglas–CES production function with parameter shares γ_s and with a constant elasticity of substitution of the CES aggregate equal to $\sigma \in (1, \infty)$. A constant per capita tax would instead result from Lindahl-type taxation if we assumed that the government produces a public good that enters the utility function in a separable way.

[4] On the practice of this discriminatory behaviour see Hoekman and Mavroidis (1997).

[5] The relevant analytical results are available from the authors.

Equilibrium in the product market requires the following equations to hold:

$$p_Z(Z_1 + Z_2) = E^P_{Z1} + E^P_{Z2} + E^G_{Z1} + E^G_{Z2}, \tag{5}$$

$$p_X x = p_X^{1-\sigma} P_1^{\sigma-1}[E^P_{X1} + (1-\phi_1)E^G_{X1}] + \theta p_X^{1-\sigma} P_2^{\sigma-1}[E^P_{X2} + (1-\phi_2)E^G_{X2}] + (\phi_1/n_1)E^G_{X1}, \tag{6}$$

$$p_X x = \theta p_X^{1-\sigma} P_1^{\sigma-1}[E^P_{X1} + (1-\phi_1)E^G_{X1}] + p_X^{1-\sigma} P_2^{\sigma-1}[E^P_{X2} + (1-\phi_2)E^G_{X2}] + (\phi_2/n_2)E^G_{X2}, \tag{7}$$

where $\theta \equiv \tau^{\sigma-1}$. Eqs. (5)–(7) close the model. Eq. (5) equates supply and demand for Z, where demand (r.h.s.) is represented in its four components: country 1's private and public expenditure and country 2's private and public expenditure. Equilibrium in the X sector requires two equations. Eqs. (6) and (7) represent the equality of demand and supply for any one variety produced in country 1 and 2, respectively. By Walras' law the equilibrium condition for Y is redundant. System (1)–(7) is composed of 11 independent equations and 12 unknowns ($p_X, p_Y, p_Z, x, n_1, n_2, Y_1, Y_2, Z_1, Z_2, w, r$). Taking p_Z as the numéraire, the system is perfectly determined.

While all endogenous variables are determined simultaneously, it is useful to inspect the subsystem (4)–(7) for an intuitive understanding of what shapes the pattern of international specialisation. Given prices and firm scale x, Eqs. (6) and (7) determine n_1 and n_2 as functions of private and government expenditure. Then, given n_1 and n_2, the four equations (4a) and (4b) determine the four unknowns Y_1, Y_2, Z_1, Z_2 as functions of factor endowments. This means that, while private and government demand determine international specialisation in the monopolistically competitive sector, factor endowments determine international specialisation in the perfectly competitive sectors. Moreover, we can confirm Baldwin's neutrality proposition by inspection of Eq. (5), which shows that world private plus government demand determine world output of Z (and Y) but not its international distribution. International specialisation in these sectors is fully determined by factor endowments via (4a) and (4b). Home bias in government procurement is therefore inconsequential for international specialisation in the perfectly competitive sectors. This is Baldwin's neutrality proposition. His result, originally derived in a small-country partial-equilibrium model, extends also to a two-country general-equilibrium setting.

A final note on the dimensionality of the model is in order. We have chosen to work with a general-equilibrium model throughout, both for strict comparability of our own findings and to show that Baldwin's neutrality proposition extends to such a setup. Trade costs segment the market for the differentiated good. In order to restore full dimensionality of the factor-price equalisation set we therefore need one more good than factors, which is why we work with a three-by-two model. Working within the factor-price equalisation set enhances the tractability of the model, and it makes our findings comparable with those of related papers. Our result in Eq. (8) below, for instance, is directly comparable to the results on the home-market effect literature.

We now explore the effect of private and government demand on international specialisation. By inspection of system (1)–(7) it is immediate that $n_1 = n_2$ is an equilibrium when countries are identical, i.e., when $E^P_{X1} = E^P_{X2}$, $E^G_{X1} = E^G_{X2}$, and $\phi_1 = \phi_2$. The nonlinearity of the model prevents us from deriving a simple reduced form. However, we can find the relationship we are interested in by differentiating system (1)–(7) with respect to changes in private and public expenditure at the equilibrium point $n_1 = n_2$. It will be convenient to use the following definitions:

$$\eta_i \equiv n_i/N, \quad E_{XW} \equiv E^P_{X1} + E^P_{X2} + E^G_{X1} + E^P_{X2},$$

$$\varepsilon^P \equiv \frac{E^P_{X1} + E^P_{X2}}{E_{XW}}, \quad \varepsilon^G \equiv \frac{E^G_{X1} + E^G_{X2}}{E_{XW}},$$

$$\varepsilon^P_i \equiv \frac{E^P_{Xi}}{E^P_{X1} + E^P_{X2}}, \quad \varepsilon^G_i \equiv \frac{E^G_{Xi}}{E^G_{X1} + E^G_{X2}}.$$

We shock expenditure in such a way that world private and world public expenditure on each commodity remain unchanged, i.e. E_{SW} $(S = X, Y, Z)$, ε^G, and ε^P are held constant. This implies that the relative prices of commodities will remain unchanged, and the effect on specialisation, if any, is due to changes in a country's share of world public and private expenditure ε^G_i and ε^P_i. Technically, this is achieved when we disturb the equilibrium by $\mathrm{d}\gamma_{Xi} = -\mathrm{d}\gamma_{Xj}$, and by $\mathrm{d}\upsilon_{Xi} = -\mathrm{d}\upsilon_{Xj}$. Differentiation around the equilibrium point, where $n_1 = n_2$, yields the following expression:

$$\mathrm{d}\eta_i = \underbrace{\frac{(1-\theta^2)\varepsilon^P}{(1-\theta)^2 + 4\theta\phi\varepsilon^G}}_{\beta_1} \mathrm{d}\varepsilon^P_i + \underbrace{\frac{(1+\theta)(1-\theta+2\theta\phi)\varepsilon^G}{(1-\theta)^2 + 4\theta\phi\varepsilon^G}}_{\beta_2} \mathrm{d}\varepsilon^G_i. \tag{8}$$

The first term on the r.h.s. is the effect of private expenditure. For convenience we denote the first coefficient by β_1. This term shows that, *ceteris paribus*, large private expenditure on X results in large domestic output of X (remember that $0 < \theta < 1$). The second term is the effect of government expenditure. For convenience we denote the second coefficient by β_2. This term shows that, *ceteris paribus*, large and home-biased government expenditure on X results in large domestic output of X. We can thus formulate a first proposition.

Proposition 1. *The country with relatively large home-biased public expenditure on the differentiated good X will, ceteris paribus, be relatively specialised in the production of X.*

It is interesting to inspect the relative size of β_1 and β_2, because this gives us the relative size of the impact of private and government demand on international specialisation. The relative size of β_1 and β_2 depends on the relative size of ε^G and ε^P. However, if we define $b_1 \equiv \beta_1/\varepsilon^P$ and $b_2 \equiv \beta_2/\varepsilon^G$, inspection of Eq. (8) shows that $b_1 < b_2$ unambiguously as long as $\phi > 0$. The presence of the home bias makes the impact of public procurement larger than the impact of private demand when both are appropriately weighted by their size. This result may be expressed in the following proposition.

Proposition 2. *The size-weighted impact of home-biased public procurement is larger than the size-weighted impact of private expenditure.*

Henceforth, we refer to Propositions 1 and 2 as the "pull effect" of home-biased public procurement. Proposition 2 can also be viewed in terms of the literature on home-market effects (Davis and Weinstein, 2003; Head and Ries, 2001; Head et al., 2002). Because of the assumed home bias in public expenditure, the pull effect is not a simple additive component of the standard home-market effect. Proposition 2 states that the home-market effect of government expenditure, per currency unit spent, is larger than the home-market effect of private demand. This difference increases in the degree of the government's home bias.

To summarise, we have found that home-biased procurement influences international specialisation in some sectors but not in others, and that its size-weighted impact on the location of increasing-returns sectors is larger than the impact of private expenditure. In the empirical section we estimate Eq. (8) and find that for the sectors where home-biased procurement influences international specialisation the estimated parameters are such that $b_1 < b_2$.

2.2. Public expenditure in a dynamic model of international specialisation

In "new economic geography" models, international specialisation is shaped by dynamic processes which result from the tension between agglomeration and dispersion forces. At high trade costs dispersion forces prevail and the industrial activity is evenly distributed across countries (no industrial agglomeration). At low trade costs agglomeration forces take over, and increasing-returns activity concentrates in a subset of countries (strong industrial agglomeration). In this section we use such a model to study the effect of home-biased government procurement on the likelihood and intensity of industrial agglomeration.

