Trade and the Effect of Public Investment on Regional Inequalities in Heterogeneously Integrated Areas

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1. INTRODUCTION

THE creation of a number of trade integration arrangements – such as the European Union (EU) and the North American Free Trade Agreement (NAFTA) – has aroused worldwide debate on the effect of trade as channelling economic activity. Trade influences a country's growth rate by impacting upon the level of economic activity and by facilitating the transmission of technology across borders (Keller, 1997). However, whereas opponents to trade integration in the US draw attention on its effects on labour markets, supporters point out the long-run beneficial impact on economic growth of a larger market for US goods.[1] Thus, an intriguing question is whether economic integration enhances any appreciable effects in the distribution of economic activity in those countries, especially those relatively poor and less developed. Although subject to changing determinants, if trade intensity is region-specific, patterns of trade might lead to a significant concentration of economic activity in a small set of regions. However, competing new economic geographic theories point out that regional integration might serve to deeply reduce inequalities in the long run (Fujita, Krugman and Venables, 1999; and Puga, 1999). Indeed, it is suggested that under conditions of

[1] Most studies coincide in suggesting that intra-regional trade creation outweighs trade diversion, although there might be increased adjustment costs arising from shifting resources across sectors and across regions (Burfisher et al., 2001).

regional integration and agglomeration economies, regional inequalities might shrink when interregional wage differentials are sizeable and labour mobility is small.

A remarkably challenging natural experiment is the one of the European Union in which, unlike in the NAFTA, specific mechanisms have been enacted to provide public assistance to less developed regions. Indeed, relatively poorer countries such as Spain have benefited from Structural Funds assigned by the EU. Thus, public investment has been envisaged as a regional policy tool designed to reduce regional disparities. However, some recent contributions suggest that the reduction of transaction costs lessens the advantage of firms to operate from peripheral areas and thus leads to the opposite effect on regional disparities (Martin and Rogers, 1995; and Martin, 1999). Interestingly, empirical studies using different methodologies (García Mila and McGuire, 2001; De la Fuente and Vives, 1995; and Boldrin and Canova, 2001) point towards a weak impact of EU regional funds on regional disparities and convergence. On the other hand, one might well argue that national public investment policies may still play a role in reducing income disparities,[2] which calls for country-specific analysis.

In examining the role of public investment in reducing regional disparities, one might need to consider the composite effect of private investment. Public investment attracts, and thus complements, private investment (e.g., countries departing from a poor level of public infrastructure), while it could act upon substituting the existing shortages of private investment due to the geographical location or, arguably, lack of entrepreneurial tradition. By distinguishing between somewhat competing theoretical conceptions of the role of public capital – entering in the production function as a complementary input to private capital (Arrow and Kurz, 1970) or, alternatively, as an input to private production (Barro, 1990) – we might provide some insights on the role of public investment as influencing regional inequalities. Yet, because the impact of public investment on the spatial distribution of economic activity might have shifted as a result of regional integration processes, we believe that part of this economic policy debate could benefit from a comprehensive examination of the specific influence of trade as driving regional disparities. That is, whether trade combined with a hypothetical reduction of transaction costs – resulting from larger public investment – influences the distribution of economic activity is our key empirical question that we address here. In doing so, whether both public and private investment exert a specific influence on regional income is a second empirical question.

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[2] That is, the effect of public investment still has to be channelled by the nation states rather than the EU. Other noteworthy differences include the fact that the European tradition of trade integration dates back to the 1950s and has progressively incorporated states and deepened its objectives.

The aims of this study are twofold. First, we aim at examining the hypothesis of trade – measured through export intensity – as channelling the effects of public investment on economic activity. Second, within this framework we evaluate the complementariness or substitutive effects of private investment in bridging regional inequalities. Our empirical analysis relies on two countries, namely Spain and Mexico, both members of the OECD – and 'followers'[3] in their respective trade integration arrangements – the European Union (EU)[4] versus the North America Free Trade Agreement (NAFTA) – but they differ in the nature of the regional integration arrangement in which they are involved with, in their level of economic development as well as in the way that public funds are internally distributed. In addition, comparing Spain and Mexico is intriguing as far as the two countries share some interesting similarities in the process of trade integration with richer partners, namely the EU and the US respectively. Theoretical reasons behind the selection of both countries are grounded in the light of the new economic geography which state that trade integration might re-orient economic activity of poorer trade partners (Fujita, Krugman and Venables, 1999). Indeed, both countries stand as examples of the effects of trade liberalisation in shifting regional economic performance (Hanson, 1996 and 1998; and Venables, 2001).

