Do Mercosur and fiscal competition help to explain recent locational patterns in Brazil?

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Abstract

Brazil experienced important transformations during the nineties. Two major reforms were the general opening of the economy and the constitution of Mercosur. On the other hand, it is a well-documented fact that Brazilian states engaged in an increasingly intense fiscal competition for attracting economic activities. According to theoretical considerations, both phenomena might, in principle, help to understand observed locational patterns changes in the last years. The present paper aims at assessing the role of those factors in the spatial dynamics exhibited by Brazilian manufacturing sector through an econometric analysis similar to Midelfart-Knarvik, Overman, Redding, and Venables (2000) and Midelfart-Knarvik, Overman and Venables (2000). Results suggest a rather robust general pattern of matching between specific industry characteristics and specific state characteristics. Mercosur seems to have had an impact on spatial developments, which is increasing over the period. Further, public aid measures also seem to have exerted an influence; nevertheless, they are only one element in the broad factor set defining locational decisions, in which regional *fundamentals* play a central role, and their relative relevance displays a declining trend.

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1. Introduction

Regional disparities are a distinctive feature of Brazilian economy. Their emergence followed the historical development of Brazil, which was based on an import-substitution industrialization (Cano, 1977). The final phase of the monotonic geographical concentration process can be sited in the seventies. Specifically, in 1970, the joint share in manufacturing value added of Sao Paulo and Rio de Janeiro, the two most developed states in the country, was 73.2% (Pacheco, 1999). Thereafter, it took place a gradual process of industrial de-concentration, whose finalization is dated by some authors in 1985 (Azzoni and Ferreira, 1997; Furquim de Azevedo and Toneto Junior, 1999). In that year, the joint share in manufacturing value added of Sao Paulo and Rio de Janeiro was 61.4%. The process did not evolve symmetrically across industrial sectors; the dispersion trend was specially important for some of them, like the consumption goods industry (Pacheco, 1999). Those spatial developments can be explained in terms of the investment behaviour of federal state-owned firms, the expansion of agriculture and mineral frontiers, active aid policies for certain regions, and high costs and agglomeration diseconomies-mainly congestion costs- in traditional industrial centres (Diniz, 1995; Diniz and Crocco, 1996).

From 1985 on, changes in locational patterns and specifically their direction were object of an intense debate in Brazilian empirical regional literature. Some authors postulate a weakening in the dispersion process and even the occurrence of a re-agglomeration process (Cano, 1997; Azzoni and Ferreira, 1997; Lavinas, García y do Amaral, 1997), other analysts maintain that the de-concentration was circumscribed to an area involving the South region, the hinterland of Sao Paulo, and the remaining Southeast region (Diniz, 1993; Diniz, 1995; Diniz and Crocco, 1996), and, finally, other economists consider that the dispersion process has continued, but a more lower path and with notorious inter-sectoral differences (Prado, 1999)[2].

During that period Brazil experienced multiple transformations. On the one hand, two major structural changes took place: the general opening of the economy (Kume, Piani, and Bráz de Sousa, 2000) and the regional integration through the formation of *Mercosur*, a trade bloc formed by Argentina, Brazil, Paraguay and Uruguay[3]. On the other hand, Brazil witnessed the intensification of a fiscal competition among states for attracting manufacturing activities, which relates to the federal dimension of the country.

Given the large pre-existent regional disparities, the locational implications of trade liberalization and fiscal dispute constitute relevants matters of concern from the economic policy point of view. This mirrors particularly in the numerous references in this respect that can be found in the Brazilian empirical literature about the spatial evolution of the domestic manufacturing sector.

Thus, according to Baer, Haddad, and Hewings (1998), with market-oriented reforms and the increased relative importance of Mercosur countries in Brazilian foreign trade, investment tend to concentrate in the Middle-South region due to the larger consumer market, the higher qualification of workforce and the better infrastructure quality. Diniz (1995) shares this position. Mendes (1997) stresses the dominance of traditional industrial states in trade relationships with Mercosur partners; a single figure can be illustrative of this point: the Southeast and South regions accounted for more than 90% of exports to those countries.

[2] Specifically, according to Diniz, the dispersion was limited to a polygon between the cities of Belo Horizonte, Uberlândia, Londrina/Maringá, Porto Alegre and Florianópolis.

[3] Bolivia and Chile are associated members.

Furquim de Azevedo and Toneto Junior (1999) and Pacheco (1999) state that the Northeast region can attract industries which are labour intensive due to the relatively low manufacturing wage that prevails there. Finally, Prado and Cavalcanti (1999) maintain that Mercosur has played an important role for understanding observed changes in locational pattern in Brazil, specially for certain industries such as transport equipment.

The literature concerning the impact brought about by fiscal competition is also prolific. Thus, Varsano (1997, 1999) states that the ultimate winners of the competition are the financially strong states, which are able to support a tax reduction and at the same time finance suitable services and economic infrastructure for attracting new firms. The Secretary for Fiscal Issues of BNDES (2000) indicates that the fiscal war did not contribute to a reduction in regional inequalities regarding industrial production. Further, states which intensively granted tax cuts seem to be those that experienced a more accentuated relative de-industrialization. Langemann (1995) and Prado and Cavalcanti (1999) also coincide in the criticism on the effectiveness of fiscal incentives. They argue that those measures are only one element in the factor set determining locational decisions, which includes adequate infrastructure, distance to input and output markets, agglomeration economies, appropriate labour force, etc, and, thus, they might be decisive only in a situation of equivalence among involved regions in terms of remaining characteristics.

However, most analyses are essentially descriptive. Formal studies linking locational dynamics, on the one hand, and trade liberalization and fiscal competition, on the other hand, are missing[4]. Hence, additional empirical research is needed in order to reach a better understanding of the role played by those phenomena in the explanation of observed spatial developments during the last years.

The present paper aims at filling this gap. We analyse manufacturing locational patterns in Brazil during the period 1990-1998 by means of an integrated econometric evaluation similar to Midelfart-Knarvik, Overman, Redding, and Venables (2000) and Midelfart-Knarvik, Overman and Venables (2000). Two central questions are then addressed: What are the main determinants of manufacturing locational patterns in Brazil? and, specifically, Did Mercosur and fiscal competition helpt to explain them?

The rest of the paper is organized as follows. Section 2 reviews the relevant theoretical literature with the purpose of providing a structure for the ulterior empirical study. Section 3 presents the data set and a preliminary descriptive examination of Brazilian locational patterns. Section 4 is reports and discusses results from econometric exercises aiming at identifying the determinants of the spatial distribution exhibited by the manufacturing sector. They indicate a general pattern of matching between industry characteristics and state characteristics, in general, and stress the importance of backward and especially forward linkages, in particular. Moreover, industries with highly tradable products tend to locate in states which are nearer Argentina and have a relatively good infrastructure. This effect seems to be increasing over the decade. The evidence does also provide a support for a role of aid policies in the definition of location, but as one out of various factors behind it.

Finally, section 5 concludes.

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[4] The works by Kume and Piani (1998) and Azzoni and Haddad (1999) could be considered exceptions in this respect. The first examines the regional effects of Mercosur through a differential-structural analysis for the period 1990-1995. The second evaluates the effects of trade liberalization on locational patterns through simulations based on a general equilibrium model calibrated for 1985 (a year before the trade reform) and with a *bottom up* approach; the authors find a positive impact for the Centre-South region, which would amplify pre-existent regional disparities.

2. *Theoretical background*

Relevant theoretical contributions to spatial economics can be broadly categorized into three schools of thought: neoclassical theory, new trade theory, and new economic geography (Brülhart, 1998). This section reviews those theoretical approaches, by examining their hypotheses and main results, overviews their predictions in terms of locational consequences of economic integration and surveys the literature relating location and fiscal policies with the purpose of endowing the ulterior empirical analysis with a theoretical structure.

2.1. Location and economic integration

The neoclassical theory

The *neoclassical theory* assumes perfect competition, product homogeneity and non-increasing returns to scale. In this framework, location is exogenously determined by *first nature factors* (Krugman, 1993), namely, the spatial distribution of technologies, natural resources and productive factors[5]. Concretely, locational patterns are essentially defined by the interaction between region and industry characteristics (Venables, 2001) and this basically implies inter-industry specialization, since that *activities settle in locations with a matching relative attribute advantage*. *Thus, industries that, say, intensively use skilled workers tend to locate in regions that are relatively abundant in that factor.*

In this context, the spatial distribution of demand is essentially relevant for trade patterns, but not for locational patterns, unless that trade costs are positive. In particular, if those costs are prohibitive, then the geographical configuration of industries mirrors the one of the demand (Brülhart, 2000).

One relevant question from the point of view of the present work is how can trade liberalization influence the configuration of economic landscape. According to the approach under consideration, the answer is that a general opening induces activities to relatively concentrate in countries with the matching true comparative advantage (Jones, 1965; Brülhart, 1998). In the case of a regional integration process, the influence of comparative advantage considerations on the spatial dynamics has singular aspects. In particular, the launching of a trade agreement among developing countries with different comparative disadvantages relative to the rest of the world that consists of a preferential reduction in tariffs holding invariant protection rate with respect to non- members would induce a relocation of manufacturing to the country that, even with a comparative disadvantage relative to the world, has a comparative advantage within the newly created regional economic space, so that consumers in both countries would be increasingly supplied with manufactures stemming from such a country (Venables, 1999, 2000).

Although relevant, comparative advantage is insufficient to explain the notorious concentration of economic activity observed in reality (Ottaviano and Puga, 1997).

[5] Most neoclassical models are "dimensionless" and deal mainly with trade issues, but, at least in some variants, they have locational implications that can be interpreted in a spatial sense (Brülhart, 2000). As Ohlin (1933) pointed out "the theory of international trade is only a part of a general localization theory" or likewise as Isard (1956) noted "trade and location are two sides of the same coin".

Particularly, there are many regions without obvious natural advantages which develop into economic centres (Krugman, 1993; Schmutzler, 1999). Which other factors can then help to understand factual patterns? The *new trade theory* makes an important contribution in this respect.

The new trade theory

The *new trade theory* combines *second nature elements* and one *first nature element,* the market dimension, which is determined by the size of the working force living in a particular region jointly with the assumption of interregional labour immobility. In general, models within this theoretical approach assume that the world consists of two regions: a big central region and a small peripheral region. The first one has an absolute factorial endowment larger than the second one, but both have the same relative endowment[6]. Moreover, they assume two productive sectors. On one hand, there is a perfectly competitive sector, which operates under constant returns to scale and whose output is costless traded, and on the other hand, there is a monopolistically competitive sector with firms producing differentiated products under conditions of increasing returns to scale which are traded at a positive cost[7].

The typical result of those models is that increasing returns sectors tend to concentrate in locations possessing the better access to the markets of their respective products. In short, *industries with high economies of scale tend to locate in regions with high market potentials.* This result derives from the interaction between scale economies and trade costs. Effectively, under economies of scale, average costs fall as the level of production rises. Then, producers have an incentive to spatially concentrate their activities, because in such a way they can operate at a more efficient level. Nevertheless, increasing returns to scale are not the only relevant consideration. Location decisions are influenced also by trade costs. Actually, firms face a trade off between them. The geographical concentration of production allows to achieve lower average costs, but simultaneously it increases the costs of selling output to disperse customers. Thus, the presence of trade costs induce firms to locate in the country which has the larger market in their goods, since in this form they are able to avoid those costs on a larger fraction of their sales. This ideas was labelled "home market effect".

The locational consequences of economic integration hinge upon the interplay between market size and factor market considerations.

Krugman (1980) and Krugman and Helpman (1985) find that, other things equal, *as trade costs fall towards zero, all increasing returns activities tend to concentrate in the larger country measured in terms of demand size*. Therefore, demand differences amplify differences in production structures. This basic analysis can be extended by allowing for a third country with the purpose of examining the repercussion of a regional integration process, like Torstensson (1995) and Brülhart and Torstensson (1996). Specifically, they assume two size-asymmetric countries forming a custom union and a remaining one as the rest of the world. They show

[6] Thus, there are no comparative advantages.

[7] Most traditional works in location theory rely implicitly or explicitly on the assumption that there exist significant economies of scale driving the concentration of economic activities, like in von Thünen (1826), Weber (1909), Christaller (1933), Lösch (1940) (Krugman, 1998). The essentiality of increasing returns for explaining the geographical distribution of economic activities constitutes the "Folk Theorem of Spatial Economics" (Scotchmer and Thisse, 1992).

that there exists an U-shaped relationship between the share of industrial production located in the large country of the custom union and the deepness of integration.

However, when factor market considerations are conveniently introduced, as in Krugman and Venables (1990), the tendency to locate in the larger market is stronger for values of trade costs that are neither too high nor too low, so that there exists an inverted-U shaped relationship between the degree of relative and absolute spatial concentration of industry in the central region and trade costs. In other words, at intermediate levels of trade costs the number of manufacturing firms located in the large region owing of its better market access is disproportionately large with respect to its share in world endowments (Amiti, 1998). The reason is that when trade costs are sufficiently high, location is mainly determined by product market competition, while when trade costs are sufficiently low the spatial result is fundamentally dictated by factor market competition (Ottaviano and Puga, 1997).

The theory underlying the home market effect can not be viewed as a complete theory of economic geography. Indeed, it assumes rather than explains international differences in manufacturing shares and income (Neary, 2000). Concretely, two main questions are left unanswered by the new trade theory: Why a priori similar countries can develop very different production structures? Why do appear clear patterns of regional specialization, so that certain sectors have a tendency to locate at the same place? The *new economic geography* provides elements which help to rationalize such phenomena.

The new economic geography

The *new economic geography* extends the line of research initiated by the new trade theory by showing that interregional demand differences are themselves endogenous (Amity, 1998). Thus, even the market size is explained within the model by starting from a featureless locus with uniformly distributed labour and output (Brülhart, 2000).

In the presence of increasing returns and trade costs, firms and workers tend to locate close to large markets. But, large markets are in turn those were more firms and workers locate (Ottaviano and Puga, 1997). Thus, there exists a sort of cumulative causation mechanism, which can originate an endogenous differentiation process of initially similar regions, so that, in this case, following the terminology coined by Krugman (1993), *second nature factors* determine the locational pattern (Brülhart, 1998)[8].

[8] The explanation of concentration in terms of a circular causation driven by the interaction among different sectors is far from new. It was already present in the geography and development literature of the 1950 and 1960 decades (Puga and Ottaviano, 1997; Krugman, 1998; Schmutzler, 1999). Thus, Hoover (1954) pointed out that economic interrelations between industries and firms are relevant factors in the determination of the overall location pattern, so that even in the absence of any initial differences, patterns of specialization and concentration of activities would inevitably emerge, not only due to the advantages from concentrating certain businesses in few places, but also from the proximity of related processes and from the closeness of consumers and producers. Myrdal (1957) maintained that the hegemony of prosperous cities is reinforced through *backwash effects* related to the induced selective migration of younger and well qualified workers. Finally, Hirschman (1958) identified a *backward linkage effect*, consisting of the inducement of local supply of required inputs for non-primary activity, and a *forward linkage effect,* consisting of the inducement of local use of locally elaborated output as inputs for other activities.

The *new economic geography* uses two main agglomeration mechanisms for formally modelling the cumulative causation process: interregional labour mobility (Krugman, 1991) and mobility of firms demanding intermediate inputs (Venables, 1996)[9].

The basic idea postulated by Krugman (1991) is that if factors, namely, industrial workers, are mobile across regions, the countervailing pressure against agglomeration exercised by the behaviour of factor markets would be eased, so that firms could exploit the demand linkages to each other workers and a persistent concentration would take place[10].

Venables (1996) shows that the agglomeration could be induced by the presence of input-output linkages among firms[11]. When imperfect competitive industries are linked through an input-output structure and trade costs are positive, the downstream industry forms the market for upstream firms and the latter are drawn to locations where there are relatively many firms of the former industry (backward linkage). Moreover, the fact of having a larger number of upstream firms in a location benefits downstream firms, which obtain their intermediate goods at lower costs, by saving transport costs and also benefiting from a larger variety of differentiated inputs (forward linkages). Hence, the joint action of those linkages might result in an agglomeration of vertically linked industries (Amiti, 1998) and could give such an equilibrium location a certain inherent stability (Venables, 1996). In this sense, the reasoning provides a rationale for the notion of industrial base.

Hence, *industries that intensively use manufacturing intermediate goods in the production process and whose demand comes to a large extent from the manufacturing sector tend to locate in regions with broad industrial bases.*

New economic geography models show that, under scale economies, labour migration and input-output linkages between firms lead to industry concentration in one region when trade costs between two initially identical regions are reduced. However, this might be only the beginning of the process. When relevant centrifugal forces related to the induced dynamics in factor markets are taken into account, the already mentioned U-curve pattern emerges again (Venables, 1996; Ludema and Wooton, 1997; Puga 1998). Thus, *at early stages of integration, concentration forces dominate and industry tends to cluster, but further integration, beyond certain threshold, promotes a re-dispersion towards the periphery, which offers lower factor costs.*

How does economic integration affect the internal geography of a country? Krugman and Livas Elizondo (1996) by developing a variant of Krugman's (1991) model which allows for three spatial units and interregional labour mobility (but no international one) shows that trade liberalization tends to promote a dispersion of manufacturing activities. A reduction in trade costs weakens backward and forward linkages by increasing the gravitation of external markets, as significant part of output becomes to be sold abroad and a significant part of consumed output becomes to be imported. As a consequence, centrifugal forces originated in

[9] There are also inter-temporal mechanisms related to factor accumulation (Baldwin, 1997) and to input-output linkages with an innovative sector (Martin and Ottaviano, 1996).

[10] The crucial point is that for industry agglomeration to occur it must be possible for firms to draw resources from elsewhere, particularly from other regions or from other sectors, so that the factors supply becomes sufficiently elastic and consequently large increases in factor prices are avoided (Puga, 1998).

[11] The benefits associated with a close location of vertically linked industries were identified by Marshall (1920). The potential importance of intermediate inputs in models of monopolistic competition of international trade was highlighted by Either (1982).

high land rents/commuting costs associated to agglomeration become dominant and the configuration of manufacturing activities moves towards a more dispersed one[12]

A similar argument can be made in terms of input-output linkages (Krugman and Livas Elizondo, 1996). It is even possible to define a cross-sectional pattern among industries. Specifically, the relative intensity of their linkages determines the relative speed in changes in spatial configuration (Fujita, Krugman, and Venables, 1999). In particular, activities with weaker forward and backward linkages may be more easily detached from existing centres. This is precisely the case of industries whose intermediate manufactured inputs and output are easily traded, respectively (Venables, 2001).