We use a variant of the model in Trionfetti (2001) which, in turn, is an extension of the model in Krugman and Venables (1995). The demand side of the model is the same as in Section 2.1 of this paper, but the supply side is slightly different. We abstract from factor endowments and assume a single factor of production, labour, and we can thus also restrict the analysis to two sectors. Employment in each sector and country is denoted by L_{Si}, where $S = X, Z$; and $i = 1, 2$. Analogously, wages in each sector and country are denoted by w_{Si}. By choice of units we set $w_{Zi} = 1$. As in the previous section, each variety of the differentiated good produced by the X sector is subject to economies of scale represented by a fixed cost and constant marginal costs. The difference is that the fixed and marginal costs are both in terms of a composite input V, which in turn is produced with labour and X itself. The input requirement per x units of output is given by $V = \alpha + \beta x$. Each firm produces V according to $V = [l/(1-\mu)]^{1-\mu}(X/\mu)^{\mu}$, where $\mu \in (0,1)$ represents the importance of the industry's output as its own intermediate input. Given this technology, the expression for total costs is $TC_i = w_{Mi}^{1-\mu} P_i^{\mu}(\alpha + \beta x)$. Finally, we should note that, unlike in the previous section, private expenditure on X now includes firms' demand for intermediate

inputs.[6] The expression for private expenditure then becomes $E_{Xi}^{P} = \upsilon_{Xi}(1-\delta_i)I_i + \mu n_i p_{Xi} x$. The market-clearing equations are the same as in the static model (Eqs. (5)–(7)), provided that we use the appropriate expressions for E_{Xi}^{P}.

Concerning the dynamics of the model, it is assumed that labour moves slowly into (out of) X as the wage in X exceeds (is smaller than) the wage in Z.[7] This assumption can be formalised with the two differential equations $\dot{L}_{X1} = \xi(w_{X1} - w_{Z1})$ and $\dot{L}_{X2} = \xi(w_{X2} - w_{Z2})$, where ξ is an arbitrary constant.[8] The total number of varieties and world employment in X is constant because world expenditure on manufactures is assumed constant over time. Individual countries' employment in X can, however, change over time. Note that, since world employment in X is constant, the two differential equations can be nicely compacted into one. Defining $\omega \equiv w_{X1} - w_{X2}$, and using the fact that labour market clearing implies that $n_1/(n_1+n_2) = L_{X1}/(L_{X1}+L_{X2})$, we can rewrite the differential equations as

$$\dot{\eta}_1 = \omega(\eta_1; \tau, \phi_1, \phi_2, \delta_1, \delta_2). \tag{9}$$

Eq. (9) highlights the fact that ω depends on the state variable η, on trade costs and on the public procurement parameters. The system is at rest when it reaches an internal solution or when the X sector is completely agglomerated in one country. Internal solutions are characterised by wage equalisation across sectors, i.e., $w_{Zi} = w_{Xi} = 1$ $(i = 1, 2)$. Complete agglomeration of X activity in one country is associated with wage inequality, i.e. $w_{X1} > 1$ if $\eta_1 = 1$, or $w_{X2} > 1$ if $\eta_1 = 0$. Whether dispersion forces or agglomeration forces prevail depends on trade costs and on the parameters of government procurement. It is to this analysis that we turn now.

The economic mechanisms at work can be described in an intuitive way. For the sake of simplicity suppose that, starting from equilibrium, the system is perturbed by a random shock that increases the number of firms in 1 and decreases it in 2. This initial perturbation sets in motion four dynamic forces. Two of these forces reinforce the initial shock, and are therefore called "agglomeration forces". The other two counteract the initial shock and are therefore referred to as "dispersion forces".

1. The expression for total costs reveals that the reduction of P_1 (and the increase of P_2) caused by the initial increase in n_1 and decrease in n_2 reduces total costs, thereby raising firms' potential profitability in 1 (and reducing it in 2), and thus favouring further entry of firms in 1 (and pushing firms out of the market in 2). This mechanism, which is known as the *forward linkage*, tends to reinforce the initial disturbance and is, therefore, an agglomeration force.
2. The expression for private expenditure shows that increase in n_1 (a decrease in n_2) increases the expenditure on manufactures produced in 1 via an increase in the

[6] Since profits are zero, firms' aggregate expenditure on X is μ times firms' aggregate revenue.

[7] Alternatively, it could be assumed that labour is perfectly mobile across sectors and that firms move to the country that yields highest profits. The dynamics resulting from this alternative assumption would be identical to those we work with.

[8] This simplifying practice, which implies myopic expectations, is generally adopted in the literature. Forward-looking expectations have been studied by Baldwin (2001) and Ottaviano (1999), who have shown that, when history matters, the direction of motion of the state variables is the same with rational expectations as with myopic expectations.

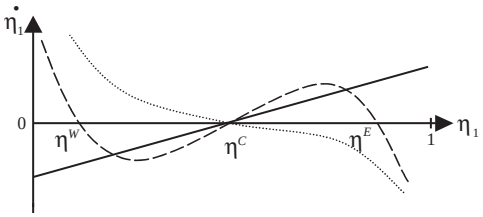

Fig. 1. Public procurement in an economic geography model.

demand for intermediate inputs. This raises potential profitability in 1 (and reduces it in 2), thereby encouraging new entry if firms in 1 (and exit in 2). This mechanism, known as *backward linkage*, tends to reinforce the initial disturbance and is therefore an agglomeration force.

3. An increase in n_1 shifts the demand faced by each firms from country 1 to the left, and vice-versa in 2. This reduces the potential profitability in 1 and increases it in 2 thus discouraging further entry of firms in 1. This mechanism, known as the *competition effect*, counteracts the initial disturbance and is therefore a dispersion force.
4. In the presence of home-biased procurement an additional force comes into play. Inspection of the r.h.s. of (6) and (7) shows that an increase in n_1 (decrease in n_2) reduces government expenditure on each variety produced in 1 and increases expenditure on each variety produced in 2, thus reducing potential profitability in 1 and increasing it in 2. This, in turn, discourages further entry of firms in 1 (while it encourages entry in 2), and therefore acts as a dispersion force. We refer to this force as the "*spread*" *effect* of home-biased public expenditure. The impact of this force is weakened as public procurement becomes more liberalised, and it disappears if procurement is fully liberalised.

The relative strength of agglomeration and dispersion forces determines the stability of the initial equilibrium. When trade costs are high enough dispersion forces always prevail, while agglomeration forces may dominate at low trade costs. We can illustrate the effect of home-biased procurement on the stability of the equilibria by use of a phase diagram (Fig. 1). This considers only the case where trade costs are sufficiently low, i.e. such that, if procurement were fully liberalised, agglomeration would occur.

There are at most three equilibria in the set $(0,1)$. Let us call the closest one to 0 the "western" equilibrium, the middle one "central" equilibrium, and the one furthest away from 0 the "eastern" equilibrium. These three equilibria are represented in Fig. 1 by η^{W}, η^{C}, η^{E}. For simplicity, we assume countries to be identical in every respect, so that $\eta^{\mathrm{C}} = 1/2$. In the previous section we were interested in the response of the equilibrium to asymmetric government demand shocks. Here we are concerned with the number and stability of the equilibria. [9]

[9] The results illustrated in Fig. 1, including the threshold values that define "large" or "small" government procurement and "high" and "low" trade costs, are derived analytically in Trionfetti (2001).

Three possibilities emerge.

1. If public procurement is fully liberalised, the central equilibrium is unstable, and the X sector completely agglomerates in country 1 or 2. This case is depicted by the solid line.
2. If public procurement is home-biased but $\phi_i E_{Xi}^G$ is small in both countries, the central equilibrium is unstable but there are two other equilibria with incomplete agglomeration (η_W and η_E), which are stable. Therefore, some but not all of the X sector eventually agglomerates in country 1 or 2. This case is depicted by the dashed line. Furthermore, the distance between η^W and η^E decreases as $\phi_i E_{Xi}^G$ increases in both countries.
3. If public procurement is home-biased and $\phi_i E_{Xi}^G$ is large in both countries, then the central equilibrium is stable. Therefore, no agglomeration will take place regardless of trade costs. This case is depicted by the dotted line.

The message emerging from these three cases is that home-biased procurement reduces the likelihood and intensity of industrial agglomeration. It does so in two ways. First, it may stabilise the central equilibrium, as is clear from a comparison of case 3 with case 1. Second, even if the central equilibrium becomes unstable, the intensity of agglomeration will relate negatively to the size of home-biased procurement. This is shown in case 2.

Proposition 3. *Large and home-biased public expenditure in one or both countries reduces the likelihood and intensity of industrial agglomeration. We refer to this proposition as the "spread" effect.*

A final clarification on the pull effect and spread effect is in order. Given an initial equilibrium (η^W, η^C, or η^E) an increase of government 1's share of world expenditure "pulls" the equilibrium to the right. Therefore, idiosyncratic home-biased government demand, all else equal, induces specialisation ("pull effect"). On the other hand, a symmetric increase in public expenditure relative to private expenditure stabilises the equilibrium. A rise in world government expenditure therefore "spreads" industries that might otherwise be subject to agglomeration forces across countries ("spread effect"). In sum, η_i is subject to two forces: the spread effect and the pull effect. Accordingly, in a cross-section setting, we would expect the variance of η_i to correlate positively with the variance of $\varepsilon_i = \varepsilon_i^P + \varepsilon_i^G$ and negatively with ε^G:

$$\mathrm{Var}(\eta_i) = c_1 \mathrm{Var}(\varepsilon_i) + c_2 \varepsilon^G, \tag{10}$$

with $c_1 > 0$ and $c_2 < 0$. We can use Eq. (10) to estimate the "spread" effect empirically while controlling for the "pull" effect.