The paper is organised as follows. Section 2 summarises the main theoretical background. Section 3 outlines the context of the Mexican and Spanish economies. Section 4 describes the empirical methodology, while Section 5 analyses the results yielded and presents a discussion of the outcome and theory. Finally, some conclusions are drawn in Section 6.

2. THEORETICAL AND EMPIRICAL BACKGROUND

In recent years regional policies in Europe and in North America have been deeply influenced by a tendency to invest in infrastructure. The logic of this position relies on the hypothetically tangible direct beneficial impact of productivity on regional growth. However, these effects, as we hypothesised, depend on the role of trade in fuelling public investment. Empirical evidence shows that an increasing volume of trade between countries is likely to reduce income gaps and

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[3] The term 'follower' used in this paper refers to the concept involving periphery areas, which are typically relatively poor and with less power to influence the development of the integration process.

[4] The EU can be conceptualised as an arrangement that goes beyond trade liberalisation. Another reference area, although exclusively grounded on promoting trade, the North America Free Trade Agreement (NAFTA), has effectively been in place since the mid-1990s. Both arrangements offer an interesting application field showing how the income of regions involved in intensive trade evolved as a result of public investment and trade.

improve economic growth (Ben-David and Loewy, 1998). However, from a specific country perspective, a movement towards free trade requires infrastructure improvements.

Standard economic theory predicts that economic integration improves the terms of trade of countries involved (Mundell, 1964) and regions within countries (Irwin and Terviö, 2000). This has been empirically tested both for the EU (Gasiorek et al., 1992) and NAFTA (Francois and Shiells, 1994). Empirical evidence suggests that increasing exports of poorer countries to their wealthier partners leads to an increase in the convergence rate between those countries (Ben-David and Kimhi, 2000). Nonetheless, trade agreements between developing countries may possibly lead to income divergence, whereby the wealthier partner benefits from the poorer; and the opposite holds when developing countries trade with high income countries. In the latter case, it is more likely to meet income convergence (Venables, 1999).

Moreover, a country's specific geography and local infrastructure are significant and important determinants of both transport costs and bilateral trade flows (Limao and Venables, 1999). For instance, landlocked regions or regions surrounded by others with a deficient infrastructure may be at a disadvantage. If this holds, a core-periphery structure could emerge. A reduction in transaction costs would lead to spatial concentration of increasing return industries in the 'core' of a trade area, whereas the periphery would specialise in constant return to scale industries (Krugman, 1991). By improving the access of poor countries (periphery) to core countries (centre) it is likely that the processes of divergence and industrial concentration would accelerate (Martin, 1999).[5] Other contributions suggest that a decline in trade costs would be expected to produce inequality among regions in the first stage followed by a second stage where inequalities would shrink (Fujita, Krugman and Venables, 1999). Empirical evidence to test new economic geography models (Hansen, 1996 and 1997) indicates that nominal wages decrease with the distance from industrial centres. Furthermore, Hanson (1998) finds that trade liberalisation shifted regional Mexican industrial employment so that it became negatively associated with distance to the US border after 1985. Furthermore, similar evidence is found in the EU. Venables (2001) identifies two European wage gradients, one from the EU core to Greece, Portugal and Spain, and another from Western to Eastern Europe.

Other related literature deals with the effect of public investment in the light of other supply-side determinants, such as human capital (Barro and Sala-i-Martin,

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[5] Martin (1999) posits at the core of the discussion the role of transaction costs between regions and also within regions, both being affected by public infrastructure. The equilibrium location of industries impacts on the common rate of innovation due to local technology spillovers lessening innovation costs and fostering industrial concentration. Accordingly, increasing returns would cause cumulative growth divergence between regions (Faini, 1984).