Note that the conclusion that trade liberalization tends to favour internal dispersion assumes a featureless space. If specific locational advantages are introduced, then it is possible to assess the direction in which manufacturing activities move. The typical example is provided by Hanson (1994, 1998). The argument is that *the opening of the economy might induce a relocation of those activities towards places with good access to relevant foreign markets.* This would suggest that if traditional centres are located in well-situated regions regarding foreign trade, then industry may not disperse. Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicaud (2000), in their turn, maintain that *if a region has a central location, that is, it is in the crossroads of two economically important regions, it may be become an industrial base, if the local market is large enough.*

2.2. Location and fiscal policy

Previously reviewed results do not have a general validity. They are not neutral to concomitant policies. In other words, the effects of economic integration on the distribution of activities across geographical units could be at least partially altered by accompanying economic policies. In this respect, it is well known that fiscal policy can also contribute to shape the economic landscape.

Trionfetti (1997) shows that public expenditures and transfer programs exert a significant influence on the location of industrial activity. If public procurement is somehow biased towards local production, in particular, if there is a market for public procurement that only can be accessed by locating production in the region, then local demand is artificially higher than it would be in a situation in which only private agents existed. Thus, this market segmentation elevates the attractiveness of the region as a location for industry, which tends to locate where the demand is higher. Specifically, because of internal economies of scale, discriminating government procurement generates a positive relationship between the level of public demand and the number of firms belonging to the monopolistic competitive sector located in the corresponding region (Brülhart and Trionfetti, 1998)[13]. This policy engenders

[12] Henderson (1996) and Isserman (1996) critic the argument by adducing that it depends on certain crucial simplifying assumptions mainly the association between economic centre and manufacturing centre and the non-tradability of agriculture goods. First, real world centres are not only manufacturing ones, but also government centres, financial centres, etc; thus, it is not unlikely that centres also benefit from trade liberalization. Second, peripheral regions could be adversely affected from the imports of agriculture goods (Schmutzler, 1999).

[13] Trionfetti (1997b) shows that, under such an arbitrary partition between foreign and domestic goods ("European system") the relative importance of trade costs as force shaping the economic landscape is greatly reduced. On the contrary, if goods are acquired regardless of the geographical location of producers ("American system"), trade costs play the traditional role in driving specialization and concentration.

"pull effects" and "spread effects". For monopolistically competitive sectors, a region with a large home-biased government expenditure on a certain good tends, other things equal, to host a relatively large share of total production of that good and to specialize in it. On the other hand, home-biased public expenditure (when symmetrically large) by acting as a dispersion force may reduce the likelihood and intensity of agglomeration of increasing returns industry (Brülhart and Trionfetti, 2002)[14].

Fiscal measures can also take the form of an improvement in infrastructure. In fact, an infrastructure–aid may have an important influence on the locational pattern resulting from economic integration (Martin and Rogers, 1994, 1995).

The quality of infrastructure determines interregional and internal trade costs[15]. Under this hypothesis, a bad infrastructure implies that a large proportion of produced and traded goods are not effectively consumed by country's residents or foreigners, but that they "disappear" in the transportation process. In this context and in the presence of scale economies, *economic integration tends to generate a geographical concentration of firms in the region with better infrastructure*, since it means a low effective price and a higher relative demand for goods produced in such territories[16].

One can then naturally think about the possibility of fiscal competition among regions in this respect. Keen and Marchand (1997) show that *the competition might affect the composition of public spending by biasing it towards public inputs entering the production function of firms (infrastructure-general training expenditures) and against items conferring direct consumption benefits (recreational facilities, social services or re-distributional payments to poorer groups).*

Obviously, the stimulus for industrial activities could come not only from the expenditure side, but also from the revenue side. Thus, on the other hand, one should count the concession of tax cuts among promotion tools, since they tend to increase *ceteris paribus* the relative profitability of the firms that decide to localize their plants in the grating region.

We know, since Oates (1972) and Gordon (1983), that a policy of tax reductions could also generate a competition among regions. The modern theory of tax competition assumes coexistent immobile and mobile production factors and politically sovereign jurisdictions and tries to explain the potential efficiency problems arising from the competition among them for the second ones. The basic idea can be summarized as follows. Under the assumption of fixed total capital stock and perfect interregional capital mobility, when one region rises its tax rate, it takes places an outflow of capital from it that benefits other regions by expanding their capital supplies, that is, there exists a positive externality, which the regional government does not take into account, since it is only interested in the welfare of its own residents[17]. Consequently, it sets tax rates and public goods provision at inefficiently low levels (Wilson, 1999). Concretely, tax competition for mobile factors distorts downwards the taxation on them, because of the non-internalised externality on other jurisdictions that

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[14] Brülhart and Trionfetti (2002) also corroborates the so-called Baldwin's neutrality proposition, namely, home bias in government procurement does not affect international specialization in perfectly competitive sectors.

[15] Martin and Rogers (1994) employ a broad definition of infrastructure, so that it does not restrict to physical infrastructure, but it also comprises any facility, good or public-sector-provided-institution like law or order which enhances the juncture production-consumption.

[16] The result would be ambiguous if the country with poorer infrastructure has a lower capital/labour ratio, since in this case it would supply a higher capital return.

[17] If the supply of capital is variable for the regions as a whole, then an increase in the tax rates by a subset of them could induce a reduction in total savings and thereby a diminution in the capital amount redirected to other regions.

comes along with one jurisdiction's tax diminution. *In a symmetric equilibrium, fiscal measures compensate and location is not affected.*

The previous analysis assumes the prevalence of perfect competition conditions and absence of trade costs or market size differentials. A new research line in the economic theory explores the joint explaining potential of the tax competition literature and some elements of the new trade theory, like imperfect competition, market size differentials and trade costs (Haufler and Wooton, 1999).

On the one hand, we can identify a set of papers relating imperfect competition and tax competition. For example, some recent studies combine oligopolistic behaviour and international mobility of firms when government compete either through local public inputs (Walz and Wellisch, 1996) or profit taxes (Janeba, 1998)[18].

On the other hand, several contributions to this strand have assumed conditions of perfect competition, but have introduced asymmetries between involved countries, typically in the form of different sizes, measured through the number of residents (Bucovetsky, 1991; Wilson, 1991; Kanbur and Keen, 1993; Trandel, 1994). A general conclusion emerging from these studies is that, in situations of international competition for mobile factors or consumers, the small country faces the more elastic tax base and consequently chooses the lower tax rate. Since the larger country is the relatively larger demander in the capital market, an increase in its tax rate depresses the after-tax return on capital by a relatively large amount. Thus, the cost of capital is less sensitive to tax changes in the larger country than in the small one, so that the former will compete less vigorously for capital through tax rate reductions and will end up with the higher tax rate. Hence, the small country attracts a more than proportional share of mobile factors or consumers and achieves the higher per capita utility level in the resulting Nash equilibrium, relative to the large country (Haufler and Wooton, 1999)[19].

None of those works explicitly considers the role of trade costs between regions. Such factor was introduced in the analysis by Haufler and Wooton (1999), who study the way in which it interacts with differential market size in influencing the tax result and the consequent locational configuration within the overall region, that is to say, once the (monopolist) firm has decided to invest in it rather than exporting from the home region. They find that, when governments can only use a lump-sum profit tax (subsidy) and face exogenous and identical transport costs for imports, then both regions will be willing to offer a subsidy to the firm and that the firm prefers to locate in the larger market where it can charge a higher producer price[20]. Therefore, in equilibrium, *the large region gets the firm* and could even charge a positive tax, to the extent that there is a sufficiently large difference in national sizes. Thus, in this environment, the answer to the question whether the large or the small country "wins" the competition for internationally mobile capital reverses. In concrete terms, *larger regions are in a better position to attract (increasing returns) activities.*

[18] Note that, models of the new trade theory and the new economic geography utilize a monopolistic competition framework à la Dixit-Stiglitz (1977), which precludes strategical interactions proper of oligopolistic settings.

[19] Alternatively, asymmetric tax competition between two regions might lead one region to opt for over-providing the public good relative to the rule for efficient provision. Effectively, differences in regional sizes may cause one region to export capital to the other; the capital-importing region has an incentive to restrict such imports, thereby reducing the required after-tax return on capital and consequently enhancing its "terms of trade". The underlying reason is the existence of a pecuniary externality (Wilson, 1999).

[20] As can be expected, the result obeys to the fact that by locating in the larger market most trade costs can be avoided.

Finally, the incorporation of an agglomeration mechanism, like interregional labour mobility (Krugman, 1991) or input-output linkages (Venables, 1996) in the setting defined by the conjunction of imperfect competition and trade costs leads to a recent strand in the literature here examined, which combines the new economic geography and tax competition developments.

This research line stresses also the idea of taxable rents related to agglomeration trends but additionally postulates that the intensity of competition can be endogenous to the deepness of trade integration (Kind, Midelfart-Knarvik, and Schjelderup, 1998; Anderson and Forslid, 1999; Ludema and Wooton; Krugman and Baldwin, 2000). The probability of intensification in the tax competition is higher when disparities in market size/production structures between integrating regions are small. Thus, Anderson and Forslid (1999) show that an economic integration between similar regions with respect to their industrial bases intensifies the competition for manufacturing through tax cuts on mobile factors, since, as trade costs decline, agglomeration forces become stronger and this raises the probability that one region emerges as the dominant. Ludema and Wooton (2000) find that economic integration increases the responsiveness of labour to tax differential and henceforth tax competition only when agglomerative forces are no sufficiently strong or the interregional mobility of labour is low in order to render possible an equilibrium with a core-periphery pattern. On the contrary, under an asymmetry scenario, there exists and inverted-U shaped relationship between the core-periphery tax gap and trade costs originated in the underlying inverted-U shaped relationship between the strength of agglomerative forces and trade costs (Anderson and Forslid, 1999; Krugman and Baldwin, 2000; and Ludema and Wooton, 2000). These forces generates then taxable rents for the country hosting industrial agglomeration, which are an increasing function of the degree of interregional labour mobility and/or the importance of input-output linkages. Effectively, according to Anderson and Forslid (1999), economic integration between one country with a large industrial sector and one country with a small industrial sector increases the scope for taxation for the first one, because of the reduction in the incentive for producing in the other country which relates to tariff savings. Ludema and Wooton (2000) maintain that if a core-periphery pattern can effectively emerges as an equilibrium, then integration reduces the labour responsiveness to tax differentials; the reason is that, once workers are concentrated in the core, any measure that strengths agglomeration forces such as a diminution of trade costs or raises the degree of spatial labour mobility deepens the tendency to remain where they are. Moreover, economic integration brought about through a lowering of trade costs can give rise to an attenuation of tax competition regardless of how does the responsiveness degree of labour with respect to tax differential vary and can even generate an increase of taxes in the interval in which the agglomerative forces reach their maximal potency. The explanation is that given the existence of a forward linkage, the so-called "consumer price effect", when workers emigrate from a country, domestic production falls and complementary foreign production rises, so that local consumers depend more heavily on imports. These purchases are subject to trade costs. Therefore, the relocation process causes a rise in domestic consumer price, whose magnitude is a decreasing function of the level of trade costs. Hence, a reduction of such costs implies a diminution of the costs coming from a tax increase. In short, as Krugman and Baldwin (2000) suggest, the fact that the industry earns more by locating in the core is known by the corresponding government, which can set a higher tax than the periphery does, as long as the difference is not sufficiently large.

3. Descriptive empirics

3.1. Data and measurement

In the empirical literature, the basic unit of analysis is normally the activity level of an industry in a certain geographic space. There are different alternatives for quantifying that level. Particularly, it has been measured through the value added (WIFO, 1999), the gross value of production (Midelfart-Knarvik, Overman, Redding, and Venables, 2000), and the level of manufacturing employment (Brülhart and Torstensson, 1996; Brülhart, 2000)[21].

Brazil has no disaggregated data on manufacturing production at state level since the industrial census of 1985. There are some estimations of such values, which result from an updating of the values registered in 1985 through production indices elaborated by IBGE for some regions and some specific states (Kume and Piani, 1998).

The fact that economic census ceased after 1985 coincided with a multiplication of regional studies relying on occupation indicators (Andrade and Serra, 1998)[22]. This paper follows a similar approach. Specifically, we adopt the industrial employment as the reference variable and the state as a reference geographical unit.

Formally, the employment level of industry k in state i at time t is denoted by $x_{ik}(t)$. This value may be expressed as a share of the total employment in the industry, in which case we have:

$$(1-a) \quad s_{ik}(t) \equiv \frac{x_{ik}(t)}{\sum_i x_{ik}(t)}$$

and for the whole manufacturing industry,

$$(1-b) \quad s_i(t) \equiv \frac{\sum_k x_{ik}(t)}{\sum_i \sum_k x_{ik}(t)}$$

Alternatively, the employment level may be expressed as a share of overall manufacturing employment in the state, in which case we have:

$$(2-a) \quad z_{ik}(t) \equiv \frac{x_{ik}(t)}{\sum_k x_{ik}(t)}$$

and for the whole country,

$$(2-b) \quad z_k(t) \equiv \frac{\sum_i x_{ik}(t)}{\sum_i \sum_k x_{ik}(t)}$$

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[21] There is a debate in the empirical literature about the convenience of using value added or gross production value as an indicator for activity level. Midelfart-Knarvik, Overman, Redding, and Venables (2000) argue that the use of value added makes the analysis more vulnerable to structural shifts in outsourcing to other sectors.

[22] See Furquim de Azevedo and Toneto Junior (1999), Pacheco (1999), and Saboia (2000).

The principal data set, a part of *RAIS*, was provided by the Brazilian Ministry of Works[23]. It covers the period 1990-1998 and presents information about the 21 manufacturing industries identified in the *IBGE* (Brazilian Statistical Bureau)-classification for each one of the 27 states integrating the Brazilian federation.

One important aspect of those data set deserves a comment. *RAIS* is an administrative report filed by all tax registered Brazilian establishments. The information contained in the base may be used for controlling labour legislation compliance, so that firms not observing the law do not appear in *RAIS*. Hence, *RAIS* might be visualized as a census of *formal* Brazilian employment (Fipe-USP, 2001)[24].

Therefore, the use of employment data for studying locational issues is essentially correct under one main condition. Because of the fact that collected statistics refer to formal employment, the informality ratio must be also similar across geographical units (Andrade and Serra, 1998) and across industries in order to avoid that differences in this respect distort the interpretations made on them. With reference to this point, we could mention that differences in the informality degree among the most important metropolis seem not to be high (Andrade and Serra, 1998)[25].

The locational inferences extracted from the employment data utilized in this case could be viewed also as a rough indicator for locational development at production level. For this to be correct it is necessary that the productivity of industrial workforce not to be significantly different across the relevant geographical units (Andrade y Serra, 1998) and across sectors.

The data set *RAIS* is combined with national production statistics from the System of National Accounts divulgated by *IBGE*, which allows a proper characterization of industries in terms of factor intensities, cost structures, and sales orientation, and with regional data from *IBGE, IPEA* (Institute of Applied Economic Research), *GEIPOT* (Brazilian Firm of Transport Planification), *DNER* (National Department of Routes) and *CNI* (National Confederation of Industries), which allow a suitable characterization of states in terms of their endowments (broadly conceived) and policies.

3.2. Spatial distribution of manufacturing employment

The Brazilian manufacturing sector has experienced a decline in its absolute size as measured by the level of employment during the nineties. The last row of table A2.1a in Appnedinx A2 shows the average number of employees in the manufacturing sector (in millions) in the three years sub-periods in which the whole sample period of 9 years was divided: 1990-1992, 1993-1995, and 1996-1998. The contraction in the industrial workforce reaches almost a half million employees between the first and the last sub-periods and measured annually almost one million employees between 1990 and 1998.

Under this scenario of general reduction in the total manufacturing labour force, there have been also noticeable modifications in the spatial pattern of employment.

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[23] RAIS (Relacao Anual de Informacoes Socias) is an Annual Social Information Report.

[24] FIPE tested the representativeness of the *RAIS* data set by comparing the information it contains on formal sector workers with the one from the household survey *PNADS* conducted by *IBGE*. The results suggest that the statistics using *RAIS* are very close to the *PNADS* statistics.

[25] For the main Brazilian metropolitan regions the informality rate, measured as the ratio of employees without "carteira" to the total occupied personal, ranged from 20.15% in Porto Alegre to 26.74% in Recife in 1995.

First, it is worth to remark the significant diminution in the share of the traditional Brazilian industrial region, the Southeast Region, which lost more than 5 percentage points between 1990-1992 and 1996-1998, and, on the other hand, the opposite behaviours in the South Region, whose share gain represents almost 60% of the fall in the former region, and in the Middle-West Region, which accounts for other 30% of such amount. In relative terms, that is to say, with respect to the initial share, this last region registered the most impressive expansion (75%).

Second, notice that changes were not uniform across states within the same region. Thus, the decline in the share of the Southeast Region might be explained through the developments in two states, Rio de Janeiro and fundamentally Sao Paulo; Minas Gerais, in its turn, has increased its share and has displaced Rio de Janeiro as the third industrial state according to the relative importance in overall employment. On the other side, the increase in the share of the South Region obeys to the manufacturing dynamics exhibited by Paraná and Santa Catarina; Rio Grande do Sul presents a much more modest rise, which mainly took place in the second sub-period and even reverted in the third one.

Finally, we can remark the performance of Rondonia in the North Region, which doubled its share and accounted for almost the half of the slight increase in the regional share along the period, and of Ceará and Pernambuco in the Northeast Region, which show opposite trends in their shares, increasing in the first case and decreasing in the second one.

3.3. Sectoral composition of manufacturing employment

Food products; clothing and footwear; and metallurgy are, in this order, the three first ranked industries according to their shares in total manufacturing employment (table A2.1b). They jointly accounts for more than one third of such total. The most salient case is the first one, which increased its share 3.6 percentage points thanks to the absorption of more than new 106.000 employees between the first and the third sub-periods in a context of general contraction in employment levels.

Under this group it is possible to identify two other groups with defined behaviour patterns. On the one hand, industries accounting for 4%-7% of total manufacturing employment, such as electrical and communication equipments; textiles; chemicals; mechanics; and transport equipments, which experienced the most significant share losses. On the other hand, industries accounting for 0.5%-4% of total manufacturing employment, such as beverages; printing and publishing; woods; plastics; furniture; and perfumes, soaps, and candles, which showed share gains (with the exception of other products).