3. Empirical evidence

Our theoretical model focuses on the distinction between final expenditure of private agents and final expenditure of the government, assuming that the latter is more

home-biased than the former. Input–output tables provide the best statistical information for a sector-level empirical quantification of these two expenditure types. Our study is based on a cross-country set of comparable input–output tables which has been compiled by Eurostat and covers up to 11 EU member countries for the period 1970–1985 in five-yearly intervals.[10] These input–output tables distinguish 18 industrial sectors.

Before we analyse the relationship between countries' sectoral specialisation and their relative public and private expenditures, some discussion of the relative home biases in public and private spending is warranted. Our key assumption is that public-sector purchasers are more home-biased than private agents. We do not seek to verify this hypothesis here, since evidence in its support has been produced elsewhere. Mastanduno (1991) and Hoekman and Mavroidis (1997) have provided compelling case studies. Trionfetti (2000) has compared import shares between public and private purchasers in the Eurostat input–output dataset that we use here (confined to 1985), and he found that import propensities were lower for public than for private purchasers in 77 percent of all observations. Similarly, the European Commission (1997) reported that, in 1987, less than two percent of public purchasing of EU countries was awarded to non-national suppliers, compared to shares ranging between 25 and 45 percent for private-sector purchases, and it identified public procurement as one of the principal remaining obstacles to a fully-fledged Single Market. *A fortiori*, discriminatory public procurement must have been a pervasive phenomenon in EU countries during the 1970–1985 period, which we cover in our empirical study.

3.1. The pull effect of public expenditure

The first two propositions derived from our model stipulate that, other things equal, relatively large discriminatory government expenditure on the product of an increasing-returns industry will result in relatively large domestic output of that product, and that this "pull effect" is stronger when exerted by public expenditure than when it comes from private demand.

We define industrial specialisation through the following measure (year subscripts implied):

$$OUTdev_{si} \equiv \left(\frac{OUT_{si}}{\sum_i OUT_{si}}\right) - \left(\frac{\sum_s OUT_{si}}{\sum_s \sum_i OUT_{si}}\right) \quad \text{where } OUTdev \in (-1,1) \tag{11}$$

and where OUT stands for output, s again represents industries and i stands for countries. In order to test the sensitivity of our results to the underlying definition of production, we compute the measure $VAdev$, which is based on value added data and constructed in identical fashion to $OUTdev$. The first summand in Eq. (9) is the empirical representation of η_i in our theoretical model, i.e. a country's share in world output of a certain industry. For the empirics we subtract from this the country's share in total world output as a scaling factor, so as to avoid spurious regression results

[10] Eurostat's input–output tables for more recent years use a less disaggregated sectoral classification for manufacturing industries and are therefore not considered in this paper. A detailed description of the data set is given in the Data Appendix.

linking expenditure and production shares solely through differences in country sizes. $OUTdev$ and $VAdev$ are centred symmetrically around zero, which represents the point where a country's share in the world production of an industry corresponds exactly to that country's share in the world's total manufacturing production. Table 5 reports the sectors of strongest and weakest specialisation according to $VAdev$ for each country.

Analogously, we construct a measure of idiosyncratic government demand (year subscripts implied):

$$DGOVdev_{si} \equiv \left(\frac{DGOV_{si}}{\sum_i DGOV_{si}}\right) - \left(\frac{\sum_s DGOV_{si}}{\sum_s \sum_i DGOV_{si}}\right)$$

$$\text{where } DGOVdev \in (-1, 1). \tag{12}$$

$DGOV$ stands for government expenditure, which we define as the sum of three expenditure headings in the input–output tables: "general public services" (NACE I810), "non-market services of education and research" (NACE I850), and "non-market services of health" (NACE I890). In addition, we compute a measure of idiosyncratic private demand $DPRIVdev$ by applying the same formula to the expenditure category "final consumption of households on the economic territory" (NACE F01); and a measure of total idiosyncratic final demand $Ddev$, which is the sum of public and private final demand. The first summand in the expression for $DGOVdev$ ($DPRIVdev$) is the empirical representation of ε_i^G (ε_i^P) in our theoretical model, while the second term provides the scaling factor needed to eliminate the possibility of contaminating regression estimates with pure country-size effects.

3.1.1. Regressing specialisation on idiosyncratic demand

We can now relate our measure of international specialisation to idiosyncratic government demand. According to our first proposition, a pull effect would manifest itself through a positive relation between these two variables. As a first exercise we have produced bivariate plots for our four sample years, based on specialisation in output (Fig. 2) and in value added (Fig. 3). A positive relationship between the two variables is apparent, but the correlations look rather weak. [11]

Our second step was to regress specialisation on idiosyncratic demand. These results are reported in Table 1. Due to the scaling of our variables we could force the constant term to zero in all specifications. [12] Although our dependent variable is bounded, we proceeded with a linear specification, since we do not want to make out-of-sample predictions and since estimations based on limited dependent variable models produced substantially equivalent results for the relevant data ranges. In Model I of Table 1, we have regressed specialisation on $Ddev$ in the pooled data. The significant positive coefficients confirm the finding of Davis and Weinstein (2003) that home markets matter for industrial location. Our result is particularly strong since we considered only

[11] We find a correlation coefficient of 0.20 between $DGOVdev$ and both $OUTdev$ and $VAdev$, pooled across sample years (see Table 2). These correlations are statistically significantly different from zero at the 99.99 percent confidence level.

[12] Estimations with a constant term or with a variable intercept (i.e. a panel) never produced significant intercept coefficients.

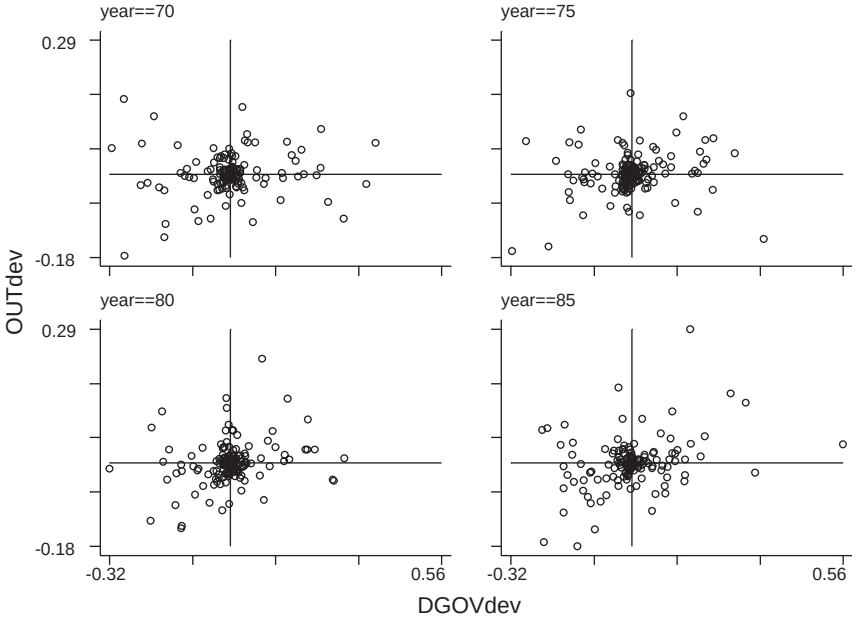

Fig. 2. The pull effect: Public expenditure and industry specialisation in output terms.

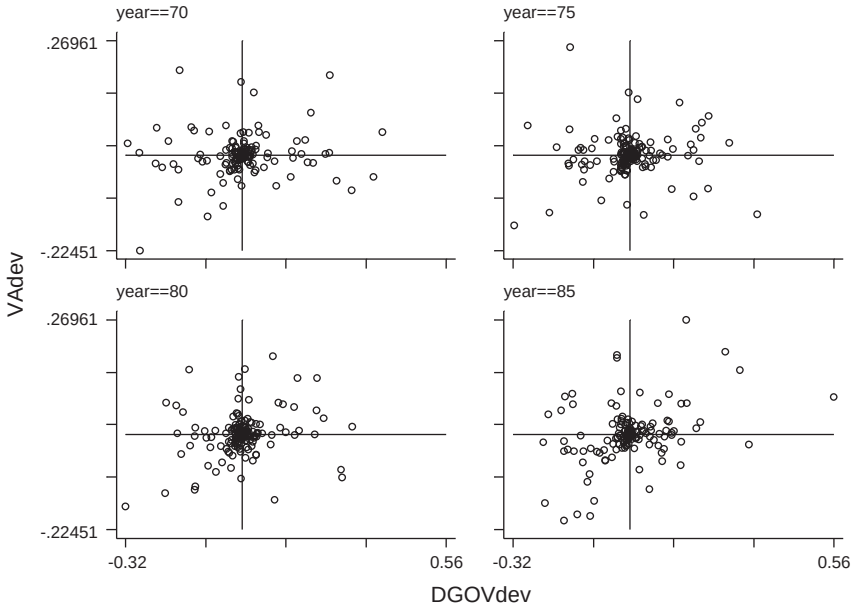

Fig. 3. The pull effect: Public expenditure and industry specialisation in value added terms.