1991).[6] Regions attracting a large share of skilled workers and infrastructures may be those that are more dynamic which, in turn, are more likely to attract private capital (Mulligan and Sala-i-Martin, 1993). Therefore, we might expect public and private capital to interact in determining economic activity. Yet, the interactions between public capital and income have been extensively examined (Arrow and Kurz, 1970; and Barro, 1990). Barro and Sala-i-Martin (1992) discuss the characteristics of different types of public investment, although they suggest that public investment plays a complementary role to private investment. However, if public capital is financed by additional taxes, this might serve to reduce resources from private capital, having thus a possible substitutive effect.[7] Finally, one might well argue that the complementariness and substitutive effects of private investment might depend on the degree of economic development (Hirschman, 1958) whereby in a preliminary state of economic development, public investment is likely to be allocated to develop urban regions whereas in advanced stages of development, public investment distribution would become more even. Accordingly, we might hypothesise that public investment follows private investment in relatively less developed countries' private investment (e.g., Mexico), whilst the opposite applies to Spain which not only benefits from EU structural funds, but arguably stands – in the period examined – at a higher degree of economic development.

3. REGIONAL INTEGRATION IN EUROPE AND NORTH AMERICA

Although differing in their objectives and speed of integration, the European Union (EU) and, more recently, the North American Free Trade Agreement (NAFTA) are two of the main regional integration arrangements which were – at least at their inception – fundamentally aimed at promoting trade. However, whilst the EU pursued some regional equality targets – especially after the approval of the Single European Act – NAFTA aimed at purely fostering free internal trade (Bosworth, Collins and Lustig, 1997).[8] Consequently, no compensatory mechanisms were developed within NAFTA at the regional level. Nonetheless, European regional policy, at least from its policy dispositions is

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[6] Empirical evidence using regional data highlights that the accumulation of human capital is among the main explanatory variables for differences in economic growth between regions (De la Fuente and Vives, 1995), preventing the marginal product of physical capital from falling (Lucas, 1993).

[7] Therefore, some approaches tend to rely exclusively on the net contribution of public investment in reducing regional disparities (Borts, 1960; and Siebert, 1969).

[8] However, some structural adjustment public programmes exist. The NAFTA-TAA programme provided assistance to workers who have lost their jobs because of increased import competition from Mexico or Canada or because of production shifts to Mexico or Canada.

designed to stimulate economic activity in less favoured regions by supplementing private sector investment. Indeed, the EU makes use of four Structural Funds through which it conveys financial assistance to regions which qualify as recipients according to their structural economic and social conditions.[9] Given that Spain stands as a net receiver, arguably these kind of funds are likely to have an impact on Spanish regional disparities (De la Fuente and Vives, 1995). However, the effect of both structural funds and national policies does not seem to provide successful results; given that the Spanish regional sigma coefficient[10] increased to 0.22 in 1998 as Table 1 exhibits. Furthermore, Figure 1 plots the Spanish per capita GDP relative to the national average in 1991 against its value in 1998, with a 45-degree line to facilitate comparison.[11] This figure suggests that, generally speaking, high-income regions have improved their position, while the remaining regions have experienced mixed results. Interestingly enough, of all southern European countries only Spain shows a weak downturn in regional income inequalities (Boldrin and Canova, 2001). In the case of the NAFTA, it can be argued that it is still too early to judge its outcome, in part because its provisions

TABLE 1
Sigma Convergence: Mexican and Spanish Regions

| Year	Mexico	Spain
1985	0.32	0.19
1988	0.41	0.19
1993	0.42	0.18
1994	0.41	0.19
1995	0.43	0.19
1996	0.44	0.19
1997	0.45	0.21
1998	0.45	0.22
1999	0.44	–
2000	0.48	–

Source: Authors' own calculations.