3.4. State characteristic bias of industries

One interesting issue to be considered is whether particular industries tend to locate in particular states. In order to address such question it is very helpful to use the notion of *State Characteristic Bias of Industries (SCI)* utilized by Midelfart-Knarvik, Overman, Redding, and Venables (2000). The index, which summarizes state characteristics for each industry, is computed by averaging characteristics of the states in which the relevant industry is located and by weighting each state characteristic by the share of the state in national manufacturing employment in the sector. Formally,

(3) $SCB_k(t) \equiv \sum_i s_{ik}(t)\varpi_i(t)$

where ϖ_i denotes a certain characteristic of state *i*. The characteristics set include: population share (*pop*), agriculture abundance (*ags*), average manufacturing wage (*mws*), skill abundance (*edus*), centrality/market power (*mp*), industrial GDP (*inds*), distance to Buenos Aires (*dist*), infrastructure (*inf*), and an index of "aggressiveness" in fiscal policy for attracting activities (*fis/aid*). A precise definition of each variable can be found in appendix A.1..

The sample contains 21 industries. In order to simplify the presentation (and introducing the formal analysis of the next section), we rank industries in decreasing order according to the respective average score over the period 1990-1998 in different characteristics and then we group them following a 7-industry categorization procedure, so that industries ranked among the top 7 receive a *H* (high), industries ranked among the middle 7 receive a *M* (medium), and industries ranked among the bottom 7 receive a *L* (low). Table A2.2 in Appendix 2 includes the following characteristics: agriculture intensity (*agi*), skill intensity (*edui*), labour intensity (*lcva*), economies of scale (*scn*), industrial intermediate consumption (*ici*), intermediate consumption from own sector (*icos*), sales to industry (*si*), final demand bias (*fd*), tradability (*trad*), and tax intensity (*ti*). As already mentioned, the definition of variables can be found in appendix A.1.. Then, for each state characteristic industries are grouped following the already described 3-category procedure according to a relevant industry characteristic. Specifically,

Table 1. Pairing between state and industry characteristics

State characteristic	***Industry characteristic***
Population	Final demand bias
Agriculture abundance	Agriculture intensity
Average manufacturing wage	Labour intensity
Skill abundance	Skill intensity
Centrality/Market power	Economies of scale
Industrial GDP	Industrial intermediate consumption
Industrial GDP	Sales to industry
Distance to Buenos Aires	Tradability
Infrastructure	Tradability
Fiscal policy	Tax intensity
Fiscal policy	Economies of scale
Aid policy	Economies of scale

Figures A2.1 have been constructed such that the vertical axis reports the state characteristic and the horizontal axis shows time. In all cases, we use a simple two-years moving average.

Graphs allow to corroborate a general pattern of matching between industry characteristics and state characteristics. Thus, skill intensive industries tend to locate in skill abundant states and industries which have important input-output linkages, that is, consume intensively industrial goods and devote a high share of its sales to manufacturing industries tend to locate in states with high shares in industrial GDP. Further, industries that are tax intensive and present high returns to scale tend to locate in states with aggressive fiscal policies, as measured by the indicator combining expenditure biases and tax cuts. This pairing picture replicates for industries with important economies of scales when the fiscal action indicator restricts to aid measures.

On the other hand, industries that intensively use labour tend to locate in states with relatively low average manufacturing wage and industries with highly transable products exhibit a bias towards locations nearer Buenos Aires[26]. In the last case, it is interesting to note that, while industries whose products score highest in tradability remain roughly constant with respect to the distance, industries with intermediate tradability have clearly tended to be drawn nearer Buenos Aires.

In the case of population, the correspondence does not seem to apply. Moreover, the match between infrastructure and tradability is not exactly, but there is an incipient movement in this direction towards the end of the period. Finally, it can be seen that it took place a slight reversion in the case of centrality/market potential such that industries with intermediate economies of scale became those which show the strongest bias to states with larger market potentials. This might well be related to the association between fiscal policies and increasing returns previously mentioned if most aggressive states in fiscal competition do not provide good access to markets, a redefinition of relevant centrality in view of the opening of the economy, and the phenomenon of downsizing that verified in Brazilian manufacturing industry[27].

One final remark should be done. Unlike the index used by Midelfart-Knarvik, Overman, Redding, and Venables (2000) and with the obvious exception of "Distance to Buenos Aires", in this case, state characteristics vary over time. This could raise some endogeneity driven concerns. In order to account for the fact that state characteristics may be influenced by locational developments, the same exercise was replicated by fixing state characteristics at the initial sample year. Formally, $SCB_k(t) \equiv \sum_i s_{ik}(t)\varpi_i(1990)$. Also in this case, results convey essentially the same message.

3.5. Industry characteristic bias of states

The issue of the particular industries different states are specialized in or specializing in can be addressed with the help of the counterpart of the concept of *State Characteristic Bias of Industries* (SCB), namely, the *Industry Characteristic Bias of States* (ICB), also proposed by Midelfart-Knarvik, Overman, Redding, and Venables (2000). The idea is to compute, for each state, the average score on each industry characteristic, and to weight each of them by the share of the industry in the state manufacturing employment. Formally,

$$(4) \quad ICB_i(t) \equiv \sum_k z_{ik}(t)\theta_k(t)$$

where θ_k is a set of industry characteristics, particularly, those listed in the previous sub-section.

By averaging across years, we can proceed to describe the *Industry Characteristic Bias* of Brazilian states over the nineties. Table A2.3 in Appendix 2 presents the results from classifying states according to the already used 3-category procedure for each industry feature.

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[26] In the present context, tradability is used as a measure indicating the inverse of the magnitude of the trade costs for the relevant sector.

[27] This issue will be formally discussed in the next section.

Some regional regularities can be detected. Rio de Janeiro, Minas Gerais, Sao Paulo, Rio Grande do Sul, Paraná, and Santa Catarina, which belong to the Southeast and South region, tend to have industrial structures characterized by low/medium final demand bias, low agriculture intensity, high skill intensity, medium/high labour intensity, high industrial intermediate consumption, medium/high importance of industry as outputs purchaser, high tradability, and low/medium tax intensity[28].

For Northern states, the picture is notably different. They have a bias towards industries with medium/high agriculture intensity, low/medium skill intensity, low returns to scale, low/medium industrial intermediate consumption, low/medium share of industry in total demand, and low tradability.

In the case of Northeaster states, we observe a tendency to specialize in industries with high final demand bias, medium/high agriculture intensity, low/medium skill intensity, medium/high economies of scale, intermediate tradability, and medium/high tax intensity.

Finally, the states forming the Middle West region exhibit a bias towards industries characterized by medium/high agriculture intensity, intermediate returns to scale, medium/low industrial intermediate consumption, low share of industry in total demand and high tax intensity.

Table A2.3 reports a categorization of states based on simple averages over the decade. Given the changes that the spatial configuration of manufacturing sector have experienced during that period, we should expect variations in the biases exhibited by state's industrial bases. Those changes could be identified by comparing rankings in the initial and the final sub-periods.

Tables A2.4a and A2.4b allow to note that most re-categorizations did take place among states belonging the North, Northeast, and Middle West regions. States in the Southeast and South regions, on the contrary, exhibit lower change frequencies and thus relative more stable industrial structures in terms of sectoral biases[29]. Regarding the South region, two interesting modifications deserve mention. On the one hand, two out of three category variations for Rio Grande do Sul (*scn* and *si*) amount to a convergence with respect to its neighbours. On the other hand, Paraná and Santa Catarina increase in relative terms their biases towards sectors with highly tradable products. An opposite movement can be seen in three states of the Northeast region, namely, Pernambuco, Alagoas, and Sergipe. Some Northern states accentuate their bias to industries that heavily depend on agriculture inputs, like Acre and Rondonia, while other states reduced this bias at the time they increased their bias towards labour-intensive sectors, such as Pará and Roraima. States in the Northeast region, show, on average, a declining bias towards high increasing returns industries, while Minas Gerais, Rio de Janeiro, and Rio Grande do Sul augmented it. Finally, in the Middle West Region we can to detect an increasing hegemony of sectors whose outputs are essentially devoted to final consumption by households and that intensively use agriculture inputs[30].

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[28] In the case of economies of scale, it is not possible to detect a clear pattern, but notice that Sao Paulo has a bias towards industries with high increasing returns to scale.

[29] From the column perspective, observe that *edui, ici,* and *trad* register the lowest number of modifications.

[30] An alternative way to identify commonalities consists of performing a cluster analysis for each sub-period. Results from the Mac Queen's K-means method reveal that Minas Gerais, Rio de Janeiro, Sao Paulo, Santa Catarina, Paraná, Bahía, Amazonas, Sergipe, and Distrito Federal belong to a same cluster in term of the biases of their industrial structures. On average, it characterizes through low agriculture intensity, low final demand bias, high skill intensity, high increasing returns to scale, high industrial intermediate consumption, high

4. Econometric Analysis

The previous section presented some preliminary partial evidence on possible explanatory variables of observed geographical developments. In particular, we have attempted to associate locational patterns with some industries and states characteristics, but we have done it in such a way that only one of them was considered at time. However, actual location is the resultant of multivariate interactions between industry and state characteristics (Midelfart-Knarvik, Overman, Redding, and Venables, 2000). Industries and states do not differ in only one feature, but their differences are multi-dimensional, as can be easily inferred by simply looking at tables A2.3 and A2.4. Thus, industries have distinct intermediate inputs structures, different biases in the main destination of their sales, might be subject to increasing returns to scale of varying degree, and may face different trade costs. On the other hand, states differ in their industrial base, the access they provide to important markets, their endowments such as the abundance of agriculture products and the skill level of their population and the fiscal policies they implement. The spatial distribution of industries may be not attributed to only one of those characteristics, but to a set of them and their interactions. Obviously, not all here considered factors need to be equally significant for the phenomenon under examination. In other words, the relevant question is: which interactions are really important for explaining the geographical configuration of Brazilian manufacturing sector? and specifically, do Mercosur and the fiscal competition among states help to understand it? In order to address this issue, the current section presents an econometric analysis based on several exercises. First, the central hypotheses are described. Second, some estimation issues are discussed and the specification is defined. Third, the main results are reported.

4.1. Main Hypotheses

Locational patterns in Brazil are described through the distribution of state shares in the national employment level for each industry, the s_{ik} variable (section 3). The approach that we follow in order to explain them has been previously used by Ellison and Glaeser (1999); Midelfart-Knarvik, Overman, Redding, and Venables (2000); and Midelfart-Knarvik, Overman, and Venables (2000). Generally, the idea is that industries that intensively use a given "factor" tend to locate in states that are relatively abundant in this "factor" (Midelfart-Knarvik, Overman, Redding, and Venables, 2000)[31]. Hence, if states differ in their endowments of educated population, then industries that intensively used well educated

importance of industry in total demand, high tradability, and low transport intensity. Towards the end of the period, there are signs indicating the incorporation of Rio Grande do Sul to that cluster and the exit of Bahía. On the other hand, Acre, Pará, Tocantis, Rondonia, and Maranhao form a cluster whose main distinguishing features are intermediate final demand bias, low scale economies, low tradability, and high transport margin. Ceará and Amapá belong to such a cluster in the first sub-period, Roraima enters into it in the second sub-period, and Rondonia leaves it in the third sub-period. Finally, Alagoas, Pernambuco, Goiás, and Mato Grosso do Sul are stable members of a cluster presenting an industrial structure with the following attributes: high final demand bias, high agriculture intensity, intermediate scale economies, and intermediate transport intensity. Paraíba and Rio Grande do Norte are initially parts of the cluster, but they leave it in the second and third sub-periods, respectively, while Mato Grosso become a member in the second sub-period.

[31] Torstensson (1997) and Brülhart and Trionfetti (1998) also employ interaction terms between country and industry characteristics in order to explain trade patterns among developed countries and locational patterns in Europe, respectively.

workers will be drawn to states with relatively high shares of them. Operatively, this implies to explain the locational patterns through a set of interactions resulting from a specific pairing of industry characteristics and states characteristics. The particular correspondence of those characteristics is defined on the basis of the relevant theories, which have been reviewed in the second section. Those interactions terms will be considered next in detail.

Table 2. Explanatory variables

Regressions				
Category	**Explanatory variables**		**Name**	**Dimension**
State characteristics	Agriculture abundance		ags	S.T
	Human capital abundance		edus	S.T
	Average manufacturing wage		mws	S.T
	Population share		pop	S.T
	Industrial GDP share		inds	S.T
	Centrality		mp	S.T
	Infrastructure		inf	S.T
	Distance to Buenos Aires		dist	S..
	Fiscal policy		fis(*)	S.T
	Aid policy		aid(*)	S.T
Industry characteristics		Agriculture intensity	agi	.IT
		Human capital intensity	edui	.IT
		Labour intensity	lcva	.IT
		Final demand bias	fd	.IT
		Industrial intermediate consumption	ici	.IT
		Sales to industry	si	.IT
		Economies of scale	scn	.IT
		Trade intensity	trad	.IT
		Tax intensity	ti	.IT
Interaction terms	Agriculture abundance	* Agriculture intensity	agsi	SIT
	Human capital abundance	* Human capital intensity	edusi	SIT
	Average manufacturing wage	* Labour intensity	mwslcva	SIT
	Population share	* Final demand bias	popfd	SIT
	Industrial GDP share	* Industrial intermediate consumption	indsici	SIT
	Industrial GDP share	* Sales to industry	indssi	SIT
	Centrality	* Economies of scale	mpscn	SIT
	Infrastructure	* Trade intensity	inftrad	SIT
	Distance to Buenos Aires	* Trade intensity	disttrad	SIT
	Fiscal policy	* Tax intensity	fisti(*)	SIT
	Fiscal policy	* Economies of scale	fisscn(*)	SIT
	Fiscal policy*Centrality	* Tax intensity	mpfisti(*)	SIT
	Aid policy	* Tax intensity	aidti(*)	SIT
	Aid policy	* Economies of scale	aidscn(*)	SIT
	Aid policy*Centrality	* Tax intensity	mpaidti(*)	SIT

Note: (*) Alternatively or pairwise combined.
S.T: Variables that vary across states and years, but not across industries.
.IT: Variables that vary across industries and years, but not across states.
SIT: Variables that vary across states, industries, and years.

Table 2 presents the state characteristics, the industry characteristics and the interactions of them that are used in the econometric exercises[32]. It specifies also the dimensions on which variables vary.

The first three interaction variables aim at capturing the contribution of *comparative advantage* considerations, as stressed by the neoclassical theory. Thus,

Hypothesis 1: Industries which intensively use agriculture inputs tend to locate in states in which agriculture accounts for an important share of total production[33].

Hypothesis 2: Industries which intensively use skilled workforce tend to be drawn to states which are relatively well endowed with skilled labour.

Hypothesis 3: Industries with relatively high use of labour in the production process show a propensity to locate in states with relatively low average manufacturing wage[34].

The next interaction terms apprehend several aspects related to the *new trade theory* and the *new economic geography*, as they refer to the interplay between trade costs, scale economies, and input-output linkages.

Hypothesis 4: Industries with high increasing returns to scale tend to locate in states with high market potentials (central places).

Hypothesis 5: Industries which devote a relatively high share of total sales to final consumption by households prefer to locate in states with high shares of population, since they provide *a priori* a better access to the relevant market than relatively inhabited ones.

Hypothesis 6: Industries for which the manufacturing sector itself is an important user of their products find advantageous to locate in states with a relatively large industrial sector, since it asures a significant demand source.

Hypothesis 7: Industries which highly rely on industrial intermediate inputs may tend to locate in states with an important industrial base, since they *a priori* offer a good access to the providers[35].

Notice that population, industrial GDP share, and centrality amount to specific forms of the common notion of market potential. One could argue, by looking at the definitions of the variables, that there exists an asymmetry among them, because centrality considers different states, while population and industrial GDP only refer to the state in question. Furthermore, one could also say that states that account for relatively large shares of total popultation do not necesessarily provide a good access to the relevant consumer markets, because they may be geographically very large and hence sparsely inhabited. In order to control for this, we use also measures of population and industry market potential that consider the own state and the other states weighted by the inverse of the respective bilateral distance.

Moreover, a reduction of trade costs (an increase in the tradability), on the one hand, induce firms in industries to locate in regions with better infrastructure, since it means a lower

[32] For a precise definition of variables and aspects related to their construction see Appendix A.1.

[33] Note that, following Midelfart-Knarvik, Overman, Redding, and Venables (2000), agriculture production is taken as an exogenous measure of "agriculture abundance".

[34] In this last case, and contrary to the former ones, the expected sign of the corresponding estimated coefficient is negative. Ellison and Glaeser (1999) include this interaction among the explanatory factors of locational patterns in the United States.

[35] Black and Henderson (1999) find that in United States capital goods plants agglomerate in locations with high manufacturing employment, which is considered by authors as a supporting evidence for the role of inter-industry linkages.

effective price for the purchaser and therefore a higher relative demand for goods produced in such territories[36]. Hence,

Hypothesis 8: Industries facing lower trade costs (and therefore trading more) tend to locate in states with relatively good infrastructure.

On the other hand, diminutions in trade costs represent a modification in the conditions of access to other markets and their subsequent greater gravitation could likely alter the balance of forces determining the predominant locational pattern. In more concrete terms, the formation of Mercosur actually expanded the set of markets that firms in the region could serve, as can be clearly seen from trade statistics. This might, to some extent, promote certain spatial shifting in manufacturing sector aiming at improving the access to those new customers. Thus, there might be an incentive for Brazilian firms to relocate their activities southwards, even more when the South region has an important own market and offers a good access to other large markets, because it lies between the traditional industrial region in Brazil, the Southeast region, and the most important Argentinean economic centres at the Pampeana region. The interaction term between tradability (as an inverse measure of trade costs) and the distance to Buenos Aires tries precisely to capture this effect[37]. In short,

Hypothesis 9: Industries facing lower trade costs (and therefore trading more than the average) tend to locate in states that are nearer Buenos Aires .

Remaining variables are included in order to evaluate the influence exercised by fiscal policies on actual locational patterns of industries. The fiscal policy variable, which is a combined indicator of "generosity" in conceded aids and bias in public expenditure composition, and the aid policy variable, which focuses exclusively on the first element, are alternatively interacted with different variables. First, following the logic of comparative advantage, we could think that

Hypothesis 10: Industries subject to relatively high taxes prefer to locate in states which dispense more favourable (and compensating) fiscal treatment.