Table 1
Demand deviations and specialisation in production: Pooled runs

Model	Regressand: / Regressors	*OUTdev* OLS/*beta* coeff. (*t* stat)	*OUTdev* R^2 No. obs	*VAdev* OLS/*beta* coeff. (*t* stat)	*VAdev* R^2 No. obs
I	*Ddev*	0.60/*0.61*	0.37	0.47/*0.42*	0.18
		(10.41)***	627	(7.13)***	627
II	*DPRIVdev*	0.55/*0.53*		0.39/*0.33*	
		(11.22)***		(6.59)***	
	DGOVdev	0.08/*0.16*	0.32	0.09/*0.17*	0.15
		(2.94)***	627	(2.75)***	627
III	1970: *DPRIVdev*	0.59/*0.63*		0.33/*0.33*	
		(7.03)***		(2.69)***	
	DGOVdev	0.05/*0.12*	0.40	0.06/*0.14*	0.12
		(1.13)	162	(1.01)	162
IV	1975: *DPRIVdev*	0.51/*0.52*		0.34/*0.32*	
		(5.77)***		(3.27)***	
	DGOVdev	0.05/*0.11*	0.30	0.01/*0.01*	0.10
		(0.83)	162	(0.07)	162
V	1980: *DPRIVdev*	0.46/*0.45*		0.37/*0.33*	
		(4.96)***		(3.55)***	
	DGOVdev	0.08/*0.14*	0.25	0.09/*0.14*	0.15
		(1.45)	159	(1.08)	159
VI	1985: *DPRIdev*	0.64/*0.50*		0.54/*0.36*	
		(5.04)***		(3.47)***	
	DGOVdev	0.13/*0.26*	0.35	0.19/*0.31*	0.26
		(2.77)***	144	(3.55)***	144
VII	*DPRIVdev*	0.51/*0.48*		0.40/*0.35*	
		(10.14)***		(6.88)***	
	DGOVdev	0.09/*0.18*		0.10/*0.19*	
		(3.28)***		(2.84)***	
	GOVBIAS	0.38/*0.02*		0.22/*0.09*	
		(0.63)		(2.35)**	
	DGOVdev ∗ *GOVBIAS*	3.59/*0.17*	0.32	0.83/*0.08*	0.18
		(3.86)***	560	(1.17)	560
VIII[a]	*DPRIVdev*	0.50/*0.47*		0.38/*0.31*	
		(8.36)***		(5.26)***	
	DGOVdev	0.09/*0.17*		0.10/*0.17*	
		(4.15)***		(3.74)***	
	Lagged dependent var.	0.38/*0.06*	0.30	0.10/*0.03*	0.16
		(0.86)	412	(0.54)	412
IX	*DPRIdev*	0.53/*0.51*		0.37/*0.32*	
		(12.14)***		(6.44)***	
	DGOVdev	0.07/*0.15*		0.09/*0.16*	
		(3.09)***		(2.75)***	
	NETEXPORT	0.04/*0.36*	0.44	0.04/*0.32*	0.25
		(10.66)	621	(8.48)**	621

Notes: See text for definition of variables and data. *t* statistics are White-adjusted. ***/**/*: statistically significant at 1/5/10 percent level.

[a]The lagged dependent variable is instrumented using lagged *DPRIVdev* and lagged *DGOVdev*, and standard errors are adjusted accordingly (see Stewart and Gill, 1998, p. 209f).

demand for final products in our definition of "home markets" and could therefore eliminate the possibility of upward bias due to simultaneity between output and demand in the case where demand includes expenditure on intermediate products as well as on final goods.

In Model II of Table 1 we have estimated Eq. (8) in the pooled dataset by taking account separately of the private and public components of idiosyncratic expenditure. Both coefficients are positive and precisely estimated, confirming our Proposition 1. The coefficients on private demand deviations (0.55 for output, 0.39 for value added) are substantially larger than those on public demand deviations (0.08 and 0.09, respectively). These estimated parameters correspond to β_1 and β_2 of Eq. (8). Recall from Section 2.1 that in interpreting these coefficients one ought to keep in mind the different sizes of private and public demand. It is through $b_1 = \beta_1/\varepsilon^P$ and $b_2 = \beta_2/\varepsilon^G$ that the pull effect of a marginal dollar spent by public and private agents can be estimated. Table 5 shows that on average private demand was roughly ten times the size of government demand. Precisely, the average share of public expenditure in total final expenditure, ε^G, pooled across years in our dataset is 0.106. Our estimated b_1 is therefore equal to 0.61 in the output specification and to 0.44 in the value added specification, while our estimate of b_2 is 0.73 and 0.87, respectively. These results suggest the presence of a pull effect of public expenditure according to our Proposition 2: an extra dollar spent by government has a stronger effect on attracting production in the relevant sector than an extra dollar spent by private agents. However, we cannot attribute statistical significance to this result, since the 95% confidence intervals of b_1 and b_2 overlap.

In a third step, we have estimated the empirical version of Eq. (8) separately for each sample year (Models III–VI in Table 1). We find evidence of an increasing tendency in the pull effect of government purchases. Over the period of our sample, therefore, the impact of (discriminatory) public expenditure on the location of manufacturing activities seems to have grown.

Fourth, we augmented the basic specification with the variable *GOVBIAS*, which is a proxy for the degree of bias in public procurement by industry and country (Table 1, model VII). This variable is taken from Nerb (1987), who, based on a survey of 11,000 European firms in the mid-1980s, reported the percentage of firms who considered the opening of public procurement markets to be "very important". This variable might be affected not only by the degree of bias of public purchasers in different industries and countries but also by the size of public procurement. However, the correlation between those two variables turns out to be very small and statistically insignificant in our dataset (see Table 6). We therefore added *GOVBIAS*, as well as an interaction term with *DGOVdev*, to the baseline specification. We find the expected positive coefficients on the two bias variables, and the estimated coefficients on idiosyncratic public and private expenditure are barely affected. This result confirms that the more biased public authorities are in their purchasing activities, the stronger is the pull effect of their expenditure.

Fifth, we re-estimated the original model including the lagged dependent variable (Table 1, model VIII). This is to account for the fact that international specialisation patterns change slowly. Since OLS yields inconsistent coefficient estimates in such a set-up, we instrumented the lagged dependent variable using the lagged explanatory

variables and corrected the standard errors accordingly. We find that the lagged dependent variable is statistically insignificant, and its inclusion does not significantly affect the estimated impact of the regressors of interest. This suggests that the five-year intervals in our data are sufficiently long to cover the adjustment lag of international production structures to changed demand patterns.

Finally, we addressed the issue of potential endogeneity. Although our theoretical model implies expenditure shares that are unaffected by supply conditions, in reality a causal link could exist that runs from output shares to expenditure shares. Specifically, if a country's price index for a particular sector is negatively correlated with that country's specialisation in the particular sector, then relatively large domestic sectors may attract relatively large domestic expenditure shares.[13] The impact of such a causal link is ambiguous *a priori:* any observed home-market effects of expenditure on output shares will be strengthened (weakened) if the price elasticity of sectoral expenditure is larger (smaller) than one. This is an empirical issue. Whilst sectoral price indices are not available for the countries in our sample, we have computed net export ratios as a proxy for international price differentials, taking account of the fact that net exporters tend to have lower domestic prices than net importers. These ratios are defined for each sector-country-year observation as: $NETEXPORT = (\text{exports} - \text{imports})/(\text{exports} + \text{imports})$. The sample correlation coefficients with $NETEXPORT$ are 0.05 for $DPRIVdev$ and 0.03 for $DGOVdev$, which are both statistically insignificant. This suggests that a low relative domestic price in a particular sector does not systematically increase or decrease domestic expenditure shares allocated to that sector.[14] In Model IX of Table 1, we have added $NETEXPORT$ to the baseline regression, and we find that this reduces the coefficients on the idiosyncratic demand variables only very slightly. The qualitative results remain unaffected: both private and public expenditure shares relate positively to production shares, and, when weighted by the relative expenditure sizes, this effect remains stronger for public than for private expenditure.

3.1.2. Adding endowments and input–output linkages

Our theoretical setup in Section 2 is richer than the empirical specification that we have estimated so far. Specifically, the models incorporate two additional determinants of international specialisation: factor-endowment differences across countries combined with different factor requirements of sectors, and agglomeration forces based on input–output linkages among firms. We therefore extend the original empirical specification that was based on Eq. (8) by adding various combinations of the following regressors (year subscripts implied):

1. $PRIMARYinter_{si} = (\text{Primary inputs used/Output})_s * (\text{Primary inputs produced/Manufacturing output})_i,$

[13] We are grateful to an anonymous referee for pointing this out. For a discussion of this point and a similar empirical strategy to ours, see also Davis and Weinstein (2003, p. 15f.).

[14] Conversely, as expected, the correlation between production shares and $NETEXPORT$ is high (0.39 for output and 0.34 for value added) and statistically significant.

2. $AGRIinter_{si} = (\text{Agricultural inputs used/Output})_s * (\text{Agricultural inputs produced/Manufacturing output})_i$,
3. $ENERGYinter_{si} = (\text{Energy inputs used/Output})_s * (\text{Energy inputs produced/Manufacturing output})_i$,
4. $CAPITALinter_{si} = (\text{Fixed capital consumption/Output})_s * (\text{Capital stock per worker})_i$,
5. $WAGESHAREinter_{si} = (\text{Wages/Output})_s * (\text{Wages/GDP})_i$,
6. $MANINPinter_{si} = (\text{Manufactured inputs used/Output})_s * (\text{Manufactured inputs produced/Manufacturing output})_i$.