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[9] EU funds are allocated according to its main objectives. About 30 per cent of the fund is spent on infrastructure investment, including telecommunications and energy, which is justified by the fact that disparities in infrastructure are larger than those in income (Martin, 1998). Another 30 per cent of the fund is allocated to support education, training systems and labour market policies. The remaining 40 per cent is devoted to subsidising industries.

[10] The sigma convergence coefficient is measured as the standard deviation of the log of per capita GDP. This coefficient measures how the distribution of income evolves over time (see Barro and Sala-i-Martin, 1995).

[11] The 45-degree line measures equality. Thus, dots over the line regions indicate an improvement in their relative position on the income scale compared to the initial year; dots beneath the line indicate that regions have worsened while dots on the line represent regions that have not changed their position.

FIGURE 1
Per Capita GDP Relative to the 1991–1998 Average: Spanish Regions
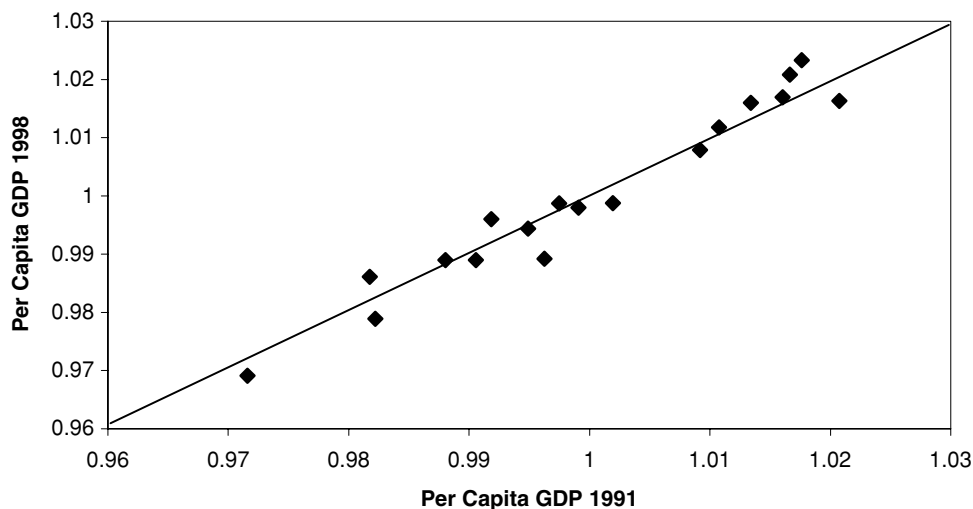
have not yet taken effect (Krueger, 2000). Between 1993 and 2001, US exports to Mexico increased by 144 per cent, and US imports from Mexico increased by 229 per cent (US National Trade Commission, 2003).[12] However, not all changes in trade patterns can be attributed to NAFTA as far as trade was also affected by other (unrelated) economic factors, e.g., economic growth and currency fluctuations. While some tariffs and other barriers were eliminated immediately, others are expected to be phased out gradually until 2008. In the Mexican case, the devaluation of the peso during NAFTA's infancy in late 1994 plunged the country into a severe recession and sharply altered trade flows.[13] In this context of recurrent crises since the mid-1980s, the differences among Mexican regions have increased. Interestingly the standards of living have become more polarised between north and south (Juan-Ramón and Rivera-Batiz, 1996),[14] with the country displaying a sigma coefficient of 0.45 in 1998, which doubles the coefficient of Spanish regions (Table 1). Unlike the EU, the NAFTA does not include any programme of structural funds to alleviate differences in regional disparities, and regional policy is left exclusively in the hands of the Mexican Federal Government. Figure 2 plots per capita GDP in 1993 relative to the national

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[12] United States International Trade Commission, Interactive Tariff and Trade Data Web http://dataweb.usitc.gov

[13] Overall US-Mexico trade has increased over the last two decades. From 1993 to 1996 annual bilateral trade grew from $81.5 billion to $128.1 billion.

[14] The north of Mexico, close to the US border, has benefited greatly from US foreign direct investment.