If states differ in other important aspects, like home market size, the impact may vary according to them; particularly, as shown by the literature relating tax competition and *new trade theory* and *new economic geography*, the attraction potential may be higher, the higher the market potential of the granting state. Thus,

Hypothesis 11: Industries subject to relatively high taxes prefer to locate in states which dispense more favourable (and compensating) fiscal treatment, specially if they have large market potentials.

On the other hand, some authors stress that usually aids measures are concentrated in large visible projects both because of their alleged higher multiplicative effects and their greater political impact; scale economies are then a natural candidate to apprehend this size effect. Henceforth,

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[36] We should remark that infrastructure, which is measured as the density of *total* asphalted roads in the state, cannot be viewed as an indicator of fiscal policies by states, due to the significant differences across them with respect to the share *total roads* that effectively are *state roads*. In some cases, like Sergipe, infrastructure would reflect almost exclusively federal fiscal policies, since more than 80% of total asphalted roads in the state correspond to *federal roads*. The opposite is true for states such as Acre and Roraima, where *federal roads* share does not exceed 15%. Therefore, the varying degree of importance of different government levels behind total observed asphalted roads makes inconvenient a direct associatiation between the quality of infrastructure and fiscal policies conducted by the respective state, but does not preclude its use as a measure of *endowment*.

[37] Also in this case one should expect a negative sign on the estimated coefficient.

Hypothesis 12: Industries with high increasing returns to scale tend to locate in states which provide more favourable fiscal conditions.

4.2. Estimation issues and specification

The dependent variable is the share of a state in national manufacturing employment in each industry, s_{ik}. Three remarks should be made in this respect.

First, the ratio can only takes values within [0,1], so that the dependent variable is truncated. As a consequence, estimation with OLS will lead to biased estimates. Therefore, it must be transformed. Midelfart-Knarvik, Overman, Redding, and Venables (2000) takes the natural logarithm of the share, in which case the dependent variable becomes $\ln s_{ik}$,[38]. Another alternative is to perform a logistic transformation, similar to Balassa and Noland (1989) and Torstensson (1997), in which case the variable becomes $\ln[s_{ik}/(1-s_{ik})]$[39]. Both variants will be considered here.

Second, taking natural logarithms raises a problem for observations which are equal to zero, since the logarithm does not exist for them[40]. This problem is typical of gravity equations and has been addressed in different ways in the literature (Stein, Daude, and Levi Yeyati, 2001). For example, Rose (2000) simply excludes the observations in which the dependent variable takes a value of zero; this strategy would be not recommendable if zero observations are relatively numerous in the sample, because it could lead to biased estimations. Hoekman, Aturupane, and Djankov (1997) and Greenaway, Elliot, and Milner (1999) resort to non-linear least squares of a logistic function. Eichengreen and Irwin (1995, 1997) propose to use *ln(1+original variable).* Wang and Winters (1991) and Kume and Piani (2000) replace the zero values by small values; one problem with this approach is the fact that gives a large weight to those observations in regressions, since the logarithm of a small number is a large negative number. In the same vein, Zhou (2002) specifically substitutes the half of the minimum value of the dependent variable for zero values. Finally, another approach consists of using a Tobit estimation procedure instead of OLS, which in the current context might be justified by assuming that zero values are due to the presence of fixed costs of establishing a plant or by assuming that employment levels below certain threshold value are incorrectly recorded as zeros. In the present case, zero observations do not seem to be quantitatively important (roughly 6% of the whole sample). Nevertheless, those observations might convey important information regarding the issue under examination. For example, shares could be systematically zero for industries with high increasing returns to scale in states with very low market potentials. For that reason and for examining the sensitivity of the main results to alternative methodologies, results using different estimation procedures will be presented.

Third, there might occurr shocks which are correlated across states and/or industries. In particular, a certain industry or state might experience a shock to its share in national manufacturing employment. Midelfart-Knarvik, Overman, and Venables (2000) suggest the use of a double relative measure robust to such shocks, specifically, $\ln[s_{ik}/(s_i z_k)]$, so that the relevant share is normalized through state and industry sizes. Results using this re-formulated dependent variable will be also reported.

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[38] Note that, under this specification, the dependent variable only takes value in the range $(-\infty,0]$.

[39] This expression ranges in $(-\infty,+\infty)$

[40] The dependent variable never takes the value one.

As already mentioned, the dependent variable is expressed as a function of state characteristics, industry characteristics, and interaction terms among them. Formally, we use the following specification:

$$(5)\quad \ln(share_{ikt}) = \sum_j \beta(j)\left(\varpi_{it}(j) - \overline{\varpi}(j)\right)\left(\theta_{kt}(j) - \overline{\theta}(j)\right) + \varepsilon_{ikt}$$

$$or\quad \ln(share_{ikt}) = \alpha + \sum_j \left(\beta(j)\varpi_{it}(j)\theta_{kt}(j) - \beta(j)\overline{\theta}(j)\varpi_{it}(j) - \beta(j)\overline{\varpi}(j)\theta_{kt}(j)\right) + \varepsilon_{ikt}$$

where *j* indexes the interaction and "share" could be the share excluding zeros, the share corrected replacing zeros by a small number and logistically transformed or the share normalized by industry and state shares. Concretely,

$$\ln s = \ln(s_{ik}),\quad excluding\ zeros$$

$$\ln ts = \ln\left(\frac{s_{ik}}{1 - s_{ik}}\right),\quad excluding\ zeros$$

$$\ln sc1 = \ln(s_{ik})\ if\ s_{ik} \rangle 0,\quad \ln sc1 = \ln\left[s_{ik} + \left(\frac{\min s_{ik}}{2}\right)\right]\quad if\ s_{ik} = 0$$

$$\ln tsc1 = \ln\left(\frac{s_{ik}}{1 - s_{ik}}\right) if\ s_{ik} \rangle 0,\quad \ln sc1 = \ln\left[\frac{s_{ik} + \frac{\min s_{ik}}{2}}{1 - \left(s_{ik} + \frac{\min s_{ik}}{2}\right)}\right]\quad if\ s_{ik} = 0$$

$$\ln nsc1 = \ln\left(\frac{s_{ik}}{s_i z_k}\right) if\ s_{ik} \rangle 0,\quad \ln nsc1 = \left[\frac{s_{ik} + \frac{\min s_{ik}}{2}}{s_i z_k}\right]\quad if\ s_{ik} = 0$$

$$where\quad \min s_{ik} = \left\{\min_{ik(i=1,\dots,N/k=1,\dots,M)} (s_{ik})\ if\ s_{ik} \rangle 0\right\}$$

$\varpi_i(j)$ is the level of the *jth* characteristic in state *i* and $\theta_k(j)$ is the industry *k* value of the industry characteristic paired with the state characteristic; the upper bar denotes a reference value.

The coefficients to estimated are the $\beta(j)$, which measures the importance of the interaction, -$\beta(j)\overline{\theta}(j)$ and -$\beta(j)\overline{\varpi}(j)$, which amount to level effects in the interaction and a constant α, which contains the sum (over j) of the products of all level effects.

The intuition behind the selected functional form is exhaustively explained in Midelfart-Knarvik, Overman, Redding, and Venables (2000). The specification includes 10 interaction terms. By examining one characteristic it is possible to illustrate its logic. Consider, for example, skill, so that *j*=skill, $\varpi_i(skill)$ is the abundance of skilled workers in state *i* and $\theta_k(skill)$ is the skill intensity of industry *k*. Then, for the case in question, expression (19) means:

- There exists an industry with skill intensity $\overline{\theta(skill)}$ whose location is independent of the skill abundance of state.

- There exists a skill abundance level $\overline{\varpi(skill)}$, such that the state's share of each industry is independent of the skill intensity of the industry.
- If $\beta(skill)\rangle 0$, then industries with skill intensity greater than $\overline{\theta(skill)}$ tend to locate in states skill abundance greater than $\overline{\varpi(skill)}$ and out of states whose skill is abundance lower than this level[41].

The equation is estimated in the first place by OLS, pooling across industries, and, in principle, across years. The exercise considers 20 industries, 27 states, and 9 years (1990-1998)[42]. Therefore, the sample contains 4860 observations, when zero shares are not excluded. Further, we condition on the standard deviation of the underlying variables in order to makes comparison across variables more appropriate, so that the coefficients that will be presented are standardized ones. Finally, there are three main sources of heteroscedasticity, across states, across industries, and across time[43]. Hence, White's heteroscedastic consistent standard errors are reported when possible and used for hypothesis testing.

One non-minor point in the present exercise is the sample size. Large sample sizes may turn inappropriate the use of classical t-value for hypothesis testing purposes (Torstensson, 1997). Generally, the use of consistent estimators causes the rejection of almost any hypothesis if the sample size is large enough (Greene, 1997). In other words, the classical testing at a fixed level of significance increasingly distorts the interpretation of data against the null hypothesis of non-significance of a variable as the sample size grows. In order to account for this problem, Leamer (1978) proposes to endogeneize the significance level to the sample size, specifically, to make the former a decreasing function of the latter. Formally, the null hypothesis should be rejected if the t-value exceeds a critical value given by $\left[\left(T^{1/T}-1\right)\left(T-k\right)\right]^{0,5}$, where *T* denotes sample size and *T-k* degrees of freedom. We will take this into account when interpreting estimation results.

Other major concern, which has its roots in the theoretical background, is raised by the fact that state's endowments may be endogenous to locational decisions by firms. This might be specially likely in a regional context like the one examined here, since factor mobility tends to be higher within countries than across them. Thus, consider, for instance, the interplay between skill abundance and skill intensity. On the one hand, firms belonging to an industry which intensively uses skilled workers may locate in a certain state due to their relative abundance of this factor, but on the other hand, it is also possible that the setting of those firms generates an inflow of well educated workers to the state (and even, in a longer run perspective, an improvement in the qualification level of local population through induced enhancements in educational institutions). In this case, endowments would be endogenous and should not be treated as exogenous explanatory variables, since otherwise resulting estimations would be inconsistent. In order to account for this possibility, several exercises were carried out. First, original regressions were reran by using only initial values (that is,

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[41] Midelfart-Knarvik, Overman, Redding, and Venables (2000) maintain that the general equilibrium nature of the system makes difficult to define the cut-off points defining abundance and intensity. They suggest that the mean or the median are intuitive candidates, but there is no a priori reason to think that they are the correct points. Note, moreover, that in the present specification one variable, like industrial GDP, captures the cut-off of the two intensities which are interacted with it.

[42] The industry "Other products", which is a residual component, was dropped out.

[43] The White's general test was conducted to test for heteroscedasticity (Greene, 1997). Unlike other usual tests, like the Goldfeld-Quandt and Breusch-Pagan, it does not require to specify its nature. In this case, it suggests that indeed there exists heteroscedasticity. The corresponding chi-square statistic is highly significant for all specifications.

scores of 1990) of state characteristics, industry characteristics, and their interactions. Second, those regressions were replicated for the period 1991-1998 by utilizing contemporaneous as well as one-period-lagged values for regressands. Third, 2SLS regressions were performed by instrumenting state characteristics and interaction terms by the respective one period lag and the Hausman test statistic was calculated.

Furthermore, state endowments and industry intensities might be systematically subject to measurement errors for one particular state or industry, which would translate in to fixed effects for the state or industry in question. Midelfart-Knarvik, Overman, and Venables (2000) test the robustness of the results with respect to such a specification error by including a full set of state and industry dummies, dropping the state and industry level variables and re-estimating the relevant equation. However, given the structure of the available data, we can naturally think also about a panel estimation. In fact, by utilizing information on both the inter-temporal dynamics and the individuality of the entities being examined, panel data allows for a better control for the effects of missing, unobserved or mismeasured variables (Hsiao, 1986). In our case, the error term varies across industries, states, and years. Therefore, we can use a three-way-error component model. Such a model might be derived from the original one by including *M-1* dummies to account for industry fixed effects and *T-1* dummies to account for time fixed effects[44]. Fixed-effect panel estimation is then applied to the one-way model defined by the larger set of units, in this case, states.

Moreover, former econometric exercises assume a relatively simple error term. Particularly, they do not take into account the possibility of groupwise heterocedasticity and cross-sectional correlation across panels. Ignoring them when they are present result in consistent but inefficient estimations of regression coefficients and biased standard errors (Baltagi, 1995; Greene, 1997). Relevant test statistics for identifying those data features were calculated and an adequate econometric strategy was used.

Finally, original estimations pool across the 9 years of the sample. This implies to assume that the parameters of the equation *(5)* are stable across time. Nevertheless, as Midelfart-Knarvik, Overman, and Venables (2000) point out, the underlying system can change as a consequence of variations in the characteristic defining the reference state, $\bar{\varpi}(j)$, the characteristic defining the reference industry, $\bar{\theta}(j)$, and the responsiveness of industries to state and industry characteristics, $\beta(j)$. Along the 1990 decade, Brazilian economy went through multiple structural reforms, like opening, regional integration, privatisations and de-regulation. Thus, it is rather likely that characteristics and sensitivity to them varied in the period under examination. In order to test for this possibility, a full set of time dummies and time-dummies interactions are included to allow those to change over time. Testing for parameter constancy simply implies to evaluate the joint significance of all time dummy variables. The Wald test was conducted with this purpose[45].

[44] One of the industry effects and one of the time effects must be dropped out to avoid perfect multicollinearity (Greene, 1997).

[45] The test F is not adequate under heteroscedasticity. Particularly, it is likely that the used significance level of the test statistic be overestimated, that is, we could regard as large a F-statitic which actually is less than the appropriate table value (Greene, 1997). For that reason, the Wald test based on the suitable White heteroscedastic consistent covariance matrix was used.

4.3. Results

Table A3.1a in Appendix 3 presents the results from the basic regression using alternative specifications of the dependent variable and two estimation procedures, OLS and Tobit[46]. The first 9 rows show the estimated coefficients on state characteristics, the second 9 rows give the estimated coefficients on industry characteristics, the next 10 rows report the estimated coefficients on the interaction variables, last 3 rows show the estimated constant, the R-square, and the number of observations.

First, two general remarks should be done regarding one of the used specification, namely, the one based on the direct taking of logarithm of the relevant share. On the one hand, the utilization of that specification implies a certain kind of asymmetry between both sides of equation (19), since the right hand side variables are defined in terms of differences[47]. On the other hand, the dependent variable only takes values within the range $(-\infty,0]$. Thus, the specification does not actually solve the truncated variable problem. However, this problem might not be of concern if all predicted values fell inside that range (Amiti, 1997). Nevertheless, this is not true[48]. Hence, hereafter only *lntsc1* and *lnnsc1* will be used as dependent variable.

Second, we should stress the notorious discrepancies in estimated coefficients for some interaction variables between estimations which explicitly exclude zero observations and the remaining ones. In particular, for the formers, the interactions between population share and final demand bias (*popfd*), average manufacturing wage and labour intensity (*mwslcva*), market potential and scale economies (*mpscn*), industrial GDP and sales to industry (*indssi*), and infrastructure and tradability (*inftrad*) seem not to be significant, while for the later the opposite is true. By examining dropped observations, it is possible to note that they essentially correspond to Northern states, which characterize through low population, medium/high average manufacturing wage, low market potential and low infrastructure, while missing industries tend to have medium/high scale economies, in various cases high final demand bias (tobacco; electrical and communication equipment; transport equipment; perfumes, soaps, and candles; and Textiles), in other cases high propensity to sale to industry (mechanics; paper; rubber) and some of them intensively use labour (mechanics, transport equipment; electrical and communication equipment). Evidently, there is certain systematic pattern in excluded observations. Therefore, dropping them amounts to an important loss of information, which might biasing estimations. Obviously, one could counterargue that those observations might introduce too much "noise" in the estimations. Nevertheless, the one-step bounded influence Welsch estimator (Maddala, 1992) suggest that main findings are not driven by influential observations.

Third, notice that that most estimated coefficients on interaction variables are similar across remaining estimations, have the sign predicted by the theory and are significant in most

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[46] Regressions using another correction for zero observations, namely, replacing of zeros with an arbitrarily small number (0.0000001) instead of the half of the minimum observation, were ran (Greene, 1997). Results are essentially the same.

[47] I thank Zhou for this observation. He also makes me note that there could exist another asymmetry source, namely, the discrepancy between the time-varying reference in the left hand side and the assumed time-invariant references in the right hand side. However, the use of a constant reference value like the mean or the median for the whole sample period in the formula defining the dependent variable does not give rise to different results.

[48] For 64 observations out of 4860 (1.32%) predicted values exceed 0. Most of them correspond to the state of Sau Paulo and concentrate in the first three years.

cases at 1% level. The relevant critical t-value adjusting for sample size is 2.91. Most coefficients remain significant under this stronger criterion.

Particular comments will concentrate precisely on those estimated coefficients, which are the variables of interest, because they measure the sensitivity of locational patterns to the matching of state and industry characteristics.

Industries that intensively use skilled workers and labour tend to locate in states with well educated labour force and with relatively low average manufacturing wages, respectively. Moreover, industries with high increasing returns to scale are mainly located in central places. Backward and forward linkages are also important for explaining locational patterns. Industries with high final demand bias and high intermediate demand bias are located close to their customers, while industries which are heavily dependent on industrial intermediate inputs are located close to their providers. This holds for both the state specific and the distance-weighted measures of population and industry market potential (table A3.1b). Moreover, industries with highly tradable products (which face lower trade costs) locate in states which are nearer Argentina and have a good infrastructure.

One notable exception is the coefficient on the interaction between agriculture abundance and agriculture intensity (*agsi*), which shows a sign that does not coincide with what we would expect from the comparative advantage theory. A possible explanation relates to transport costs. The location of industries which intensively used agriculture inputs is not only determined by the availability of inputs. Most of them exhibit also a medium/high bias to final demand, so that it is also convenient for them to locate close to their customers. Further, agriculture abundant states do not generally appear among the ones with higher population shares. Then, the relevant question for firms is what is more profitable to let transport costs fall on inputs transfers or on reaching purchasers. According to the classical spatial economics, which takes elements from the gravitational physics, the results might be some combination of those alternatives with varying weights according to their relative importance. In this context, the observed result could be perfectly natural[49].

Finally, the interaction between fiscal policy and tax intensity have the correct sign, but seems to be insignificant. The results might be indicating what diverse surveys previously have shown, namely, *fundamentals* (including those that are the result of horizontal policies such as education) are so or even more important than fiscal aid as locational factors (Langemann, 1995; Prado and Cavalcanti, 1999; Morriset and Pirnia, 2000). This would correspond to an equilibrium situation in a neoclassical tax competition game. However, it might also be possible that the interaction is wrongly formulated, because of diverse reasons: some missing scaling factor, endogeneity problems, some lacking specificiness element, or directly the use of an irrelevant fiscal policy variable.