The first five regressors are interaction variables capturing the factor abundance of countries and the factor intensities of industries, in the spirit of Heckscher–Ohlin theory. The sixth regressor is constructed in order to control for input–output linkages among manufacturing industries, which can give rise to endogenous geographical concentrations (an "industrial base") as described in Section 2.2. Details on the construction of these variables are given in Appendix A.

If factor endowments and input–output linkages are important determinants of industrial specialisation among EU countries, then we would expect to find positive and significant coefficients on all of the regressors. Our results for the entire data set, reported in Table 2, are largely consistent with those theoretical priors. We have experimented with varying specifications of the estimating equation as well as with estimation techniques that take account of potential year-specific heteroskedasticity.[15] Almost all of the estimated coefficients are positive, and many are statistically significant. The exception is the variable capturing input–output linkages, which seems very sensitive to the chosen specification and gives rise to significant positive as well as negative coefficients. A comparison of the results in Table 2 with those of Table 1 shows that inclusion of the additional regressors adds very little to the explanatory power of the model; *R*-squares are raised only slightly, and the estimated coefficients on *DGOVdev* and *DPRIVdev* are very stable. It is of course not unexpected that endowment differences explain a small share of observed specialisation differences across the relatively homogeneous countries of Western Europe; nor would it appear surprising that we struggle to pick up robust evidence of geographical industry clusters based on input linkages, given that such concentrations of manufacturing activity would more likely appear in region-level data than in a country-level dataset.

The main aim of this exercise, however, is to test the robustness of the estimated coefficients on the variables that represent idiosyncrasies in public and private final expenditure. Our estimated relationships turn out to be remarkably unaffected by the inclusion of any combination of additional control variables. The coefficients on *DGOVdev* and on *DPRIVdev* are always statistically significantly positive. In the third-last row of Table 2 we report the relevant *bs*, that is the coefficients appropriately scaled for

[15] The estimation might be more efficient if one could account for potential correlation of disturbances across years. This cannot be done for the entire dataset, due to the unbalanced nature of the panel, but estimation on the subsample of countries for which we have observations for all four sample years produced substantially equivalent results.

Table 2
Demand deviations, supply-side locational determinants and specialisation in production: Pooled runs

Model:	I		II		III		IV		V	
Estimation method:	OLS[a]		OLS[a]		OLS[a]		OLS with panel-corrected standard errors[b]		Feasible GLS (panel heteroskedasticity)[c]	
Regressand:	*OUTdev*	*VAdev*	*OUTdev*	*VAdev*	*OUTdev*	*VAdev*	*OUTdev*	*VAdev*	*OUTdev*	*VAdev*
Regressors										
DPRIVdev	0.54	0.38	0.54	0.38	0.56	0.41	0.56	0.42	0.55	0.39
	(11.38)***	(6.60)***	(11.52)***	(6.65)***	(9.26)***	(6.52)***	(14.88)***	(9.67)***	(15.15)***	(9.81)***
DGOVdev	0.08	0.09	0.08	0.09	0.08	0.13	0.08	0.13	0.07	0.11
	(2.86)***	(2.72)***	(2.86)***	(2.72)***	(2.56)***	(3.76)***	(4.56)***	(6.46)***	(4.17)***	(6.16)***
PRIMARYinter	1.68	1.37								
	(3.88)***	(2.43)**								
AGRIinter			2.91	2.22	2.72	2.15	2.72	2.15	2.65	2.01
			(7.29)***	(3.73)***	(7.57)***	(4.21)***	(5.60)***	(3.92)***	(5.60)***	(3.85)***
ENERGYinter			0.12	0.37						
			(0.17)	(0.38)						
CAPITALinter	1.47	1.23	0.64	0.58						
	(1.67)*	(1.06)	(0.73)	(0.48)						
WAGESHAREinter					1.49	2.39	1.49	2.39	1.56	2.48
					(2.24)***	(2.55)***	(2.86)***	(4.11)***	(3.05)***	(4.43)***
MANINPinter	0.26	1.50	−0.04	1.28	−0.43	−0.73	−0.43	−0.73	−0.39	−0.62
	(0.73)	(2.27)**	(−0.11)	(1.89)*	(−1.34)	(−1.84)*	(−0.99)	(−1.50)	(−0.92)	(−1.33)
b_1 versus b_2[d]	0.60, 0.73	0.43, 0.87	0.61, 0.73	0.43, 0.87	0.63, 0.69	[0.47, 1.13]*	0.63, 0.69	[0.47, 1.13]*	0.62, 0.63	[0.44, 1.00]*
Adjusted R^2	0.33	0.17	0.36	0.18	0.37	0.27	n.a.	n.a.	n.a.	n.a.
No. Obs.	627	627	627	627	555	555	555	555	555	555

***/**/*: Statistically significant at 1/5/10 percent level. *95 percent confidence intervals do not overlap.

[a]White-adjusted t statistics in brackets.

[b]Years defined as panels. Beck and Katz (1995) adjusted z statistics in brackets.

[c]Years defined as panels. Observations are assumed to be heteroskedastic across panels, but uncorrelated across panels and non-autocorrelated within panels. z statistics in brackets.

[d]b_1 and b_2 are the estimated coefficients on *DPRIVdev* and *DGOVdev*, respectively, divided by the relevant share of private/public expenditure in total expenditure.

the relative size of private and public expenditure. In line with our first two theoretical propositions for increasing-returns sectors, b_2 is always larger than b_1; although, for most specifications, this difference is not statistically significant. We therefore conclude (a) that both private and government demand idiosyncrasies are a significant factor shaping the patterns of industrial specialisation among EU countries, and (b) that idiosyncrasies in public-sector demand matter more than those in private-sector demand, i.e. there is evidence of a pull effect from public expenditure.

As a complement to the pooled runs, we have also estimated our model separately for each of the 18 industries in our sample. Table 3 reports these results. All variables with names ending on "*abund*" correspond to the country-level endowment abundance terms, i.e. the second multiplicand in each expression that defines the interaction terms given above. We find largely plausible coefficients on our control variables (food sectors are bigger in countries with abundant agricultural inputs, textiles and leather industries are smaller in countries with a large industrial base, etc.). There are a number of industries with statistically significant positive specialisation effects of public expenditure (metal goods, motor vehicles, other transport equipment, rubber and plastic, instrument engineering). On the other hand, there are industries where endowments have significant explanatory power and expenditure shares do not (chemicals, meat products, timber and furniture, paper and printing). If we took our static model literally, we would attribute the former set of industries to the monopolistically competitive category, whilst the latter industries would be of the perfectly competitive type. However, some caution is warranted in the interpretation of these results. Most strikingly, we find implausibly negative and significant coefficients on the public expenditure variable for two industries, electrical goods and beverages. These counterintuitive results serve as a reminder of the large range of unexplained variation in our specialisation measures, and they are possibly due to correlation of idiosyncrasies in public expenditure with some other unobserved variable that determines specialisation. This caveat notwithstanding, the industry-by-industry regressions support the earlier finding that demand deviations have significant pull effects on sectoral specialisation among EU countries.

3.2. The spread effect of public expenditure

According to our third theoretical proposition, the share of (home-biased) public expenditure in an increasing-returns sector will relate negatively to the degree of specialisation of that sector across countries. This spread effect of government demand is not immediately evident in our dataset. Fig. 4 plots industry averages of absolute specialisation measures ($|OUTdev|$) on the industry share of public expenditure scaled to domestic absorption. For each of the four sample years, we find a tight cluster of observations near the origin and a single outlier far to the northeast. Fitting a linear regression line to these data yields a statistically significant positive slope coefficient (Table 4, Model Ia). This result holds virtually unchanged when, following Eq. (10), we in addition control for the standard deviation of *DGOVdev* (Table 4, Model Ib). Our initial result is thus diametrically opposed to our theoretical proposition that government expenditure attenuates specialisation pressures.