FIGURE 2
Per Capita GDP Relative to the Mean, 1993–2000: Mexican Regions
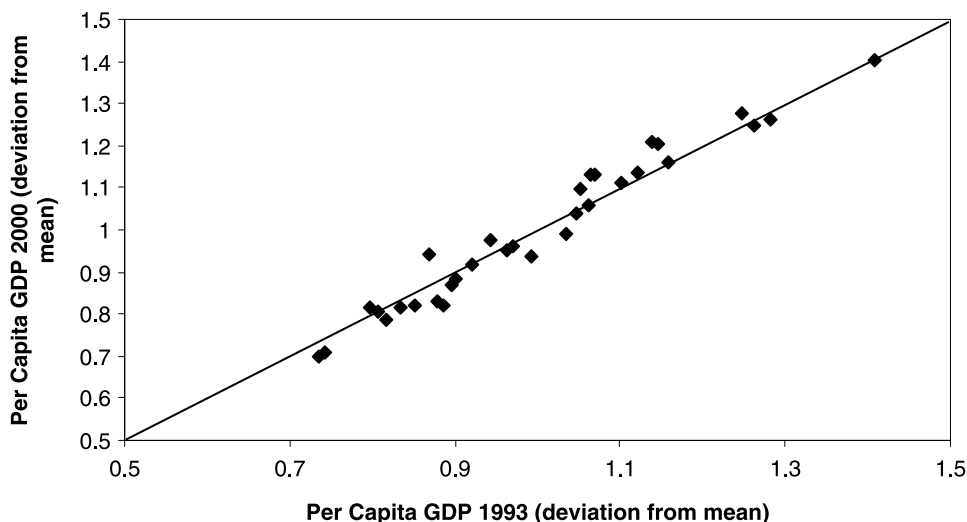
average against the same variable for year 1998, and draws a 45-degree line for comparison. Although most of the states remain close to the 45-degree line it is noticeable that the regions with higher per capita GDP in 1993 are slightly above the 45-degree line, while regions with lower per capita GDP in 1993 tend to stay along the 45-degree line or under that line.

4. EMPIRICAL ANALYSIS AND THE DATA

a. Empirical Specification

As noted, this paper aims at empirically estimating the impact of trade, public investment and other relevant factors on regional income which is taken as an indicator of economic activity. However, notice that at the regional level, measures of the relative position in the regional income distribution would yield equivalent results as estimating the effect of the relevant variables on income. From a pure growth model the main explanatory variables are taken in per capita terms (y_{it})[15] where y_{it} denotes regional income obtained using the log of per capita GDP, i refers to the geographical unit and t to time. Our model includes as

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[15] Departing from the conventional production function Y_{it} where K_{it} is stock of capital of the economy, G_{it} refers to public investment and L_{it} total employed population. Assuming constant reruns to scale, $y = Y/L$, $k = K/L$, $g = G/L$.

explanatory variables, per capita public investment (g_{it}) and per capita private investment (k_{it}). Moreover, other explanatory variables are population's schooling attainment (S_{it}) as influencing industrial localisation,[16] and our key variable is regional trade (T_{it}), which is weighted by regional income to account for a degree of region/state openness. Furthermore, a set of regional specific characteristics (Z) are included in equation (1) as follows:

$$y_{it} = y(g_{it}, k_{it}, T_{it}, S_{it}, Z_{it}). \tag{1}$$

Measuring the effect of public and private investment in developing and transition economies where data on capital stocks are not available often implies undertaking some assumptions to capture the influence of both public and private. Indeed, in this study for Mexico only the flow of public investment (g) was available rather than the stock which in turn was measured in per capita terms. However, it is common practice in the absence of capital stock to interpret investment as a proxy for total capital. Additionally, a variable for private capital (k) was used in the analysis to take into account the hypothetical complementary role of private investment. One would expect public investment to reduce regional inequalities if public investment is allocated to poorer regions. However, if public investment is allocated to encourage trade – and, as we show, if trade propensity is more intense in relatively richer regions – then it might be reasonable to expect an opposite effect. The effect of public investment in the income equation is information of the existence of regional inequalities once accounting for other repressors (e.g., education, trade etc).