In the first case, we can think that the effectiveness of fiscal policies for inducing the location is not uniform across state sizes. Particularly, as the literature combining the new trade/the new economic geography and the tax competition literatures shows, states with higher market potential are in a better position to conduct a fiscal war, so they likely end winning the dispute[50]. To take into account this possibility we scale the fiscal policy variable by multiplying it with the centrality index. Regression results using this interaction term are

[49] By assuming vertically linked industries with different factor intensities, Amiti (2001) shows that, for some ranges of transport costs, firms may locate in regions where standard trade models would suggest they would not locate. For instance, labour-intensive downstream firms may locate in the capital abundant region in order to be close to the intermediate input suppliers. *Mutatis mutandis*, a similar argument seems to apply in this case.

[50] See also Varsano (1997, 1999).

reported in table A5.1c. The evidence is mixed, since it seems to have a significant positive effect in the *lntsc1* specification and a negative but insignificant one in the *lnnsc1* specification.

In the second case, we should not disregard that industries with high tax intensity might prefer to locate in states with more generous fiscal policies, but also they can have lower/higher tax intensity because they mainly locate in particular states with more or less lax fiscal policies[51]. One way to assess this argument is to run 2SLS by instrumenting involved variables, *fis*, *ti*, and *fisti,* with their corresponding one-period-lagged values and by subsequently performing a Hausman specification test. Obtained results do not support that explanation.

In the third case, the idea is that those policies may be specially directed to certain industries, essentially with larger plant sizes, because of its visibility for political uses (Furquim de Azevedo and Toneto Junior, 1999) and/or allegedly multiplier effects (Prado and Cavalcanti, 1999)[52]. Technical reasons, related to increasing returns to scale, would play also a role. To evaluate this alternative an interaction term between the fiscal policy indicator and scale economies was constructed. Results, which are presented in table A3.1c, are again not conclusive. The effect is positive across specifications, but it is only significant for the one using *lnnsc1*. In sum, the evidence in this regard shows a mixed picture, which does not allow for clear-cut conclusions, as for former variables.

Lastly, note that the fiscal policy variable employed so far is an amalgam of an indicator of aggressiveness in conceded aid measures and an indicator of the bias in public expenditure. This combined index might imply the averaging of policy actions with different degrees of specificity and hence effectiveness and thus it might impede the identification of their incidence. One natural alternative is then to evaluate the impact of only one of those components, specifically, the one concentrated on aid policies. Results are reported in table A3.1d. In this case, estimated coefficients have the expected sign and are significant for both specifications when the relevant variable is interacted with tax intensity and scale economies, which would suggest that industries facing higher tax burdens and exhibiting important returns to scale tend to locate in states that are more generous in the fiscal incentives they grant. Nevertheless, we should remark that, as it is evident from overall results, aid measures are only one element in a broader set of factors determining locational decisions, in which regional *fundamentals* play a decisive role.

Tables A3.2a-A3.2c report estimations from econometric strategies aiming at addressing potential endogeneity problems. We find find basically the same results pattern that we found in original regressions. The Hausman test statistics indicates that in most cases the null hypothesis of non contemporaneous correlation between the explanatory variables and the error term cannot be rejected[53]. In concrete terms, according to the overall evidence, results obtained with contemporaneous values of right-hand-side variables do not significantly differ from the ones emerging when lagged-values are employed. In this sense, endogeneity seems to be a less severe problem.

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[51] Note that, for the 1990 decade, states jointly accounted on average for 25%-30% of aggregate tax collection (Lemgruber, 1999).

[52] Furquim de Azevedo and Toneto Junior (1999) maintain, moreover, that obtaining fiscal incentives depends on having relevant information and negotiation power, which tends to be subjected to scale economies. They suggest that the notorious increase in the establishment size of footwear industry in the states of Ceará and Paraíba might be related to the granting of fiscal aids.

[53] Note that only for (5)-(6) the Hausman statistics reaches a conventional significance level, but it does not constitute compelling evidence.

Tables A3.3a and A3.3b present estimation results from substituting industry and state characteristics with a set of industry and state dummies and from the three way error component model (fixed effects), which aims at dealing with possible mismeasurement problems. Again, results are similar to those previously reported.

On the other hand, the modified Wald statistic for groupwise heteroscedasticity in residuals (Greene, 1997) suggests that the null hypothesis of homoscedasticity across panels should be rejected, while Breusch-Pagan LM test (Greene, 1997) indicates that the null hypothesis of independence of errors across panels should be also rejected[54]. Thus, an alternative econometric strategy is required. The fact that the number of units (540=20 industries*27 states) is substantially larger than the number of time periods (9 years) precludes FGLS due to the implied singularity and thus non-invertibility of the estimated disturbances covariance matrix. We can then use OLS but replacing OLS standard errors with panel-corrected-standard errors accounting for heteroscedasticity and contemporaneous correlation across panels (Beck and Katz, 1995). Results obtained by using that estimation method are reported in table A3.4. Obviously, differences with respect to original regression express only in terms of the standard errors. Corrected standard errors are lower for various estimated coefficients. In sum, previous findings are confirmed and to some extent strengthened.

Furthermore, the Wald test leads to reject the null hypothesis that parameters are stable across the whole sample years; the relevant statistic, which has approximately a standard normal distribution, is significant at least at the 5% level for all specifications[55].

By replicating the test for different time periods, it is possible to determine that the sample should be split in the following sub-periods, 1990-1992, 1993-1994, 1995-1998 when the dependent variable is *lntsc1* and 1990-1993, 1994-1998 when the dependent variable is *lnnsc1*. Next tables report the OLS estimates with White-corrected standard errors for the different sub-periods.

Note, first, that a general pattern can be identified for some variables. Thus, there is a declining trend for *popfd*, *mpscn*, and *indssi*, while the opposite is valid for *disttrad* and *inftrad*. In turn, *indsici* exhibit a rather stable behaviour.

First, the reduction in the estimated coefficient on the interaction between centrality and scale economies might be related to the significant downsizing process that the Brazilian manufacturing sector experienced in the 1990 decade (Saboia, 1997, 2000)[56]. Effectively, this might be the case since the aforesaid process has evolved asymmetrically across industries, such that it was particularly intense for industries traditionally located in states with high market potentials. In fact, industries that registered the highest reductions in average establishment size, namely, transport equipment and rubber, are mainly concentrated in central states, basically in the South and Southeast region[57]. Moreover, the rather simultaneous opening of economies that took place in South America might have implied a

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[54] Given the data dimensionality, one alternative to address this issue is to focus on one dimension of the panel at a time (say, industries or states) and to perform FGLS estimation; however, in this case, estimates, albeit consistent, will be inefficient and will have the wrong covariance matrix. Another alternative, which the one that we use, consists of grouping by industry and state simultaneously, so that the panel index would become each industry in each state.

[55] The Wald test statistic has a Chi-square distribution. However, since in our case the degrees of freedom are significantly large (232), we need to resort to a limiting distribution. In the case of a Chi-square variable the most frenquently used approximation is approximately standard normal distributed (Greene, 1997).

[56] Recall that scale economies are captured through establishment size (see Appendix A.1.).

[57] Those states accounted on average for more than 90% and more than 80% of industry employment, respectively.

redefinition of relevant market potentials through the larger weight gained by foreign markets.

Second, the increased estimated coefficient on the interactions involving tradability confirms the growing importance of trade relationships in the determination of locational patterns. The reciprocal opening of the economies in the region rises the gravitation of foreign markets, which concretely means that a higher share of production becomes exported. Hence, it should be not to surprising the diminution in the relative importance in backward linkages in a context of increasing tradability. On the contrary, the strength of the forward linkage seem to be rather stable over the decade, which suggests that Brazilian manufacturing sector still heavily relies on locally produced industrial inputs. Probably, the tariff structure with varying degrees of protection according to the value added level of products and the relative industrial size of the country within Mercosur in conjunction with the fact that intermediate industrial consumption seems to be more intense than demand linkages play a role in such result.

Third, it is not possible to identify a clear time pattern for the interactions between skill abundance and skill intensity and average manufacturing wage and labour intensity[58]. They remain significant in the last sub-period for both specifications.

Fourth, the negative estimated coefficient on the interaction between agriculture abundance and agriculture intensity seems to consolidate towards the end of the period, by becoming significant at least at 10% level.

Fifth, the interaction between the fiscal policy variable and tax intensity seems insignificant in whole sample period and for each of the sub-periods in which it was split out. On the other hand, the interactions between the aid policies indicator and tax intensity and that indicator and scale economies reproduce the already noted declining trend, which might suggest that fiscal instruments are becoming increasingly ineffective due to their relative generalization and consequent lost of differentiating power across states in locational decisions by firms, as would be the case in an equilibrium scenario of traditional tax competition.

5. Concluding remarks

Brazil has been subject to diverse significant structural changes during the nineties. The general opening of the economy and the regional integration in the context of Mercosur are without doubt part of them. On the other hand, with those changes as background, the country witnessed an intensification of the fiscal dispute among states seeking to attract manufacturing activities. Both phenomena might according to theoretical considerations play a role in explaining observed locational changes in the manufacturing sector during the last years. This paper aims at evaluating this possibility by means of an an econometric analysis based on the approach developed by Midelfart-Knarvik, Overman, Redding, and Venables (2000) and Midelfart-Knarvik, Overman, and Venables (2000).

Locational decisions by firms are affected by diverse factors, including the characteristics of the industry they belong to, the features of states in terms of their "endowments", and their interactions. One general notion, which fits in different theoretical approaches, is that firms that intensively use one particular "factor" should be drawn into regions in which such a

[58] For *lnnsc1,* both estimated coefficients show a reduction (in absolute value).

“factor” is relatively abundant and out of regions exhibiting relative scarcity of it. Thus, the utilization of interaction variables of the form “industry intensity” multiplied by “state’s factor abundance” appears as a natural meaningful strategy to examine the responsiveness of location to the matching of involved characteristics. Observed locational patterns are the resultant of multivariate interactions between state and industry characteristics; each of them might have distinct relative importance and this influence might vary across time. The effect of those variables can be formally evaluated by means of an econometric analysis including both state and industry characteristics, to control for level effects, and interaction terms. This has been the strategy followed in the paper.

Results indicate that industries that intensively used skilled workers and labour tend to locate in states with well educated labour force and with relatively low average manufacturing wages, respectively. Moreover, industries with high increasing returns to scale are mainly located in central places. Backward and forward linkages are also important for explaining locational patterns. Industries with high final demand bias and high intermediate demand bias are located close to their customers, while industries which are heavily dependent on industrial intermediate inputs are located close to their providers. Moreover, industries with highly tradable products (which face lower trade costs) locate in states which are nearer Argentina and have a good infrastructure. On the contrary, industries that heavily use agriculture inputs seem not to exhibit a bias towards location in states with agriculture abundance; this result might reflect the tension between the convenience of being located near to inputs and the convenience of being located near the customers when there exist differentiated transport costs in different phases of production and distribution process and the alternative locations do not coincide. Lastly, interactions involving a fiscal indicator which combines generosity in aids and biases in public expenditures towards inputs entering the production function of firms are insignificant, while, on the contrary, interactions for which that fiscal indicator restricts itself to the aid component, prove to be significant; in particular, industries facing higher tax burdens, and exhibiting important returns to scale tend to locate in states that are more generous in the fiscal incentives they grant. Nevertheless, it should be remarked that, as it is evident from overall results, aid measures are only one element in a broader set of factors determining locational decisions, in which regional *fundamentals* (broadly conceived, that is, including those that are the result of horizontal policies such as education) play a decisive role.

The relative importance of those factors has varied over the sample period. Specifically, we detect a declining trend in the estimated coefficients on backward linkages and an opposite one for the ones on the interactions between tradability and distance to Buenos Aires and tradability and infrastructure, which would suggest the increasing locational gravitation of foreign markets. Moreover, there is a reduction in the estimated coefficient on the interaction between centrality and scale economies, which might be related to the redefinition of relevant market potentials of regions that this higher influence of external factors would provoke and to the industry-asymmetric downsizing process that took place in the nineties.

On the other hand, forward linkages seem to be stable along this decade, may be because of the tariff structure with varying degrees of protection according to the value added in the product and the relatively high relative industrial size of the country within Mercosur.

Finally, the insignificance of the interaction between fiscal policies and tax intensity replicates in each sub-period, while the interactions between aid policies and tax intensity and scale economies reproduce the already noted declining trend, which indicates that fiscal instruments are becoming increasingly ineffective due to their relative generalization.

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A. Appendix

A.1. Variables

Some aspects of the construction of the variables deserve an explanation.

Market potential

The market potential of a state is captured through the index proposed by Keeble et al. (1986). Formally,

$$MP_i(t) \equiv \sum_{j \neq i} \frac{Y_j(t)}{d_{ij}} + \frac{Y_i(t)}{d_{ii}}$$

where i is the focal state, j corresponds to remaining states in the country, Y_i is the GDP of state i, d_{ij} measures the distance between the capitals of states i and j and d_{ii} is the intra-state distance, given by 1/3 of the radius of a circle with the same area as the state i (Leamer, 1997). The value of the measure is higher, the higher the own GDP, viewed as a proxy for own market size, and the lower the distance to the main markets of other states. Thus, central states are those that have a large market and a favourable location in terms of access to the markets of other locations.

Fiscal policy/Aid policy

The variable *fis* (fiscal policy) amounts to an index of "fiscal aggressiveness" in trying to attract firms. A higher value of the index means higher "aggressiveness" in stimulating the location of activities.

It results from combining two indices.

One index measures how generous are the incentives provided by the different states in order to induce the location of firms. This index has been constructed by working out the tables on state aid policies in Piancastelli and Perobelli (1996) and CNI (1998), taking into account the different conditions on the conceded benefits (percentage of tax reductions, duration, remission period, interest rate, and magnitude of foreseen monetary correction). The data in the first publication was taken as representative for the first half of the decade, while the data published in the second one were assumed to be valid for the remaining period[59].

The other index measures the joint share of expenditure for regional development, infrastructure, and industry and services in total state expenditure. The index was elaborated from a fiscal data basis kindly provided by Fernando Blanco Cossio at IPEA (Rio de Janeiro).

[59] It should be noted that some data might be missing and that there exist asymmetries in the presentation of the information.

The variable *aid* (aid policy) consists only of the first index.

Agriculture intensity, final demand bias, sales to industry, industrial intermediate consumption, tradability, transport intensity, and tax intensity

The necessary data to calculate the intensity measure were taken from the National Account System of Brazil elaborated and published on Internet by IBGE. Unfortunately, they were not available for the 20 disaggregation which was used here (IBGE Economic Sub-sectors Classification), so they had to be mapped into it.

Economies of scale

Trying to measure scale economies is problematic, since those economies could be product-specific, plant-specific or due to multi-plant operations (Amiti, 1997). Here, by following Kim (1995) and Amity (1997), economies of scale are captured by establishment size, that is, the average number of employees per establishment in the industry in question. There are other possible measures, like the one developed by Pratten (1988) and extensively used by other authors. Pratten ranked industries "in order of the importance of the economies of scales for spreading development costs and for production costs". The classification bases on two criteria: engineering estimates of the minimum efficient plant scale relative to the industry's output, and estimates of the cost gradient below the minimum efficient scale. Thus, the ranking is based on observed plant size but also on (unexploited) potential for scale economies (Brülhart, 1998). However, the estimation are exclusively based on information about developed countries. For that reason its use for a developing country like Brazil could be inconvenient.

Distance to Buenos Aires

Distance between each state capital and Buenos Aires (taken as the main economic centre of Argentina) could not be obtained. They had to be estimated. Calculations habe been made by using the formula of geodesic distances by CEPII (2001). Formally, the distance between two points *i* and *j* is given by:

$$d_{ij} = 6370 * ar\cos\begin{bmatrix}\cos\left(lat_j/57{,}2958\right)*\cos\left(lat_i/57{,}2958\right)*\cos\left(\min\left(360-abs(long_j-long_i\right), abs\left(long_j-long_i\right)/57{,}2958\right)\\ +\sin\left(lat_j/57{,}2958\right)*\sin\left(lat_i/57{,}2958\right)\end{bmatrix}$$

where *lat* is latitude and *long* means longitude.

Trade costs - Tradability

Usually, models refer to trade costs in general way, that is, they are conceived as broad impediments to transactions, including man-made barriers (i.e. tariffs) as well natural barriers (i.e. transportation costs). For the case under consideration, it is not possible to obtain a measure that properly corresponds to that notion and even less that was specific for Mercosur. Therefore, we adopt an index of industry output tradability (exports plus imports divided by production value) as an indicator for the inverse of the trade costs severity for the sector. In spite of the non-discriminatory character of the measure, its evolution may well reflect the opening policy by Brazilian government. In this respect, we should note that Mercosur have had an impact on trade flows, even after controlling for distance, adjacency, and overall openness (Garriga and Sanguinetti, 1995).