Table 3
Demand deviations, Supply-side locational determinants and specialisation in production: Industry runs (dependent variable = *VAdev*, 35 observations)

Regressors:	*DPRIdev*		*DGOVdev*		*GOVBIAS*		*GOVBIAS ∗DGOVdev*		*AGRI-abund*		*ENERGY-abund*		*CAPITAL-abund*		*MANINP-abund*	
NACE code: Industry	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.	*OLS* coeff.	*Beta* coeff.
1170: Chemicals	−0.08	*0.27*	−0.01	−0.06	0.16	*0.25*	4.59	*0.45*	0.24	*0.28*	−0.06	*−0.07*	0.31	*0.33*	0.001	*0.002*
1190: Metal goods	0.09	*0.14*	0.14	*0.49*	0.13	*0.10*	0.38	*0.02*	−0.21	*−0.15*	−0.30	*−0.19*	0.26	*0.17*	−0.04	*−0.08*
1210: Machinery	0.22	*0.53*	−0.06	*−0.14*	−0.07	*−0.02*	8.76	*0.22*	−0.69	*−0.31*	0.23	*0.10*	−0.40	*−0.16*	0.21	*0.23*
1230: Office machines	0.70	*0.98*	0.02	*0.03*	−0.04	*−0.02*	−2.37	*−0.15*	−0.44	*−0.16*	0.08	*0.03*	−0.35	*−0.11*	0.05	0.04
1250: Electrical goods	−0.13	*−0.12*	−0.11	*−0.31*	0.10	*0.07*	0.80	*0.05*	0.41	*0.22*	0.47	*0.23*	−0.10	*−0.05*	0.60	*0.80*
1270: Motor vehicles	0.10	*0.05*	0.46	*0.88*	−0.11	*−0.04*	−1.18	*−0.04*	−0.69	*−0.22*	0.60	*0.19*	−0.86	*−0.25*	0.14	*0.11*
1290: Other transp. eq.	0.14	*0.11*	0.49	*0.69*	−0.06	*−0.01*	3.92	*0.17*	0.69	*0.14*	0.24	*0.05*	−0.15	*−0.03*	−0.13	*−0.07*
1310: Meat products	0.11	*0.10*	0.06	*0.09*	0.19	*0.12*	0.66	*0.02*	1.33	*0.66*	−0.41	*−0.20*	1.36	*0.68*	0.09	*0.12*
1330: Dairy produtcs	1.76	*0.74*	0.08	*0.05*	0.76	*0.21*	1.71	*0.03*	1.40	*0.30*	0.54	*0.12*	0.18	*0.04*	0.18	*0.09*
1350: Other food	0.91	*0.23*	0.22	*0.33*	0.68	*0.37*	2.24	*0.08*	1.14	*0.48*	0.32	*0.14*	−0.004	*−0.002*	−0.22	*−0.23*
1370: Beverages	−0.02	*−0.05*	−0.22	*−0.75*	−0.02	*−0.01*	3.26	*0.25*	0.61	*0.32*	−0.10	*−0.05*	0.50	*0.26*	0.11	*0.14*
1390: Tobacco products	−0.04	*−0.02*	0.11	*0.21*	−0.31	*−0.07*	−3.42	*−0.17*	−1.64	*−0.28*	0.19	*0.03*	−1.18	*−0.20*	−1.23	*−0.52*
1410: Textiles, clothing	2.28	*0.72*	−0.19	*−0.23*	0.25	*0.07*	8.43	*0.10*	−0.27	*−0.08*	−0.62	*−0.16*	0.10	*0.03*	−0.89	*−0.63*
1430: Leather, footwear	3.29	*0.76*	0.002	*0.002*	0.15	*0.03*	1.23	*0.03*	−0.07	*−0.01*	−0.82	*−0.14*	0.54	*0.09*	−0.88	*−0.42*
1450: Timber, furniture	0.57	*0.48*	−0.12	*−0.7*	−0.30	*−0.14*	−5.03	*−0.31*	−0.68	*−0.27*	−0.70	*−0.26*	0.12	*0.04*	−0.57	*−0.57*
1470: Pulp, paper, printing	0.11	*0.12*	−0.16	*−0.35*	−0.03	*−0.02*	4.75	*0.21*	0.48	*0.31*	0.52	*0.30*	−0.59	*−0.34*	0.25	*0.39*
1490: Rubber, plastic	0.05	*0.11*	0.11	*0.84*	−0.04	*−0.04*	−0.79	*−0.13*	−0.45	*−0.47*	0.08	*0.08*	−0.22	*−0.21*	−0.11	*−0.29*
1510: Instrum. engineering and other manuf.	0.46	*0.31*	0.38	*0.08*	0.04	*0.02*	0.37	*0.01*	0.27	*0.07*	0.21	*0.05*	−0.37	*−0.09*	−0.04	*−0.03*

Note: Dark shading: statistical significance at 1 percent level, light shading: statistical significance at 5 percent level.

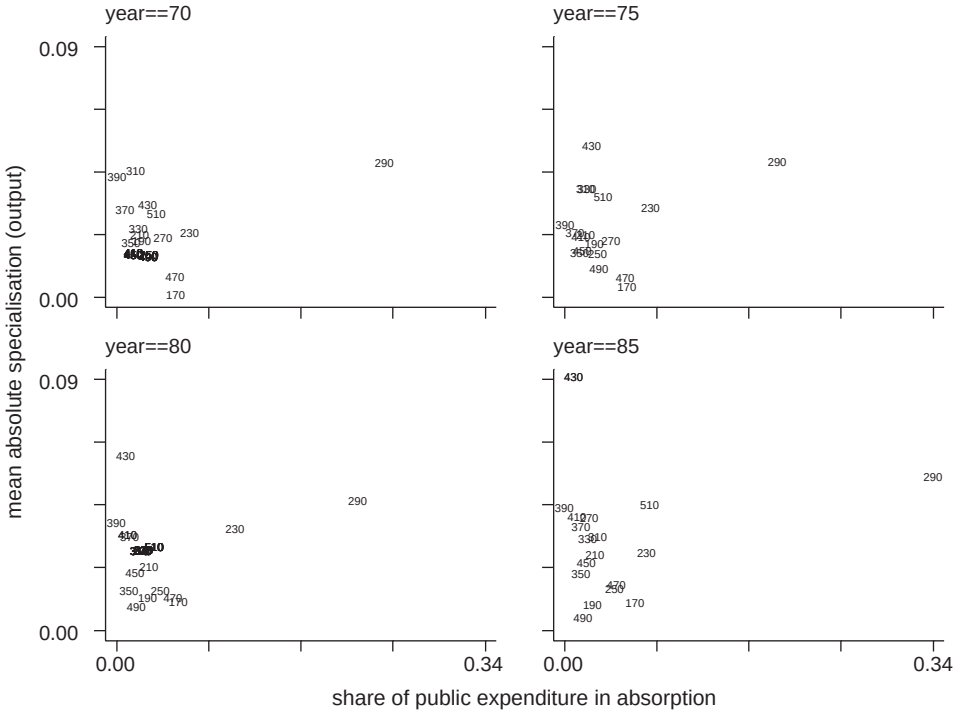

Fig. 4. The spread effect: Public expenditure and industry specialisation in output terms: All industries (NACE codes).

It is worth taking a closer look at the data. Fig. 4 shows that the single outlier in all years relates to the "other transport equipment" sector (NACE 290). If we drop this observation from the data set, we find the expected negative impact of public expenditure on specialisation in output terms (Fig. 5) and in value added terms (Fig. 6). These negative relationships are confirmed by fitting a linear model to the censored dataset (Table 4, Models IIa,b). Hence, our data set as a whole appears to reject the spread effect, yet the elimination of a single industry overturns this result in favour of our proposition.

Is it justifiable to drop NACE 290 from the dataset for the purpose of this exercise? In principle, since it is the sector that exhibits by far the largest share of public-sector demand (see Fig. 4), NACE 290 might provide our most reliable observation. On the other hand, there are good reasons to believe that the allocation of production in many subsectors of this industry are not primarily driven by market forces. Around two thirds of output values in NACE 290 are accounted for by aircraft production (including military). Inspection of the raw data reveals that in all sample years the most specialised countries (in terms of both *OUTdev* and *VAdev*) were the UK and France, while Italy and Germany are consistently situated at the bottom of the specialisation scale. This pattern bears a remarkable resemblance with the development of defence production

Table 4
The spread effect: Public expenditure and the intensity of specialisation (intercept coefficients not reported)

Model	Notes	Regressand:	Mean|*OUTdev*|		Mean|*VAdev*|	
		Regressors	OLS/*beta* coeff. (*t* stat)	R^2 No. obs	OLS/*beta* coeff. (*t* stat)	R^2 No. obs
Ia	• All industries	*DGOV/Absorption*	0.06/*0.23*	0.09	0.03/*0.11*	0.10
	• Year fixed effects		(2.74)***	72	(1.09)	72
Ib	• All industries	*DGOV/Absorption*	0.06/*0.24*	0.13	0.03/*0.11*	0.18
	• Year fixed effects		(2.98)***	72	(1.31)	72
		Std. dev. of *DGOVdev*	0.07/*0.21* (2.00)**		0.12/*0.29* (2.16)**	
IIa	• NACE 290 dropped	*DGOV/Absorption*	−0.17/*−0.26*	0.11	−0.23/*−0.29*	0.19
	• Year fixed effects		(−1.68)*	68	(−2.05)***	68
IIb	• NACE 290 dropped	*DGOV/Absorption*	−0.16/*−0.24*	0.13	−0.19/*−0.26*	0.23
	• Year fixed effects		(−1.51)	68	(−1.94)*	68
		Std. dev. of *DGOVdev*	0.05/*0.13* (1.23)		0.08/*0.22* (1.69)*	
IIIa	• 1970	*DGOV/Absorption*	−0.02/*−0.34*	0.12	−0.01/*−0.22*	0.05
	• NACE 290 dropped		(−1.25)	17	(−0.85)	17
IIIb	• 1975	*DGOV/Absorption*	−0.02/*−0.28*	0.08	−0.03/*−0.34*	0.12
	• NACE 290 dropped		(−1.26)	17	(−1.47)	17
IIIc	• 1980	*DGOV/Absorption*	−0.02/*−0.29*	0.08	−0.03/*−0.37*	0.14
	• NACE 290 dropped		(−1.28)	17	(−1.63)	17
IIId	• 1985	*DGOV/Absorption*	−0.04/*−0.38*	0.14	−0.05/*−0.45*	0.20
	• NACE 290 dropped		(−1.49)	17	(−1.79)*	17