In addition to the variables included in (1), we might find some evidence of a catching-up process. That is, part of the variability of regional income is captured by the initial income levels. Empirically, this feature is measured using a variable that takes the value of the initial regional GDP. Consequently, we have decided to use a five-year lag of the log of per capita GDP (y_{it-5}) as a variable that measures the catching-up effect without being influenced by the use of a specific initial period.

Regional income may be influenced by some region-specific individual effects, for example, unobserved characteristics of the areas influencing the process that do not change over time.[17] Since specific individual effects might bias the

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[16] Regions with high education attainments should show greater economic activity and, in turn, greater regional income (Krugman, 1991).

[17] In order to control for these effects, and following the patterns of disparities, we first use a set of dummy variables to isolate the effect of, in the case of Mexico, being an oil producer (OIL), a region in the (NORTH) or in the (CENTRE) of the country; in the case of Spain dummies employed were being an island (ISLAND) and being along the northern border (North Border) to account for the greater economic dynamism that border regions might have.

estimates, the model allows for region-specific fixed effects and time effects in order to control for variables that might have common effects on the regions in a given year, such as business cycles, etc. The empirical model specified is the following:

$$y_{it} = \alpha + \beta_1 T_{it} + \beta_2 g_{it} + \beta_3 k_{it} + \beta_4 S_{it} + \beta_5 y_{it-5} + \beta_6 Z_{it} + u + \varepsilon_{it}. \tag{2}$$

The model in equation (2) includes trade as an explanatory variable where u refers to the fixed-effects parameter and ε is a random disturbance. However, trade is commonly determined by income and, thus, the above specification could bring endogeneity concerns (Frankel and Romer, 1999; and Irwin and Terviö, 2000). To deal with this problem, equation (2) is estimated using instrumental variables using 2SGLS, as is common practice when using panel data models to account for endogeneity. Furthermore, we estimate the model using the Arellano and Bond (1991) method to account for the bias introduced by the lagged endogenous variables as well as endogeneity in the repressors.[18]

The complimentariness or substitution relationship between public and private investment is measured by examining the sign of the coefficients. A positive significant coefficient implies that both compete in determining regional income and growth, whereas a null (non-significant) coefficient implies that the effect of one sort of investment is driven by the other. A negative coefficient of private investment could be interpreted as public investment crowding-out private investment and thus negatively affecting income.

The central variables to describe our model are trade and geographic specific variables. Economic activity and trade are dependent on geographical characteristics such as proximity to the border (McCallum, 1995; Crucini et al., 2000; Anderson and Wincoop, 2001; and Brown and Anderson, 2002). However, there is still significant debate on board. Peach and Adkinson (2000) analysed the border effect on the opposite side of the NAFTA – that is the frontier between the USA and Mexico – and found that in US border regions the NAFTA agreement has not yet increased economic activity. We include two region-specific variables to measure the possible effects of economic integration, 'Centre' in Mexico and 'North border' in Spain, as defined in Table 2. Other determinants are possible economic agglomerations resulting from natural endowments such as oil production in Mexico (Oil) and the specific effects of certain isolated regions in Spain such as the Balearic Islands and the Canary Islands.

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[18] Arellano and Bond (1991) is a generalised method of moments (GMM) estimator that treats the model as a system of equations, one for each time period. The equations differ only in their instrument/moment condition sets where the predetermined and endogenous variables (in first differences) are instrumented with suitable lags of their own levels.

b. The Data

Data used for Mexican regions have been collected for the period 1993 to 2000 (the only period for which data on exports were available at the time of the study) and data from Spain refer, to the period 1991 to 1998[19] and were collected from different sources.[20] The variables are inserted in logarithm form except when expressed as an index or as a percentage. Table 2 displays a set of basic statistics used for the variables, as well as the definition of the variables employed.