Regressions			
Explanatory variables			
Variable	**Definition**	**Source**	**Period**
State´s share of industry employment	Ln of state´s share in each industry employment, correcting for zeros (log. transf., norm.)	Own elaboration on MW	1990-1998
Explanatory variables			
State characteristics	**Definition**	**Source**	**Period**
Agriculture abundance	Agriculture as a share of state GDP	IPEA	1990-1998
Human capital abundance	Population older than 10 years with at least secondary school as a share of total population	IBGE	1990-1998
Average manufacturing wage	Number of minimal wages averaged across industries	MW	1990-1998
Population share	State population as a share of national population	IBGE	1990-1998
Industrial GDP share	State industrial GDP as a share of national industrial GDP	IPEA	1990-1998
Centrality	Measure of market potential (market acces), based on GDP and distances	Own elaboration on IBGE and DNER	1990-1998
Infrastructure	Kilometers of asphalted routes per 100 km^2	Own elaboration on GEIPOT	1990-1998
Distance to Buenos Aires	Distance between the capital of the state and Buenos Aires in 1000km^2	Own elaboration on IBGE and CEPII	-
Fiscal policy	Index of aggresiveness in fiscal policy formed on the basis of aid policies and expenditure composition	Own elaboration on CNI and IPEA	1990-1998
Aid policy	Index of aggresiveness in fiscal policy formed on the basis of aid policies	Own elaboration on CNI and IPEA	1995,1998
Industry characteristics	**Definition**	**Source**	**Period**
Agriculture intensity	Agriculture inputs a share of value of production	Own elaboration on IBGE	1990-1998
Human capital intensity	Workers with at least secondary school as a share of total labour force	Own elaboration on MW	1990-1998
Labour intensity	Labour compensation as a share of value added	Own elaboration on IBGE	1990-1998
Final demand bias	Sales to households as a share of total demand	Own elaboration on IBGE	1990-1998
Industrial intermediate consumption	Industrial intermediates as a share of value of production	Own elaboration on IBGE	1990-1998
Sales to industry	Sales to industry as a share of total demand	Own elaboration on IBGE	1990-1998
Economies of scale	Number of workers per establishment	Own elaboration on MW	1990-1998
Trade intensity	Exports plus imports as a share of value of production	Own elaboration on IBGE	1990-1998
Tax intensity	Taxes as a share of supply at market value	Own elaboration on IBGE	1990-1998
Interactions			

Abbreviations:

IBGE	Brazilian Institute of Geography and Statistics
IPEA	Institute of Applied Economic Research
MW	Ministry of Works
DNER	National Departament of Routes
GEIPOT	Brazilian Firm of Transport Planification
CNI	National Confederation of Industries
CEPII	Centre d´Estudes Prospectives et d´Informations Internationales

A.2. Descriptive empirics

Table A2.1a

Spatial distribution of manufacturing employment (1990-1998) - Percentages

Period / State/Region	1990-1992 (I)	1993-1995 (II)	1996-1998 (III)	Var. (II)/(I)	Var. (III)/(I)
Acre	0.04	0.04	0.05	0.00	0.01
Amazonas	1.08	0.99	1.15	-0.09	0.07
Pará	0.97	1.03	1.07	0.06	0.10
Rondonia	0.15	0.21	0.33	0.06	0.18
Amapá	0.02	0.03	0.03	0.01	0.01
Roraima	0.01	0.01	0.02	0.00	0.01
Tocantis	0.05	0.05	0.08	0.00	0.04
North Region	**2.33**	**2.37**	**2.74**	**0.04**	**0.41**
Maranhao	0.37	0.38	0.44	0.01	0.06
Piauí	0.25	0.29	0.34	0.04	0.09
Ceará	1.83	2.00	2.46	0.17	0.64
Rio Grande do Norte	0.69	0.62	0.76	-0.07	0.07
Paraíba	0.76	0.71	0.89	-0.06	0.13
Pernambuco	3.77	2.94	2.91	-0.83	-0.86
Alagoas	1.12	1.12	1.32	0.00	0.20
Sergipe	0.46	0.39	0.40	-0.07	-0.06
Bahía	1.85	1.79	1.83	-0.06	-0.02
Northeast Region	**11.10**	**10.23**	**11.36**	**-0.87**	**0.25**
Minas Gerais	8.17	9.04	9.98	0.87	1.80
Espiritu Santo	1.13	1.19	1.34	0.06	0.21
Rio de Janeiro	9.12	8.14	7.26	-0.99	-1.86
Sao Paulo	45.53	43.76	40.19	-1.78	-5.35
Southeast Region	**63.96**	**62.12**	**58.76**	**-1.84**	**-5.19**
Paraná	5.16	5.89	6.75	0.72	1.59
Santa Catarina	5.82	6.63	6.88	0.81	1.05
Rio Grande do Sul	9.62	10.17	9.99	0.55	0.37
South Region	**20.60**	**22.69**	**23.62**	**2.09**	**3.02**
Mato Grosso	0.45	0.64	0.94	0.19	0.48
Mato Grosso do Sul	0.33	0.43	0.56	0.09	0.22
Goiás	0.97	1.22	1.64	0.25	0.67
Distrito Federal	0.25	0.31	0.39	0.06	0.14
Middle-West Region	**2.01**	**2.60**	**3.52**	**0.58**	**1.51**
Brazil (mill. emp.)	**5.09**	**4.91**	**4.66**	**-0.19**	**-0.44**

Table A2.1b

Sectoral composition of manufacturing employment (1990-1998) - Percentages

Period / Industry	1990-1992 (I)	1993-1995 (II)	1996-1998 (III)	Var. (II)/(I)	Var. (III)/(I)
Non-metallic minerals	5.66	4.96	5.47	-0.70	-0.19
Metallurgy	10.28	10.61	10.40	0.33	0.13
Mechanics	6.50	6.20	5.73	-0.30	-0.77
Electrical and communication equipment	5.66	4.60	4.04	-1.06	-1.62
Transportation equipment	6.83	6.69	6.44	-0.14	-0.39
Woods	3.49	3.86	3.98	0.37	0.49
Furniture	2.87	2.99	3.53	0.12	0.66
Paper	2.27	2.48	2.56	0.21	0.29
Printing and publishing	3.58	3.50	4.03	-0.08	0.45
Rubber	1.42	1.61	1.53	0.19	0.12
Leather and hides	1.01	1.23	1.21	0.22	0.20
Chemicals	4.41	4.09	3.60	-0.32	-0.82
Pharmaceuticals	1.14	1.08	1.24	-0.06	0.10
Perfumes, soaps, and candles	0.69	1.08	1.43	0.40	0.74
Plastics	3.31	3.61	3.91	0.29	0.59
Textiles	6.90	6.49	5.35	-0.40	-1.55
Clothing, footwear, and cloth goods	12.25	12.94	12.24	0.69	-0.01
Food products	14.44	16.10	18.04	1.66	3.60
Beverages	3.02	3.21	3.33	0.19	0.31
Tobacco	0.45	0.49	0.44	0.04	-0.01
Other products	3.83	2.18	1.51	-1.65	-2.33
Total manufacturing industry	**5.09**	**4.91**	**4.66**	**-0.19**	**-0.44**

Table A2.2

Industry characteristics (1990-1998 Average)

Industry	agi	edui	lcva	scn	ici	icos	si	fd	trad	transp	ti
Non-metallic minerals	M	L	L	L	M	M	M	L	L	H	H
Metallurgy	M	M	M	M	H	H	H	L	M	M	L
Mechanics	L	H	M	M	M	L	M	L	H	L	L
Electrical and communication equipment	L	H	M	H	H	M	L	M	H	M	M
Transportation equipment	L	M	H	H	H	H	M	M	H	L	M
Woods	H	L	H	L	L	M	M	M	L	H	M
Furniture	H	L	H	L	L	M	M	M	L	H	M
Paper	M	M	H	H	M	H	H	L	L	H	L
Printing and publishing	M	H	H	L	M	H	H	L	L	H	L
Rubber	H	M	L	M	H	H	H	L	M	M	H
Leather and hides	L	L	H	M	H	L	L	H	H	L	M
Chemicals	M	H	L	M	L	H	H	M	M	M	M
Pharmaceuticals	M	H	L	H	M	M	L	H	M	L	H
Perfumes, soaps, and candles	L	M	L	L	M	M	L	H	M	L	H
Plastics	L	M	M	M	M	L	H	L	L	M	M
Textiles	H	L	L	H	H	H	H	M	L	L	L
Clothing, footwear, and cloth goods	L	L	H	L	H	L	L	H	H	L	M
Food products	H	L	M	M	L	M	M	H	M	H	M
Beverages	H	M	M	H	L	M	L	H	M	H	H
Tobacco	H	H	L	H	L	L	L	H	H	M	H
Other products	M	H	M	L	L	L	M	M	H	M	H

Figure A2.1

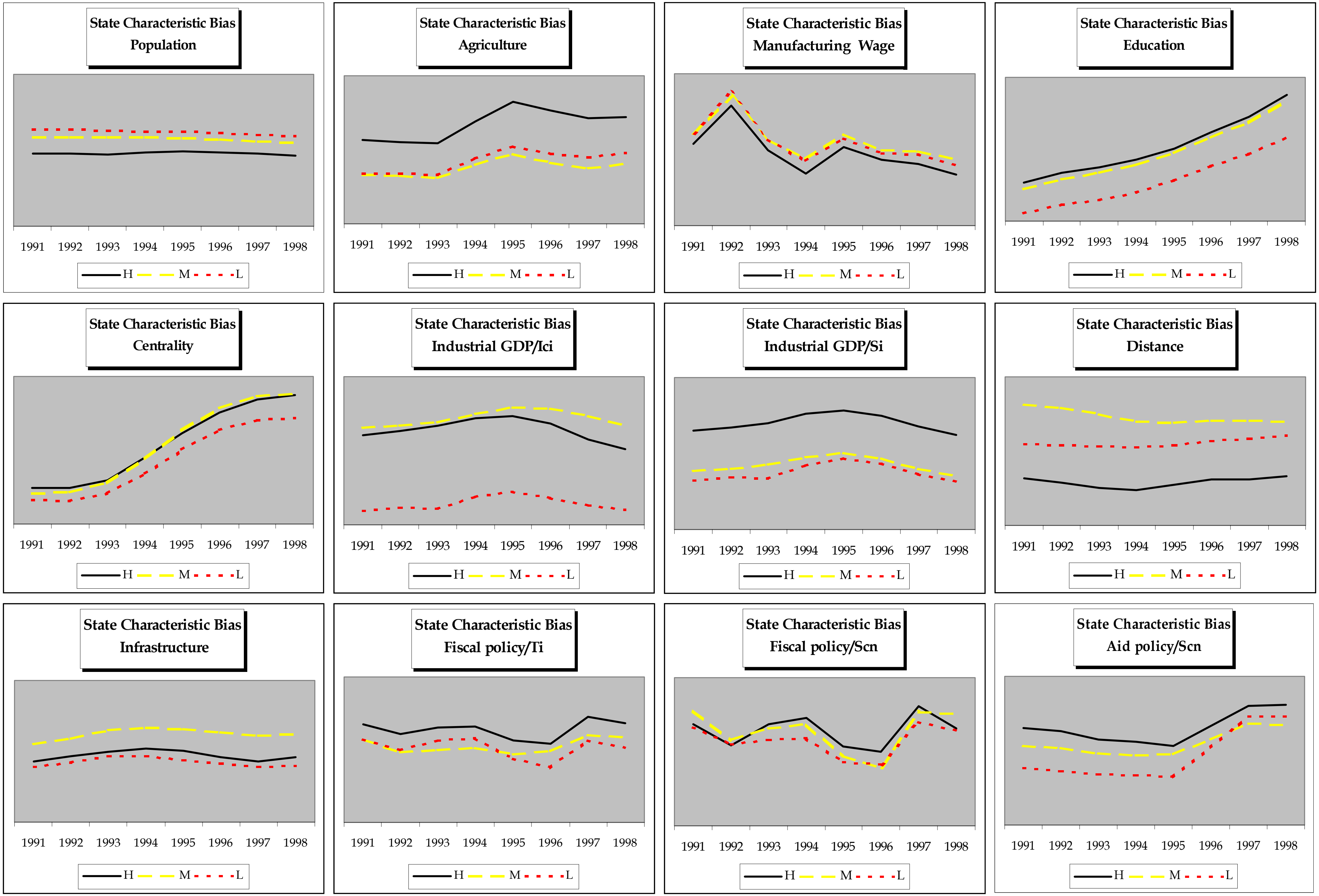
State Characteristic Bias
Population
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Agriculture
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Manufacturing Wage
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Education
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Centrality
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Industrial GDP/Ici
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Industrial GDP/Si
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Distance
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Infrastructure
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Fiscal policy/Ti
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Fiscal policy/Scn
1991 1992 1993 1994 1995 1996 1997 1998
H M L
State Characteristic Bias
Aid policy/Scn
1991 1992 1993 1994 1995 1996 1997 1998
H M L

Table A2.3

Industry characteristic bias of states (1990-1998, Average)

State	fd	agi	lcva	edui	scn	ici	icos	si	trad	transp	ti
Acre	L	H	M	L	L	L	M	M	L	H	H
Amazonas	L	L	L	H	H	H	L	M	H	L	H
Pará	M	M	H	L	L	L	M	M	L	H	L
Rondonia	M	M	H	L	L	L	L	L	L	H	L
Amapá	L	H	H	H	L	M	H	H	L	M	M
Roraima	M	H	M	M	H	L	M	L	L	H	H
Tocantis	M	M	L	L	L	L	H	M	L	H	M
Maranhao	L	M	M	M	L	M	H	H	L	H	L
Piauí	H	L	M	M	M	M	L	L	M	M	H
Ceará	H	L	H	L	M	H	M	M	H	L	M
Rio Grande do Norte	H	H	L	L	H	M	H	M	M	L	M
Paraíba	H	M	M	M	H	M	M	M	M	M	H
Pernambuco	H	H	L	M	M	L	M	L	M	L	M
Alagoas	H	H	L	L	H	L	L	L	M	M	M
Sergipe	M	M	L	M	H	H	H	H	M	L	M
Bahía	L	M	L	H	H	M	H	H	M	L	L
Minas Gerais	L	L	M	H	M	H	H	H	H	L	L
Espiritu Santo	M	L	H	L	L	H	M	H	M	M	M
Rio de Janeiro	L	L	M	H	M	H	M	H	H	L	L
Sao Paulo	L	L	M	H	H	H	H	H	H	L	L
Paraná	M	M	H	H	M	M	L	M	H	M	L
Santa Catarina	M	L	H	M	L	H	L	H	H	M	L
Rio Grande do Sul	H	L	H	M	L	H	L	L	H	L	L
Mato Grosso	M	H	M	L	L	L	L	L	L	H	M
Mato Grosso do Sul	H	H	L	M	M	L	M	L	L	H	H
Goiás	H	H	L	H	M	M	L	L	M	M	H
Distrito Federal	L	M	H	H	M	M	H	M	H	M	H

Table A2.4

Industry characteristic bias of states (1990-1992)

State	fd	agi	lcva	edui	scn	ici	icos	si	trad	transp	ti
Acre	L	M	M	M	L	L	M	M	L	H	H
Amazonas	L	L	L	H	H	H	M	M	H	L	H
Pará	M	H	M	L	L	L	M	M	L	H	M
Rondonia	M	M	H	L	L	L	L	L	L	H	M
Amapá	M	H	H	H	M	M	H	H	M	M	M
Roraima	M	H	M	M	H	L	L	L	L	H	H
Tocantis	M	M	H	L	L	L	H	M	L	H	L
Maranhao	L	M	M	M	L	M	H	H	L	H	M
Piauí	H	L	M	M	L	H	L	L	L	M	H
Ceará	H	M	M	L	M	H	M	M	M	L	L
Rio Grande do Norte	H	H	L	L	H	M	L	L	M	L	M
Paraíba	H	H	L	L	H	M	L	M	M	M	H
Pernambuco	H	H	L	M	H	L	M	L	H	M	H
Alagoas	H	H	L	L	H	L	L	L	H	M	H
Sergipe	M	L	L	M	H	M	H	H	H	L	L
Bahía	L	M	L	H	H	M	H	H	M	L	L
Minas Gerais	L	L	H	H	M	H	H	H	H	L	L
Espiritu Santo	M	L	H	L	L	H	H	H	M	M	M
Rio de Janeiro	L	L	L	H	M	H	M	H	H	L	M
Sao Paulo	L	L	M	H	H	H	H	H	H	L	L
Paraná	M	M	H	H	M	M	L	M	M	M	L
Santa Catarina	L	L	H	M	M	H	M	H	M	M	L
Rio Grande do Sul	H	L	H	M	L	H	L	L	H	L	L
Mato Grosso	H	H	M	L	L	L	L	L	L	H	M
Mato Grosso do Sul	M	H	L	H	M	L	M	L	L	H	M
Goiás	H	M	M	M	M	M	M	M	M	M	H
Distrito Federal	L	M	H	H	M	M	H	M	H	H	H
H(mean)	0.473	0.205	0.378	0.169	0.399	0.473	0.239	0.314	0.169	0.040	0.121
M(mean)	0.394	0.140	0.369	0.137	0.349	0.433	0.220	0.265	0.142	0.026	0.106
L(mean)	0.332	0.082	0.352	0.120	0.287	0.393	0.206	0.225	0.123	0.018	0.098

Industry characteristic bias of states (1996-1998)

State	fd	agi	lcva	edui	scn	ici	icos	si	trad	transp	ti
Acre	L	H	M	L	L	L	L	L	L	H	H
Amazonas	L	L	L	H	H	H	L	L	H	L	H
Pará	M	M	H	L	L	L	M	M	L	H	L
Rondonia	M	H	H	L	L	L	L	L	L	H	L
Amapá	M	H	H	H	H	L	H	M	L	H	H
Roraima	L	M	H	M	L	L	M	M	L	H	H
Tocantis	L	M	L	M	L	M	M	M	L	H	H
Maranhao	L	M	M	M	M	M	H	H	L	H	M
Piauí	H	L	M	M	M	M	L	L	M	M	H
Ceará	H	L	H	L	L	H	L	M	H	L	M
Rio Grande do Norte	M	M	L	L	H	M	H	H	M	L	H
Paraíba	H	M	M	M	H	H	M	M	M	L	H
Pernambuco	H	H	L	H	M	L	M	L	M	M	M
Alagoas	H	H	L	L	M	L	M	L	L	M	L
Sergipe	M	M	L	M	H	M	H	H	M	M	H
Bahía	M	M	L	H	H	M	H	H	M	M	M
Minas Gerais	L	L	M	H	H	H	H	H	H	L	L
Espiritu Santo	M	L	M	L	L	H	M	M	M	M	M
Rio de Janeiro	L	L	M	H	H	H	H	H	H	L	L
Sao Paulo	L	L	M	H	H	H	H	H	H	L	L
Paraná	M	M	H	H	M	M	L	M	H	M	L
Santa Catarina	M	L	H	M	M	H	M	H	H	M	L
Rio Grande do Sul	H	L	H	M	M	H	L	M	H	L	M
Mato Grosso	H	H	M	L	L	L	L	L	L	H	M
Mato Grosso do Sul	H	H	L	L	M	L	M	L	M	H	M
Goiás	H	H	L	M	M	M	L	L	M	L	M
Distrito Federal	L	H	H	H	L	M	H	H	H	M	L
H(mean)	0.492	0.229	0.367	0.215	0.284	0.453	0.236	0.291	0.221	0.031	0.122
M(mean)	0.399	0.164	0.353	0.177	0.245	0.411	0.211	0.248	0.172	0.021	0.113
L(mean)	0.357	0.103	0.325	0.155	0.216	0.361	0.195	0.213	0.152	0.016	0.106

Note 1: Marked elements correspond to changes in the group with respect to the initial sub-period.
Note 2: By looking at the averages, it is clear that some biases allow a better separation among the groups than others. In other words, biases do not offer homogeneous discriminating criteria due to the different variability of the corresponding scores.