***/**/* Statistically significant at 1/5/10 percent level.

across EU countries that resulted from the peace agreements signed after the second world war. A case can thus be made for considering the high absolute specialisation index for NACE 290 as the outcome of determinants that are outside our modelling framework. Based on this argument, we proceeded to work with a censored dataset, excluding NACE 290. [16]

We estimated a linear relationship between the share of government expenditure in domestic absorption and the intensity of specialisation, allowing for year-specific fixed effects (Table 4, Models IIa,b). The negative and significant coefficient estimates provide support for the spread effect. We also find the expected positive partial correlation between the variance of government expenditure and the index of specialisation. Finally, we ran the regression separately for each sample year and obtained consistently negative parameter estimates (Table 4, Models IIIa–d). The year-by-year coefficients

[16] Four-digit data, taken from the OECD's Comtap database, show that in 1985 production of aircraft accounted for 67 (66) percent of output in the "other transport equipment" industry in the UK (France), while the corresponding shares for Germany and Italy were considerably lower at 44 percent and 25 percent, respectively. This suggests that specialisation patterns in NACE 290 are shaped by the location of aircraft production, which is highly politicised at the supra-national level.

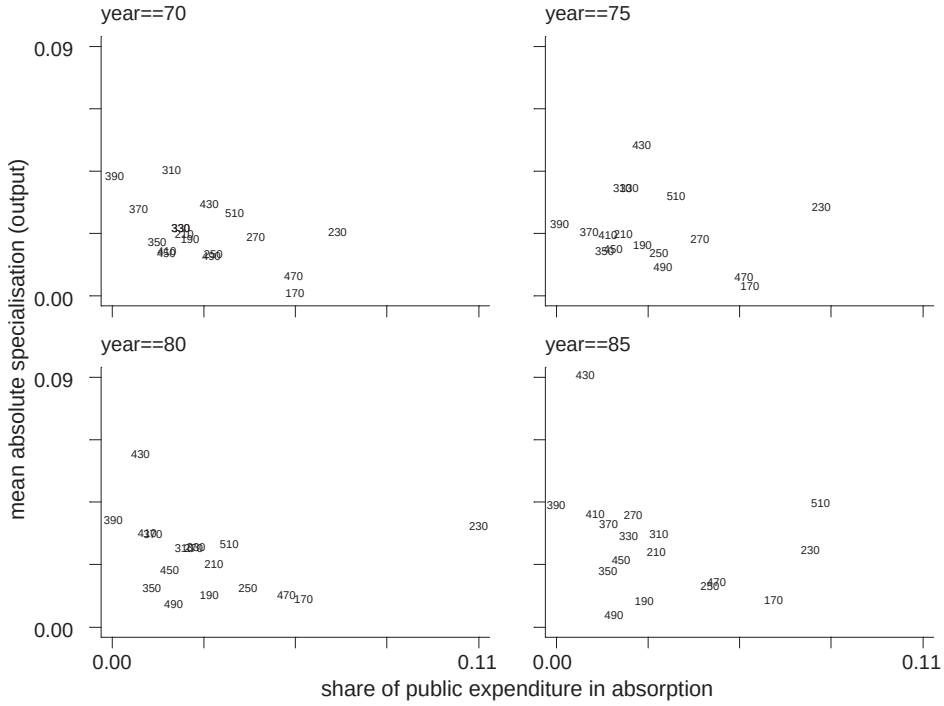

Fig. 5. The spread effect: Public expenditure and industry specialisation in output terms: NACE 290 dropped (NACE codes).

are statistically significant only in one of eight cases, but, given the small sample size at the year level and the stability of the estimated coefficients, our finding seems quite robust.[17]

Arguably our test of the spread effect could be biased due to unobserved determinants of the intensity of industrial specialisation that are statistically correlated with public expenditure shares. This is a valid concern, but we face two problems in trying to address it. First, theory does not serve as a useful guide to the specification of control variables in such an exercise. While trade and geography models are useful in predicting where certain types of industries will concentrate, they do not provide us with priors on what features make certain industries more or less concentrated across countries. Second, the conventional empirical method to address such uncertainty in a context like ours is to introduce dummy variables for unknown panel-specific effects; but we

[17] Controlling for the variance in government expenditure shares across industries does not significantly affect the estimated coefficients and standard errors on *DGOVI/Absorption* in the year-by-year regression runs. To test the sensitivity of the result to the scaling of the regressors, we also estimated the model on the share of public expenditure in total final expenditure (instead of absorption), and found the results substantially unchanged. All these results are available from the authors.

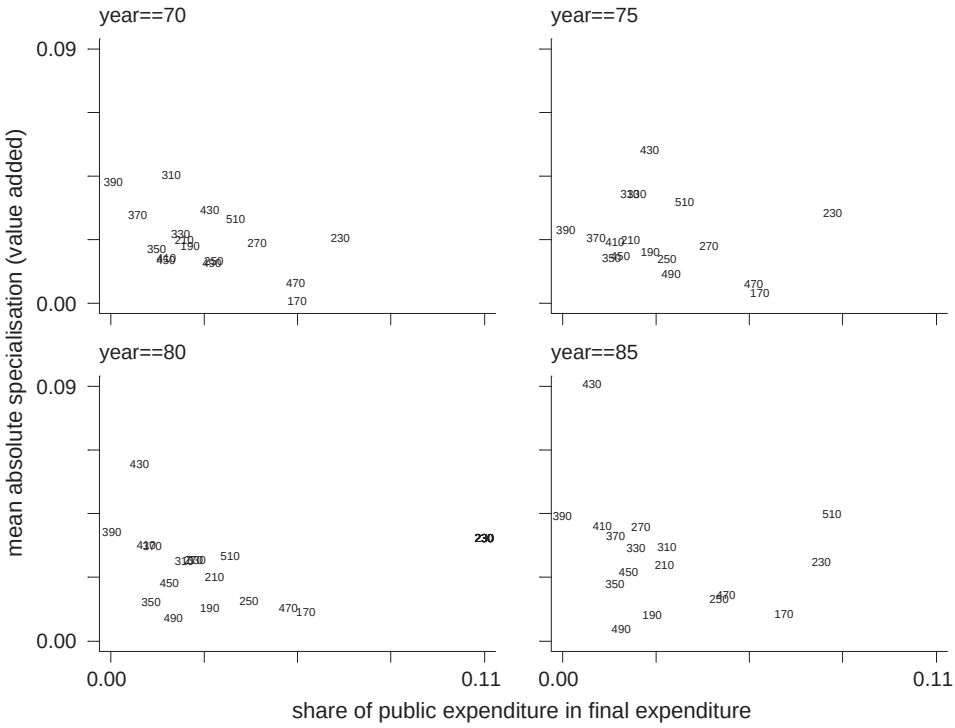

Fig. 6. The spread effect: Public expenditure and industry specialisation in value added terms: NACE 290 dropped (NACE codes).

are constrained in such an exercise by a lack of degrees of freedom.[18] Our empirical verdict in favour of the spread effect must therefore remain a qualified one.

4. Conclusions

This paper sheds light on the consequences of home-biased public expenditure on the pattern of international specialisation and on industrial agglomeration. The theoretical analysis is based on models in the mould of the new theories of international trade and economic geography, and the empirical estimations draw on an input–output panel data set for EU countries.

In the theoretical part, our paper contributes to the literature by studying the location effects of public procurement theoretically in models with both perfectly competitive and monopolistically competitive sectors and in models with cumulative agglomera-

[18] Estimation of the model with industry as well as year fixed effects in the censored dataset produced consistently negative coefficients on public expenditure shares, but statistical significance was never found. These results are available from the authors on request.

tion features. While our analysis confirms that home-biased procurement is neutral in perfectly competitive sectors, it suggests that there are "pull" and "spread" effects in monopolistically competitive sectors. The "pull" effect means that a country with relatively large home-biased government expenditure on a certain good will tend to host a relatively large share of world production of that good. The "spread" effect means that symmetrically large home-biased public procurement reduces the likelihood and intensity of agglomeration of increasing-returns industries.

The existence of pull and spread effects is explored empirically in an input–output dataset for eleven EU countries, covering the period 1970–1985. To our knowledge, this is the first empirical investigation of the effect of public procurement on international specialisation in a panel data setting with a full industrial cross-section. We find evidence in support of the pull effect. On average, a country with large government procurement on a good will tend to specialise in the production of that good. We also find that the effect of government demand on international specialisation is stronger than the effect of private demand. Further, we find empirical support for the spread effect. Industries that are subject to a relatively large share of public expenditure tend to be less concentrated across EU countries.

This study is purely positive in nature. Yet, our results may be informative for policy making, especially in the context of the WTO Government Procurement Agreement and of the EU's ongoing effort to complete its single public procurement market.

Acknowledgements

The authors gratefully acknowledge financial support from the Swiss National Science Foundation, from the British Economic and Social Research Council ("Evolving Macroeconomy" programme, ESRC grant L138251002) and from the French Commissariat Général du Plan (convention no. 5, 2000). We have benefited from useful suggestions made by seminar participants at the Universities of Paris 1 and Paris 12 and by an anonymous referee.