TABLE 2
Variable Definition and Descriptive Statistics
(Mean and standard deviation in parentheses)

Variable	Definition	Mexico	Spain
y_{it}[a]	Log of the per capita GDP	2.54 (0.44)	12.28 (2.85)
y_{it-5}[b]	Log of the per capita GDP lagged 5 years	2.47 (0.43)	12.17 (2.86)
T_{it}[c]	The ratio of the state's exports to the state's GDP	0.153 (0.21)	0.186 (0.38)
g_{it}[d]	Log of the per capita public investment	5.97 (0.71)	10.81 (2.85)
k_{it}[a]	Log of per capita gross capital formation	8.98 (0.54)	8.97 (2.99)
S_{it}	Log of the average years of schooling of population aged 15 and over	1.96 (0.14)	6.87 (0.85)
Centre	1 for Mexico DF	0.15 (0.36)	–
Oil	1 for Campeche and Tabasco	0.06 (0.36)	–
Island	1 for Islands (Balearics and Canaries)	–	0.12 (0.32)
North border	1 for North border (Catalonia, Basque Country, Navarra and Aragon)	–	0.23 (0.42)

Notes:
[a] Instituto Nacional de Estadística, Geografía e Informática (México) and Contabilidad Regional de España, Instituto Nacional de Estadística (Spain).
[b] Secretaría de Comercio y Fomento Industrial (México) and Instituto de Comercio Exterior (Spain).
[c] Statistical Annexes of the Presidential Address to the Nation (México) and Contabilidad Regional de España, Instituto Nacional de Estadística (Spain).
[d] Statistical Annexes of the Presidential Address to the Nation (México) and IVIE (Instituto Valenciano de Investigaciones Económicas) and Bancaja (Spain).

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[19] We have not included year 1999 in order to prevent the empirical analysis to be influenced by the setting up of the common currency (the euro).
[20] Data from Mexico was principally provided by the Instituto Nacional de Estadística, Geografía e Informática (INEGI – National Institute of Statistics, Geography and Information Systems). Data on Spanish regions were obtained from ICEX and Base de Datos de Conocimiento Regional BBV (Table 2 describes in detail the sources and limitations of the data employed).

TABLE 3
Determinants of Regional Income in Mexico
(Dependent variable: log of per capita GDP per state)

	GLS	GLS	2SLS	2SLS	Arellano/Bond (1991)
Intercept	0.093	−2.29***	0.190	−2.05***	−0.003**
	(0.168)	(0.408)	(0.63)	(0.39)	(0.001)
y_{it-5}	0.978***	–	0.95**	–	0.763***
	(0.025)		(0.026)		(0.003)
T_{it}	0.06*	0.1744	−0.030	0.488***	0.372***
	(0.048)	(0.126)	(0.075)	(0.168)	(0.032)
g_{it}	0.0231*	0.170***	0.024**	0.211***	0.017***
	(0.012)	(0.029)	(0.013)	(0.034)	(0.045)
k_{it}	−0.010	−0.031	−0.017	−0.046	−0.065
	(0.012)	(0.031)	(0.011)	(0.029)	(0.052)
S_{it}	−0.015	2.05***	−0.05	1.85***	−0.04***
	(0.073)	(0.131)	(0.075)	(0.142)	(0.012)
Oil	−0.60*	−0.04	−0.45	−0.04	−0.13
	(0.17)	(0.03)	(0.39)	(0.03)	(0.45)
Centre	0.049**	0.020**	0.027**	0.001	0.24**
	(0.064)	(0.040)	(0.01)	(0.009)	(0.040)
Wald test χ^2	5768.8	628.3	5719.65	647.17	45,788
	(0.00)	(0.00)	(0.00)	(0.00)	
R^2	0.87	0.90	0.88	0.88	
N	256	256	256	256	256
χ^2 Hausman fixed vs random	214.42	151.48			
	(0.00)	(0.00)			
Sargan test					23.39

Notes:
***, ** and * denote significance at 1, 5 and 10 per cent, respectively. All regressions include time effects. Diagnostic tests refer to the hypothesis that all parameters are zero. Hausman is employed to select the fixed effects and random effect model and the Sargan test is used to elucidate the existence of variable over-identification.