A.3. Econometric evidence

Table A3.1a

Basic regressions							
	OLS	**OLS**	**OLS**	**OLS**	**OLS**	**Tobit**	**Tobit**
	lns	**lnts**	**lnsc1**	**lntsc1**	**lnnsc1**	**lntsc1**	**lnnsc1**
inds	-1.461	-1.453	-2.000	-1.992	-1.533	-2.054	-1.593
	(0.070)***	(0.075)***	(0.095)***	(0.099)***	(0.101)***	(0.127)***	(0.137)***
pop	2.107	2.143	2.681	2.715	1.060	2.781	1.126
	(0.069)***	(0.071)***	(0.087)***	(0.088)***	(0.083)***	(0.094)***	(0.101)***
ags	-0.170	-0.169	0.178	0.179	0.351	0.224	0.395
	(0.045)***	(0.045)***	(0.057)***	(0.057)***	(0.064)***	(0.044)***	(0.047)***
mws	0.428	0.456	0.794	0.821	0.624	0.866	0.667
	(0.088)***	(0.089)***	(0.114)***	(0.115)***	(0.122)***	(0.119)***	(0.128)***
edus	-0.410	-0.416	-0.321	-0.327	-0.028	-0.319	-0.017
	(0.070)***	(0.071)***	(0.080)***	(0.081)***	(0.078)	(0.087)***	(0.094)
mp	-0.400	-0.439	-1.068	-1.104	-0.819	-1.188	-0.898
	(0.066)***	(0.068)***	(0.084)***	(0.085)***	(0.091)***	(0.103)***	(0.111)***
dist	-0.434	-0.443	-0.492	-0.502	0.046	-0.504	0.045
	(0.047)***	(0.047)***	(0.054)***	(0.054)***	(0.054)	(0.066)***	(0.071)
inf	0.601	0.611	1.050	1.059	0.435	1.112	0.482
	(0.054)***	(0.055)***	(0.068)***	(0.069)***	(0.073)***	(0.073)***	(0.079)***
fis	0.084	0.077	0.052	0.045	-0.034	0.041	-0.037
	(0.057)	(0.057)	(0.070)	(0.070)	(0.071)	(0.072)	(0.078)
fd	-0.121	-0.107	-0.510	-0.497	-0.326	-0.534	-0.359
	(0.057)**	(0.057)*	(0.075)***	(0.075)***	(0.083)***	(0.070)***	(0.076)***
agi	0.377	0.371	0.982	0.978	0.775	1.040	0.835
	(0.062)***	(0.062)***	(0.085)***	(0.085)***	(0.098)***	(0.078)***	(0.084)***
lcva	0.083	0.104	0.215	0.234	0.352	0.251	0.369
	(0.058)	(0.059)*	(0.075)***	(0.075)***	(0.086)***	(0.076)***	(0.082)***
edui	-0.038	-0.052	-0.123	-0.138	-0.036	-0.141	-0.036
	(0.072)	(0.073)	(0.090)	(0.091)	(0.092)	(0.086)	(0.093)
scn	-0.485	-0.494	-0.854	-0.863	-0.752	-0.913	-0.797
	(0.040)***	(0.041)***	(0.054)***	(0.054)***	(0.062)***	(0.047)***	(0.051)***
ici	0.033	0.019	0.347	0.335	0.052	0.364	0.079
	(0.054)	(0.054)	(0.073)***	(0.073)***	(0.081)	(0.072)***	(0.077)
si	0.058	0.063	-0.373	-0.369	-0.314	-0.404	-0.349
	(0.066)	(0.067)	(0.086)***	(0.086)***	(0.089)***	(0.084)***	(0.090)***
trad	0.231	0.231	0.104	0.104	-0.228	0.096	-0.239
	(0.064)***	(0.065)***	(0.076)	(0.076)	(0.070)***	(0.101)	(0.109)**
ti	0.266	0.261	0.045	0.039	0.195	0.017	0.177
	(0.085)***	(0.086)***	(0.106)	(0.106)	(0.114)*	(0.104)	(0.112)
popfd	0.037	0.005	0.145	0.114	0.229	0.126	0.237
	(0.045)	(0.047)	(0.061)**	(0.063)*	(0.068)***	(0.074)*	(0.080)***
agsi	0.182	0.186	-0.130	-0.127	-0.266	-0.153	-0.294
	(0.055)***	(0.056)***	(0.079)*	(0.079)	(0.090)***	(0.052)***	(0.056)***
mwslcva	-0.074	-0.112	-0.371	-0.408	-0.521	-0.442	-0.553
	(0.094)	(0.094)	(0.119)***	(0.120)***	(0.128)***	(0.133)***	(0.143)***
edusi	0.198	0.218	0.365	0.385	0.376	0.395	0.384
	(0.088)**	(0.089)**	(0.105)***	(0.106)***	(0.099)***	(0.102)***	(0.110)***
mpscn	0.016	0.037	0.163	0.182	0.383	0.205	0.403
	(0.037)	(0.039)	(0.047)***	(0.048)***	(0.055)***	(0.059)***	(0.063)***
indsici	0.367	0.498	0.500	0.631	0.650	0.646	0.666
	(0.060)***	(0.066)***	(0.080)***	(0.084)***	(0.084)***	(0.121)***	(0.130)***
indssi	0.044	0.022	0.122	0.101	0.163	0.110	0.171
	(0.039)	(0.041)	(0.052)**	(0.054)*	(0.054)***	(0.078)	(0.084)**
disttrad	-0.548	-0.545	-0.506	-0.503	-0.400	-0.513	-0.409
	(0.072)***	(0.072)***	(0.079)***	(0.080)***	(0.073)***	(0.102)***	(0.110)***
inftrad	0.076	0.074	0.150	0.148	0.175	0.169	0.196
	(0.059)	(0.059)	(0.067)**	(0.067)**	(0.063)***	(0.069)**	(0.075)***
fisti	-0.031	-0.022	0.077	0.084	0.161	0.103	0.176
	(0.094)	(0.095)	(0.118)	(0.118)	(0.124)	(0.118)	(0.127)
Constant	-5.930	-5.897	-7.154	-7.115	0.488	-7.293	0.304
	(0.468)***	(0.471)***	(0.557)***	(0.559)***	(0.587)	(0.585)***	(0.630)
Observations	4603	4603	4860	4860	4860	4860	4860
R-squared	0.67	0.68	0.64	0.66	0.29		

Table A3.1b

MP for pop and inds		
	OLS	**OLS**
	lntsc1	**lnnsc1**
nmppopfd	0.313	0.434
	(0.091)***	(0.096)***
nagsi	-0.119	-0.260
	(0.082)	(0.092)***
nmwslcva	-0.424	-0.578
	(0.123)***	(0.130)***
nedusi	0.383	0.367
	(0.099)***	(0.101)***
nmpscn	0.206	0.426
	(0.059)***	(0.057)***
nmpiici	0.644	0.764
	(0.122)***	(0.112)***
nmpisi	0.230	0.269
	(0.072)***	(0.065)***
ndisttrad	-0.531	-0.397
	(0.086)***	(0.076)***
ninftrad	0.106	0.129
	(0.071)	(0.066)*
nfisti	0.091	0.189
	(0.122)	(0.125)

Table A3.1c

Basic regressions - Alternative interactions for fiscal policy								
	1	2	3	4	5	6	7	8
	lntsc1	lntsc1	lntsc1	lntsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1
popfd	0.117	0.116	0.115	0.116	0.233	0.237	0.231	0.234
	(0.062)*	(0.063)*	(0.063)*	(0.063)*	(0.068)***	(0.068)***	(0.067)***	(0.067)***
agsi	-0.129	-0.123	-0.129	-0.125	-0.278	-0.261	-0.274	-0.274
	(0.078)*	(0.079)	(0.079)	(0.079)	(0.089)***	(0.090)***	(0.090)***	(0.090)***
mwslcva	-0.418	-0.387	-0.408	-0.387	-0.549	-0.527	-0.519	-0.526
	(0.120)***	(0.121)***	(0.120)***	(0.121)***	(0.128)***	(0.128)***	(0.128)***	(0.128)***
edusi	0.379	0.403	0.386	0.404	0.359	0.372	0.380	0.375
	(0.107)***	(0.106)***	(0.106)***	(0.106)***	(0.100)***	(0.101)***	(0.099)***	(0.100)***
mpscn	0.181	0.134	0.183	0.136	0.382	0.393	0.388	0.403
	(0.048)***	(0.052)***	(0.048)***	(0.052)***	(0.056)***	(0.057)***	(0.055)***	(0.058)***
indsici	0.632	0.615	0.631	0.616	0.657	0.650	0.650	0.654
	(0.084)***	(0.087)***	(0.084)***	(0.086)***	(0.087)***	(0.084)***	(0.084)***	(0.084)***
indssi	0.104	0.146	0.102	0.145	0.168	0.164	0.167	0.157
	(0.053)**	(0.057)**	(0.054)*	(0.057)**	(0.054)***	(0.057)***	(0.054)***	(0.057)***
disttrad	-0.500	-0.517	-0.501	-0.515	-0.389	-0.398	-0.390	-0.385
	(0.080)***	(0.080)***	(0.080)***	(0.080)***	(0.074)***	(0.073)***	(0.073)***	(0.074)***
inftrad	0.152	0.161	0.150	0.162	0.188	0.173	0.183	0.180
	(0.068)**	(0.068)**	(0.068)**	(0.068)**	(0.064)***	(0.064)***	(0.063)***	(0.064)***
fisti		0.062				0.045		
		(0.124)				(0.127)		
fisscn	0.073	0.052		0.055	0.278	0.266		0.289
	(0.121)	(0.128)		(0.122)	(0.138)**	(0.144)*		(0.138)**
nmpfisti			0.170	0.167			-0.037	-0.054
			(0.062)***	(0.062)***			(0.070)	(0.071)
Observations	4860	4860	4860	4860	4860	4860	4860	4860
R-squared	0.65	0.66	0.66	0.66	0.29	0.29	0.29	0.29

Table A3.1d

Basic Regressions						
	1	2	3	4	5	6
	lntsc1	lnnsc1	lntsc1	lnnsc1	lntsc1	lnnsc1
popfd	0.106	0.223	0.123	0.238	0.115	0.231
	(0.062)*	(0.068)***	(0.063)*	(0.068)***	(0.062)*	(0.068)***
agsi	-0.119	-0.255	-0.115	-0.256	-0.122	-0.260
	(0.078)	(0.089)***	(0.079)	(0.090)***	(0.077)	(0.087)***
mwslcva	-0.402	-0.516	-0.370	-0.506	-0.417	-0.553
	(0.119)***	(0.127)***	(0.121)***	(0.128)***	(0.119)***	(0.128)***
edusi	0.380	0.371	0.401	0.379	0.377	0.356
	(0.107)***	(0.100)***	(0.108)***	(0.101)***	(0.108)***	(0.100)***
mpscn	0.181	0.379	0.120	0.361	0.163	0.347
	(0.048)***	(0.054)***	(0.052)**	(0.056)***	(0.047)***	(0.055)***
indsici	0.631	0.649	0.613	0.642	0.633	0.656
	(0.084)***	(0.084)***	(0.087)***	(0.084)***	(0.083)***	(0.087)***
indssi	0.102	0.168	0.184	0.202	0.102	0.166
	(0.053)*	(0.053)***	(0.060)***	(0.060)***	(0.053)*	(0.054)***
disttrad	-0.508	-0.405	-0.527	-0.412	-0.517	-0.419
	(0.079)***	(0.073)***	(0.080)***	(0.073)***	(0.080)***	(0.074)***
inftrad	0.141	0.169	0.157	0.175	0.135	0.162
	(0.068)**	(0.064)***	(0.069)**	(0.064)***	(0.068)**	(0.064)**
aidti	0.493	0.570				
	(0.133)***	(0.137)***				
mpaidti			0.263	0.102		
			(0.073)***	(0.081)		
aidscn					0.526	0.787
					(0.135)***	(0.151)***
Observations	4860	4860	4860	4860	4860	4860
R-squared	0.66	0.30	0.65	0.29	0.65	0.29

Robust Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Tables A3.2a and A3.2b

Regressions with 1990 values for explanatory variables	1	2	3	4	5	6
	lntsc1	lnnsc1	lntsc1	lnnsc1	lntsc1	lnnsc1
popfd	0.113	0.239	0.104	0.236	0.109	0.241
	(0.059)*	(0.065)***	(0.059)*	(0.066)***	(0.058)*	(0.066)***
agsi	-0.116	-0.281	-0.108	-0.275	-0.109	-0.276
	(0.070)*	(0.087)***	(0.072)	(0.088)***	(0.071)	(0.085)***
mwslcva	-0.619	-0.863	-0.602	-0.855	-0.598	-0.849
	(0.148)***	(0.153)***	(0.146)***	(0.153)***	(0.146)***	(0.152)***
edusi	0.361	0.467	0.364	0.469	0.370	0.476
	(0.100)***	(0.094)***	(0.106)***	(0.096)***	(0.105)***	(0.097)***
mpscn	0.241	0.320	0.238	0.316	0.220	0.295
	(0.049)***	(0.052)***	(0.050)***	(0.052)***	(0.050)***	(0.054)***
indsici	0.843	0.823	0.842	0.824	0.837	0.819
	(0.077)***	(0.090)***	(0.077)***	(0.090)***	(0.077)***	(0.094)***
indssi	0.110	0.179	0.108	0.182	0.107	0.181
	(0.051)**	(0.053)***	(0.050)**	(0.052)***	(0.050)**	(0.052)***
disttrad	-0.219	-0.165	-0.221	-0.171	-0.251	-0.206
	(0.090)**	(0.089)*	(0.089)**	(0.089)*	(0.089)***	(0.090)**
inftrad	0.127	0.102	0.125	0.099	0.104	0.075
	(0.075)*	(0.077)	(0.076)	(0.077)	(0.076)	(0.077)
fisti	-0.072	0.048				
	(0.122)	(0.132)				
aidti			0.267	0.305		
			(0.135)**	(0.138)**		
aidscn					0.518	0.602
					(0.129)***	(0.143)***
Observations	4860	4860	4860	4860	4860	4860
R-squared	0.65	0.29	0.65	0.29	0.65	0.28

Robust Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Regressions with lagged explanatary variables	1	2	3	4	5	6	7	8	9	10	11	12
	lntsc1	lntsc1	lnnsc1	lnnsc1	lntsc1	lntsc1	lnnsc1	lnnsc1	lntsc1	lntsc1	lnnsc1	lnnsc1
popfd	0.112	0.097	0.214	0.205	0.102	0.089	0.206	0.199	0.109	0.097	0.212	0.207
	(0.065)*	(0.066)	(0.071)***	(0.071)***	(0.065)	(0.065)	(0.071)***	(0.071)***	(0.065)*	(0.065)	(0.072)***	(0.072)***
agsi	-0.134	-0.133	-0.278	-0.289	-0.130	-0.126	-0.272	-0.279	-0.132	-0.128	-0.276	-0.284
	(0.083)	(0.086)	(0.094)***	(0.097)***	(0.082)	(0.085)	(0.094)***	(0.097)***	(0.081)	(0.084)	(0.092)***	(0.095)***
mwslcva	-0.405	-0.375	-0.479	-0.455	-0.404	-0.366	-0.479	-0.446	-0.427	-0.375	-0.527	-0.470
	(0.124)***	(0.130)***	(0.133)***	(0.139)***	(0.123)***	(0.129)***	(0.132)***	(0.138)***	(0.123)***	(0.129)***	(0.133)***	(0.138)***
edusi	0.389	0.432	0.382	0.455	0.386	0.430	0.379	0.453	0.378	0.430	0.356	0.443
	(0.109)***	(0.119)***	(0.103)***	(0.112)***	(0.110)***	(0.120)***	(0.103)***	(0.113)***	(0.111)***	(0.121)***	(0.103)***	(0.113)***
mpscn	0.152	0.145	0.343	0.290	0.149	0.141	0.339	0.286	0.131	0.128	0.307	0.261
	(0.051)***	(0.050)***	(0.059)***	(0.058)***	(0.051)***	(0.050)***	(0.059)***	(0.058)***	(0.050)***	(0.050)**	(0.059)***	(0.059)***
indsici	0.619	0.644	0.651	0.657	0.620	0.644	0.652	0.655	0.624	0.644	0.661	0.660
	(0.086)***	(0.089)***	(0.086)***	(0.092)***	(0.085)***	(0.089)***	(0.085)***	(0.092)***	(0.084)***	(0.089)***	(0.089)***	(0.094)***
indssi	0.103	0.091	0.160	0.152	0.101	0.092	0.160	0.156	0.100	0.091	0.157	0.154
	(0.056)*	(0.056)	(0.056)***	(0.056)***	(0.055)*	(0.055)*	(0.055)***	(0.055)***	(0.054)*	(0.055)*	(0.056)***	(0.056)***
disttrad	-0.509	-0.540	-0.436	-0.447	-0.511	-0.547	-0.439	-0.454	-0.521	-0.557	-0.454	-0.469
	(0.083)***	(0.095)***	(0.075)***	(0.087)***	(0.082)***	(0.095)***	(0.075)***	(0.087)***	(0.083)***	(0.095)***	(0.076)***	(0.088)***
inftrad	0.182	0.157	0.203	0.195	0.179	0.151	0.200	0.190	0.174	0.142	0.194	0.179
	(0.071)**	(0.079)**	(0.066)***	(0.074)***	(0.071)**	(0.080)*	(0.066)***	(0.075)**	(0.071)**	(0.080)*	(0.066)***	(0.075)**
fisti	0.026	0.055	0.073	0.121								
	(0.118)	(0.130)	(0.124)	(0.135)								
aidti					0.432	0.444	0.481	0.495				
					(0.138)***	(0.142)***	(0.141)***	(0.145)***				
aidscn									0.518	0.429	0.780	0.616
									(0.146)***	(0.142)***	(0.163)***	(0.160)***
Observations	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320
R-squared	0.66	0.65	0.30	0.28	0.66	0.65	0.30	0.28	0.66	0.65	0.30	0.28

Note:

(1,3,5,7,9,11): Regressions for the period 1991-1998 with contemporaneous explanatory variables.

(2,4,6,8,10,12): Regressions for the period 1991-1998 with one period lagged explanatory variables.