Appendix A. Data

Our input–output data are taken from the Eurostat "National Accounts ESA" series. We have data for 18 NACE two-digit manufacturing sectors, up to 11 EU countries and four sample years (1970, 1975, 1980 and 1985). The country coverage in each sample year can be gleaned from Table 5. We did not use more recent data, since the available level of sectoral disaggregation in data after 1985 is significantly lower. The data for 1970 and 1975 were converted into deutschmarks at current exchange rates, and those for 1980 and 1985 were converted into current ECUs. The sample contains up to 630 country-industry-year observations.

Most of the interaction terms used in the model underlying Tables 2 and 3 are based on variables taken from the input–output database:

- *PRIMARYinter*: "Primary inputs used" is defined as the value of goods from NACE industries I010–I150 (agricultural and mineral products, power) that are used as

Table 5
Descriptive statistics

Country	Year	Share of private final demand in manufacturing output	Share of public final demand in manufacturing output	Sector of strongest specialisation[a]	Sector of weakest specialisation[a]
Belgium	70	0.349	0.020	Instrument engineering and other manuf.	Machinery
	75	0.338	0.019		
	80	0.344	0.021		
West Germany	70	0.273	0.040	Motor vehicles	Tobacco products
	75	0.274	0.046		
	80	0.273	0.041		
	85	0.252	0.041		
Denmark	70	0.385	0.041	Meat products	Motor vehicles
	75	0.356	0.044		
	80	0.324	0.047		
	85	0.321	0.040		
Spain	75	0.425	0.013	Leather, footwear	Machinery
	80	0.378	0.024		
	85	0.370	0.030		
France	70	0.330	0.029	Other transport equipment	Tobacco products
	75	0.334	0.030		
	80	0.328	0.028		
	85	0.325	0.040		
Italy	70	0.379	0.013	Leather, footwear	Tobacco products
	75	0.344	0.019		
	80	0.314	0.017		
	85	0.300	0.024		
Netherlands	70	0.354	0.023	Tobacco products	Office machines
	75	0.337	0.018		
	80	0.325	0.025		
	85	0.271	0.029		
Portugal	80	0.331	0.016	Textiles, clothing	Machinery
U.K.	70	0.347	0.050	Tobacco products	Leather, footwear
	75	0.289	0.049		
	80	0.275	0.066		
	85	0.284	0.076		
Ireland	70	0.552	0.011	Office machines	Motor vehicles
	75	0.464	0.019		
	85	0.363	0.019		
Luxemburg	70	0.616	0.013	Rubber, plastic	Office machines
Sample Average	70	0.398	0.027	(n.a)	(n.a)
	75	0.351	0.029		
	80	0.321	0.032		
	85	0.311	0.037		

[a]Calculated on the basis of value added data ($VAdev$) in most recent available sample year.

Table 6
Correlations

	VAdev	*Ddev*	*DGOVdev*	*DPRIVdev*	*GOVBIAS*	*PRIMARY-inter*	*AGRI-inter*	*ENERGI-inter*	*CAPITAL-inter*	*WAGESHARE-inter*	*MANINP-inter*
OUTdev	0.77*	0.61*	0.20*	0.54*	0.05	0.13*	0.21*	0.02	0.12*	0.24*	0.05
MANINPinter	0.12*	0.04	−0.01	0.02	0.06	0.07	0.18*	0.01	0.13*	0.10	
WAGESHAR-Einter	0.24*	0.17*	−0.04	0.17*	0.09	0.29*	0.33*	−0.07	0.19*		
CAPITALinter	0.10	0.12*	0.09	0.08	0.03	−0.002	0.18*	0.15*			
ENERGYinter	0.02	0.01	0.01	−0.003	0.13*	−0.05	0.08				
AGRIinter	0.16*	0.05	−0.003	0.01	0.02	0.65*					
PRIMARYinter	0.10	0.02	−0.02	0.02	−0.05						
GOVBIAS	0.09	−0.04	0.08								
DPRIVdev	0.35*	0.75*	0.09								
DGOVdev	0.20*	0.40*									
Ddev	0.42*										

*Statistically significant at the 1 percent level.

intermediate inputs in the 18 manufacturing sectors in the home country. "Primary inputs produced" is the total value of output of NACE industries I010–I150 that is produced in the home country and used as an input in one of the manufacturing industries.

- *AGRIinter*: "Agricultural inputs used" and "produced" are defined equivalently, but restricted to NACE industry I010 (agriculture, forestry and fishing).
- *ENERGYinter*: "Energy inputs used" and "produced" are defined equivalently, but restricted to NACE industries I020–I150 (power and mineral products).
- *WAGESHAREinter*: This is based on the heading "gross wages and salaries" in the input–output tables (NACE F010). Coverage of this variable over countries and years is incomplete.
- *MANINPinter*: "Manufactured inputs used" is defined as the value of goods from the 18 NACE industries I270–I510 (manufacturing) that are used as inputs for production in those sectors in the home country. "Manufacturing inputs produced" is the total output of NACE industries I270–I510 that is produced in the home country and used as an input in one of those industries.

For the construction of *CAPITALinter* we used data on "fixed capital consumption" in the input–output table (NACE F080), and values for "capital stock per worker" are taken from the Penn World Tables. Coverage of this variable over countries and years is incomplete.

Descriptive statistics and correlations are given in Tables 5 and 6.

References

Baldwin, R.E., 1970. Nontariff Distortions of International Trade. Brookings Institution, Washington, DC.

Baldwin, R.E., 1984. Trade policies in developed countries. In: Jones, R., Kenen, P. (Eds.), Handbook of International Economics. North-Holland, Amsterdam.

Baldwin, R.E., 2001. The core–periphery model with forward-looking expectations. Regional Science and Urban Economics 31, 21–49.

Beck, N., Katz, J.N., 1995. What to do (and not to do) with time-series cross-section data. American Political Science Review 89, 634–647.

Branco, F., 1994. Favoring domestic firms in procurement contracts. Journal of International Economics 37, 65–80.

Brülhart, M., Trionfetti, F., 2002. Testing trade theories when expenditure is home biased. Mimeo., University of Lausanne.

Davis, D.R., Weinstein, D.E., 2003. Market access, economic geography and comparative advantage: An empirical assessment. Journal of International Economics 59, 1–23.

Emerson, M., Aujean, M., Catinat, M., Goybet, P., Jacquemin, A., 1988. The Economics of 1992: The E.C. Commission's Assessment of the Economic Effects of Completing the Internal Market. Oxford University Press, Oxford.

European Commission, 1997. Single Market Review: Public Procurement. Kogan Page, London.

Head, K., Ries, J., 2001. Increasing returns versus national product differentiation as an explanation for the pattern of U.S.–Canada Trade. American Economic Review 91, 858–876.

Head, K., Mayer, T., Ries, J., 2002. On the pervasiveness of home market effects. Economica 69, 371–390.

Helpman, E., Krugman, P., 1985. Market Structure and Foreign Trade. MIT Press, Cambridge, MA.

Hoekman, B.M., Mavroidis, P.C. (Eds.), 1997. Law and Policy in Public Purchasing: The WTO Agreement on Government Procurement. University of Michigan Press, Ann Arbor, MI.

Krugman, P., Venables, A.J., 1995. Globalization and the inequality of nations. Quarterly Journal of Economics 110, 857–880.
Laffont, J.-J., Tirole, J., 1991. Auction design and favoritism. International Journal of Industrial Organization 9, 9–42.
Martin, P., Rogers, C.A., 1995. Industrial location and public infrastructure. Journal of International Economics 39, 335–351.
Mastanduno, M., 1991. Do relative gains matter? America's response to Japanese industrial policy. International Security 16, 73–113.
Mattoo, A., 1996. The government procurement agreement: Implication of economic theory. The World Economy 19, 695–720.
McAfee, R.P., McMillan, J., 1989. Government procurement and international trade. Journal of International Economics 26, 291–308.
Miyagiwa, K., 1991. Oligopoly and discriminatory government procurement policy. American Economic Review 81, 1321–1328.
Naegelen, F., Mougeot, M., 1998. Discriminatory public procurement policy and cost reduction incentives. Journal of Public Economics 67, 349–367.
Nerb, G., 1987. The completion of the internal market: A survey of European industry's perception of the likely effects. Research on the Costs of Non-Europe: Basic Findings. European Commission, Brussels.
Ottaviano, G.I.P., 1999. Integration, geography and the burden of history. Regional Science and Urban Economics 29, 245–256.
Stewart, J., Gill, I., 1998. Econometrics, 2nd Edition. Prentice-Hall, Englewood Cliffs, NJ.
Trionfetti, F., 2000. Discriminatory public procurement and international trade. World Economy 23, 57–76.
Trionfetti, F., 2001. Public procurement, economic integration, and income inequality. Review of International Economics 9, 29–41.
Vagstad, S., 1995. Promoting fair competition in public procurement. Journal of Public Economics 58, 283–307.
Weichenrieder, J.A., 2001. Public procurement in the presence of capital taxation. Regional Science and Urban Economics 31, 339–353.