Robust Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Tables A3.2c

Instrumental variables regressions (2SLS), 1991-1998												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	lntsc1	**lntsc1**	**lnnsc1**	**lnnsc1**	**lntsc1**	**lntsc1**	**lnnsc1**	**lnnsc1**	**lntsc1**	**lntsc1**	**lnnsc1**	**lnnsc1**
popfd	0.112	0.085	0.214	0.186	0.102	0.079	0.206	0.187	0.109	0.104	0.212	0.211
	(0.065)*	(0.069)	(0.071)***	(0.072)***	(0.065)	(0.068)	(0.071)***	(0.071)***	(0.065)*	(0.068)	(0.072)***	(0.073)***
agsi	-0.134	-0.155	-0.278	-0.347	-0.130	-0.133	-0.272	-0.312	-0.132	-0.133	-0.276	-0.307
	(0.083)	(0.091)*	(0.094)***	(0.100)***	(0.082)	(0.087)	(0.094)***	(0.096)***	(0.081)	(0.089)	(0.092)***	(0.095)***
mwslcva	-0.405	-0.739	-0.479	-0.418	-0.404	-0.762	-0.479	-0.447	-0.427	-0.844	-0.527	-0.646
	(0.124)***	(0.220)***	(0.133)***	(0.230)*	(0.123)***	(0.219)***	(0.132)***	(0.228)*	(0.123)***	(0.218)***	(0.133)***	(0.225)***
edusi	0.389	0.281	0.382	0.667	0.386	0.279	0.379	0.665	0.378	0.270	0.356	0.648
	(0.109)***	(0.134)**	(0.103)***	(0.141)***	(0.110)***	(0.135)**	(0.103)***	(0.141)***	(0.111)***	(0.137)**	(0.103)***	(0.144)***
mpscn	0.152	0.040	0.343	0.281	0.149	0.025	0.339	0.259	0.131	0.047	0.307	0.227
	(0.051)***	(0.065)	(0.059)***	(0.070)***	(0.051)***	(0.066)	(0.059)***	(0.069)***	(0.050)***	(0.059)	(0.059)***	(0.064)***
indsici	0.619	0.658	0.651	0.671	0.620	0.658	0.652	0.665	0.624	0.674	0.661	0.702
	(0.086)***	(0.098)***	(0.086)***	(0.098)***	(0.085)***	(0.098)***	(0.085)***	(0.097)***	(0.084)***	(0.098)***	(0.089)***	(0.101)***
indssi	0.103	0.059	0.160	0.119	0.101	0.073	0.160	0.148	0.100	0.078	0.157	0.142
	(0.056)*	(0.061)	(0.056)***	(0.058)**	(0.055)*	(0.059)	(0.055)***	(0.056)***	(0.054)*	(0.059)	(0.056)***	(0.057)**
disttrad	-0.509	-0.290	-0.436	-0.449	-0.511	-0.292	-0.439	-0.455	-0.521	-0.294	-0.454	-0.475
	(0.083)***	(0.156)*	(0.075)***	(0.153)***	(0.082)***	(0.157)*	(0.075)***	(0.153)***	(0.083)***	(0.158)*	(0.076)***	(0.155)***
inftrad	0.182	0.336	0.203	0.154	0.179	0.334	0.200	0.152	0.174	0.330	0.194	0.131
	(0.071)**	(0.084)***	(0.066)***	(0.076)**	(0.071)**	(0.084)***	(0.066)***	(0.077)**	(0.071)**	(0.086)***	(0.066)***	(0.078)*
fisti	0.026	0.403	0.073	0.694								
	(0.118)	(0.230)*	(0.124)	(0.242)***								
aidti					0.432	0.940	0.481	1,224				
					(0.138)***	(0.249)***	(0.141)***	(0.259)***				
aidscn									0.518	-0.274	0.780	0.951
									(0.146)***	(0.366)	(0.163)***	(0.414)**
Observations	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320	4320
R-squared	0.66	0.66	0.29	0.30	0.66	0.66	0.30	0.30	0.66	0.65	0.30	0.29
H (28)/H(27)		27.28		20.18		48.13		16.96		14.42		17.08

Note:

inds, pop, ags, mws, edus, mp, inf, fis, popfd, agsi, mwslcva, edusi, mpscn, indsici, indssi, disttrad, inftrad, fisti or aidti or aidscn were instrumented through the respective one-period-lagged-value.

Robust Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.3a

Dummies instead industry and state characteristics				
	1	**2**	**3**	**4**
	lntsc1	**lnnsc1**	**lntsc1**	**lnnsc1**
popfd	0.108	0.259	0.109	0.260
	(0.046)**	(0.060)***	(0.046)**	(0.060)***
agsi	-0.042	-0.186	-0.038	-0.185
	(0.057)	(0.086)**	(0.057)	(0.086)**
mwslcva	-0.137	-0.200	-0.137	-0.193
	(0.048)***	(0.061)***	(0.048)***	(0.060)***
edusi	0.268	0.183	0.265	0.187
	(0.045)***	(0.056)***	(0.045)***	(0.056)***
mpscn	0.227	0.277	0.225	0.277
	(0.039)***	(0.049)***	(0.039)***	(0.049)***
indsici	0.610	0.533	0.607	0.531
	(0.062)***	(0.070)***	(0.062)***	(0.069)***
indssi	0.092	0.192	0.096	0.194
	(0.042)**	(0.049)***	(0.042)**	(0.049)***
disttrad	-0.271	-0.350	-0.271	-0.348
	(0.044)***	(0.056)***	(0.044)***	(0.056)***
inftrad	0.150	0.193	0.150	0.191
	(0.042)***	(0.051)***	(0.042)***	(0.051)***
fisti	0.099	0.043		
	(0.049)**	(0.064)		
aidti			0.123	0.004
			(0.053)**	(0.068)
Observations	4860	4860	4860	4860
R-squared	0.80	0.41	0.80	0.41

Robust Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.3b

Three-way error component model (Fixed Effects)												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	lntsc1	**lntsc1**	**lnnsc1**	**lnnsc1**	**lntsc1**	**lntsc1**	**lnnsc1**	**lnnsc1**	**lntsc1**	**lntsc1**	**lnnsc1**	**lnnsc1**
popfd	0.101	0.101	0.230	0.230	0.092	0.092	0.223	0.223	0.099	0.099	0.231	0.231
	(0.053)*	(0.044)**	(0.068)***	(0.059)***	(0.053)*	(0.044)**	(0.068)***	(0.059)***	(0.052)*	(0.044)**	(0.067)***	(0.059)***
agsi	-0.112	-0.112	-0.283	-0.283	-0.107	-0.107	-0.275	-0.275	-0.106	-0.106	-0.274	-0.274
	(0.037)***	(0.056)**	(0.048)***	(0.085)***	(0.037)***	(0.055)*	(0.048)***	(0.085)***	(0.037)***	(0.054)**	(0.047)***	(0.083)***
mwslcva	-0.411	-0.411	-0.556	-0.556	-0.405	-0.405	-0.552	-0.552	-0.404	-0.404	-0.550	-0.550
	(0.095)***	(0.088)***	(0.123)***	(0.115)***	(0.095)***	(0.089)***	(0.122)***	(0.115)***	(0.095)***	(0.088)***	(0.122)***	(0.115)***
edusi	0.292	0.292	0.385	0.385	0.290	0.290	0.382	0.382	0.308	0.308	0.406	0.406
	(0.075)***	(0.074)***	(0.097)***	(0.089)***	(0.075)***	(0.074)***	(0.096)***	(0.089)***	(0.074)***	(0.074)***	(0.096)***	(0.089)***
mpscn	0.280	0.280	0.359	0.359	0.275	0.275	0.352	0.352	0.255	0.255	0.329	0.329
	(0.044)***	(0.040)***	(0.057)***	(0.051)***	(0.044)***	(0.040)***	(0.057)***	(0.051)***	(0.044)***	(0.039)***	(0.057)***	(0.051)***
indsici	0.710	0.710	0.686	0.686	0.708	0.708	0.682	0.682	0.705	0.705	0.679	0.679
	(0.087)***	(0.058)***	(0.111)***	(0.069)***	(0.087)***	(0.058)***	(0.111)***	(0.069)***	(0.086)***	(0.057)***	(0.111)***	(0.068)***
indssi	0.088	0.088	0.160	0.160	0.087	0.087	0.163	0.163	0.087	0.087	0.163	0.163
	(0.056)	(0.039)**	(0.072)**	(0.047)***	(0.055)	(0.038)**	(0.071)**	(0.046)***	(0.055)	(0.038)**	(0.071)**	(0.046)***
disttrad	-0.459	-0.459	-0.401	-0.401	-0.466	-0.466	-0.411	-0.411	-0.479	-0.479	-0.426	-0.426
	(0.073)***	(0.056)***	(0.095)***	(0.066)***	(0.073)***	(0.056)***	(0.094)***	(0.066)***	(0.073)***	(0.057)***	(0.094)***	(0.066)***
inftrad	0.130	0.130	0.177	0.177	0.126	0.126	0.173	0.173	0.116	0.116	0.160	0.160
	(0.050)***	(0.047)***	(0.065)***	(0.058)***	(0.050)**	(0.047)***	(0.065)***	(0.058)***	(0.050)**	(0.047)**	(0.064)**	(0.058)***
fisti	0.025	0.025	0.108	0.108								
	(0.084)	(0.091)	(0.108)	(0.119)								
aidti					0.430	0.430	0.511	0.511				
					(0.103)***	(0.099)***	(0.133)***	(0.125)***				
aidscn									0.644	0.644	0.751	0.751
									(0.097)***	(0.112)***	(0.125)***	(0.137)***
Observations	4860	4860	4860	4860	4860	4860	4860	4860	4860	4860	4860	4860

Note:

(1,3,5,7,9,11): Standard error in parentheses; (2,4,6,8,10,12): Robust standard errors in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.4

OLS with panel corrected standard errors						
	1	**2**	**3**	**4**	**5**	**6**
	lntsc1	**lnnsc1**	**lntsc1**	**lnnsc1**	**lntsc1**	**lnnsc1**
popfd	0.114	0.229	0.106	0.223	0.115	0.231
	(0.032)***	(0.064)***	(0.031)***	(0.063)***	(0.031)***	(0.064)***
agsi	-0.127	-0.266	-0.119	-0.255	-0.122	-0.260
	(0.024)***	(0.037)***	(0.026)***	(0.040)***	(0.026)***	(0.039)***
mwslcva	-0.408	-0.521	-0.402	-0.516	-0.417	-0.553
	(0.074)***	(0.106)***	(0.073)***	(0.105)***	(0.072)***	(0.100)***
edusi	0.385	0.376	0.380	0.371	0.377	0.356
	(0.067)***	(0.067)***	(0.067)***	(0.067)***	(0.070)***	(0.070)***
mpscn	0.182	0.383	0.181	0.379	0.163	0.347
	(0.053)***	(0.077)***	(0.052)***	(0.075)***	(0.052)***	(0.075)***
indsici	0.631	0.650	0.631	0.649	0.633	0.656
	(0.045)***	(0.053)***	(0.046)***	(0.053)***	(0.045)***	(0.053)***
indssi	0.101	0.163	0.102	0.168	0.102	0.166
	(0.028)***	(0.049)***	(0.028)***	(0.048)***	(0.027)***	(0.047)***
disttrad	-0.503	-0.400	-0.508	-0.405	-0.517	-0.419
	(0.059)***	(0.057)***	(0.059)***	(0.057)***	(0.060)***	(0.058)***
inftrad	0.148	0.175	0.141	0.169	0.135	0.162
	(0.032)***	(0.034)***	(0.033)***	(0.035)***	(0.033)***	(0.036)***
fisti	0.084	0.161				
	(0.083)	(0.091)*				
aidti			0.493	0.570		
			(0.086)***	(0.103)***		
aidscn					0.526	0.787
					(0.068)***	(0.069)***
Observations	4860	4860	4860	4860	4860	4860

Panel corrected standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.5a

	Subperiods											
	1990-1998	1990-1992	1993-1994	1995-1998	1990-1998	1990-1992	1993-1994	1995-1998	1990-1998	1990-1992	1993-1994	1995-1998
	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1	lntsc1
popfd	0.114	0.203	0.140	0.031	0.106	0.184	0.133	0.028	0.115	0.196	0.138	0.031
	(0.063)*	(0.106)*	(0.127)	(0.083)	(0.062)*	(0.105)*	(0.126)	(0.082)	(0.062)*	(0.106)*	(0.125)	(0.082)
agsi	-0.127	-0.070	-0.060	-0.201	-0.119	-0.061	-0.049	-0.199	-0.122	-0.065	-0.040	-0.199
	(0.079)	(0.116)	(0.150)	(0.118)*	(0.078)	(0.116)	(0.151)	(0.117)*	(0.077)	(0.116)	(0.149)	(0.116)*
mwslcva	-0.408	-0.526	-0.303	-0.367	-0.402	-0.443	-0.293	-0.370	-0.417	-0.454	-0.293	-0.382
	(0.120)***	(0.252)**	(0.221)	(0.154)**	(0.119)***	(0.249)*	(0.221)	(0.154)**	(0.119)***	(0.252)*	(0.221)	(0.154)**
edusi	0.385	0.288	0.404	0.278	0.380	0.304	0.407	0.276	0.377	0.308	0.414	0.280
	(0.106)***	(0.186)	(0.220)*	(0.157)*	(0.107)***	(0.192)	(0.220)*	(0.158)*	(0.108)***	(0.191)	(0.218)*	(0.158)*
mpscn	0.182	0.480	0.293	0.118	0.181	0.475	0.287	0.117	0.163	0.450	0.258	0.108
	(0.048)***	(0.079)***	(0.110)***	(0.059)**	(0.048)***	(0.080)***	(0.110)***	(0.059)**	(0.047)***	(0.081)***	(0.110)**	(0.059)*
indsici	0.631	0.782	0.681	0.683	0.631	0.778	0.674	0.682	0.633	0.773	0.672	0.682
	(0.084)***	(0.148)***	(0.153)***	(0.089)***	(0.084)***	(0.146)***	(0.153)***	(0.090)***	(0.083)***	(0.148)***	(0.155)***	(0.090)***
indssi	0.101	0.162	0.100	0.036	0.102	0.161	0.104	0.036	0.102	0.158	0.100	0.037
	(0.054)*	(0.093)*	(0.100)	(0.066)	(0.053)*	(0.089)*	(0.100)	(0.066)	(0.053)*	(0.091)*	(0.100)	(0.064)
disttrad	-0.503	-0.160	-0.407	-0.540	-0.508	-0.163	-0.410	-0.538	-0.517	-0.193	-0.437	-0.542
	(0.080)***	(0.136)	(0.155)***	(0.116)***	(0.079)***	(0.135)	(0.156)***	(0.116)***	(0.080)***	(0.137)	(0.158)***	(0.118)***
inftrad	0.148	-0.032	0.094	0.236	0.141	-0.051	0.095	0.238	0.135	-0.073	0.074	0.237
	(0.067)**	(0.110)	(0.145)	(0.100)**	(0.068)**	(0.111)	(0.143)	(0.101)**	(0.068)**	(0.110)	(0.144)	(0.101)**
fisti	0.084	-0.133	0.080	0.058								
	(0.118)	(0.249)	(0.278)	(0.135)								
aidti					0.493	0.712	0.443	0.198				
					(0.133)***	(0.271)***	(0.298)	(0.165)				
aidscn									0.526	0.871	0.820	0.300
									(0.135)***	(0.239)***	(0.306)***	(0.159)*
Observations	4860	1620	1080	2160	4860	1620	1080	2160	4860	1620	1080	2160
R-squared	0.66	0.66	0.68	0.69	0.66	0.66	0.68	0.69	0.65	0.66	0.68	0.69

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.5b

	Subperiods								
	1990-1998	1990-1993	1994-1998	1990-1998	1990-1993	1994-1998	1990-1998	1990-1993	1994-1998
	lnnsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1	lnnsc1
popfd	0.229	0.406	0.101	0.223	0.400	0.097	0.231	0.413	0.102
	(0.068)***	(0.106)***	(0.083)	(0.068)***	(0.106)***	(0.083)	(0.068)***	(0.107)***	(0.085)
agsi	-0.266	-0.169	-0.398	-0.255	-0.147	-0.395	-0.260	-0.146	-0.387
	(0.090)***	(0.122)	(0.119)***	(0.089)***	(0.121)	(0.120)***	(0.087)***	(0.116)	(0.118)***
mwslcva	-0.521	-0.798	-0.363	-0.516	-0.771	-0.368	-0.553	-0.781	-0.399
	(0.128)***	(0.230)***	(0.146)**	(0.127)***	(0.228)***	(0.145)**	(0.128)***	(0.228)***	(0.147)***
edusi	0.376	0.365	0.350	0.371	0.370	0.347	0.356	0.378	0.331
	(0.099)***	(0.152)**	(0.136)***	(0.100)***	(0.153)**	(0.136)**	(0.100)***	(0.153)**	(0.136)**
mpscn	0.383	0.631	0.094	0.379	0.618	0.093	0.347	0.586	0.083
	(0.055)***	(0.083)***	(0.064)	(0.054)***	(0.082)***	(0.064)	(0.055)***	(0.084)***	(0.067)
indsici	0.650	0.637	0.697	0.649	0.629	0.698	0.656	0.625	0.699
	(0.084)***	(0.144)***	(0.097)***	(0.084)***	(0.144)***	(0.097)***	(0.087)***	(0.148)***	(0.105)***
indssi	0.163	0.288	0.069	0.168	0.301	0.070	0.166	0.296	0.071
	(0.054)***	(0.091)***	(0.065)	(0.053)***	(0.089)***	(0.065)	(0.054)***	(0.090)***	(0.064)
disttrad	-0.400	-0.164	-0.539	-0.405	-0.180	-0.539	-0.419	-0.215	-0.548
	(0.073)***	(0.112)	(0.096)***	(0.073)***	(0.112)	(0.096)***	(0.074)***	(0.113)*	(0.098)***
inftrad	0.175	0.017	0.318	0.169	0.010	0.317	0.162	-0.017	0.318
	(0.063)***	(0.096)	(0.087)***	(0.064)***	(0.096)	(0.087)***	(0.064)**	(0.096)	(0.087)***
fisti	0.161	0.184	0.063						
	(0.124)	(0.241)	(0.127)						
aidti				0.570	0.855	0.232			
				(0.137)***	(0.248)***	(0.142)			
aidscn							0.787	1,067	0.374
							(0.151)***	(0.246)***	(0.149)**
Observations	4860	2160	2700	4860	2160	2700	4860	2160	2700
R-squared	0.29	0.30	0.33	0.30	0.30	0.33	0.29	0.30	0.31

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%