5. RESULTS

This section reports the empirical estimates of the study. Results from equation (2) are shown in Table 3 for the Mexican regions and Table 4 for Spain. Table 5 contains estimates of auxiliary regional trade propensity determinants to improve the understanding of interactions in the instrumental variables estimation procedure.[21] Estimates for Mexico cover 32 regions and eight years, and

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[21] Hypothetically, the variables employed may raise concerns about the existence of endogeneity, heteroscedasticity and multicollinearity issues and about whether the results are robust. To account for all of these issues, we adopted the Hausman test (Hausman, 1978) for endogeneity, and the White test for heteroscedasticity (White, 1980). Multicollinearity has been tested through the variation inflation factor.

TABLE 4
Determinants of Regional Income in Spain
(Dependent variable: log of per capita GDP per state)

	GLS	GLS	2SLS	2SLS	Arellano/Bond (1991)
Intercept	1.326***	1.608***	1.0134***	2.137***	−0.019**
	(0.170)	(0.309)	(0.215)	(0.421)	(0.008)
y_{it-5}	0.707***	–	0.720***	–	0.764***
	(0.057)		(0.057)		(0.03)
T_{it}	−0.282***	−0.349***	−0.239**	−0.048	−0.197**
	(0.066)	(0.121)	(0.101)	(0.19)	(0.110)
g_{it}	0.056*	0.284***	0.042**	0.332***	0.038**
	(0.033)	(0.050)	(0.018)	(0.058)	(0.020)
k_{it}	0.023***	0.708***	0.224***	0.642***	0.182***
	(0.049)	(0.056)	(0.053)	(0.068)	(0.026)
S_{it}	−0.086***	0.087**	−0.094***	0.033	−0.087
	(0.170)	(0.037)	(0.215)	(0.421)	(0.060)
Island	−0.06	0.11	−0.059	−0.19	−0.039
	(0.04)	(0.08)	(0.046)	(0.15)	(0.110)
North border	−0.153**	−0.038	−0.152**	−0.041	−0.156**
	(0.029)	(0.052)	(0.032)	(0.045)	(0.078)
R^2	0.99	0.99	0.99	0.99	
Wald test χ^2	1554.38	4329.67	16,897.5	4456.78	61,803
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	119	119	119	119	119
χ^2 Hausman fixed vs random	50.50	27.09			
	(0.000)	(0.00)			
Sargan test					16.09

Notes:
***, ** and * denote significance at 1, 5 and 10 per cent, respectively. All regressions include time effects. Diagnostic tests refer to the hypothesis that all parameters are zero. Hausman is employed to select the fixed effects and random effect model and the Sargan test is used to elucidate the existence of variable over-identification.

estimates for Spain cover the 17 regions (Autonomous Communities) and seven years. We have estimated the regression models using generalised least squares (GLS) to correct for possible autocorrelation within panels along with cross-sectional correlation and/or heteroscedasticity across panels. In addition, we use 2SGLS to account for endogeneity. Because we use the lag of regional income as an explanatory variable we have performed the Arellano and Bond (1991) estimator to account for the effect of the lags of the endogenous variables. The regression results should be read as follows. The first two columns refer to GLS estimates, the next two columns focus on the 2SLS and the final column reports the results of the Arellano-Bond (1991) dynamic panel data estimator. For both Mexico and Spain the panel data models were estimated using fixed effects, after passing the Hausman test as shown repectively in Tables 3 and 4.

Let us first describe the effects of public investment in regions income (growth). From Tables 3 and 4, we find that the effect of public investment in Mexico is positive and significant and the explanatory power of the equations is notably high. However, private investment is never significant, which provides evidence that private investment in Mexico might not substitute public investment but rather have a complementary role, the coefficient of public investment might instead capture the effects that private investment have on regional income and growth (Table 3). Similarly, public investment exercised a significant impact on regional income growth in Spain although private investment exerted a positive and significant effect as well (Table 4). The fact that both are significant implies that there is a distinguished impact of private investment which does not purely complement public investment, but rather acts as a substitute. Thus, consistent with some prior research (Mulligan and Sala-i-Martin, 1993) income gaps would be expected to perpetuate pre-existing inequalities as far as public investment does not follow private funds. Interestingly, the effect of private investment on growth is around four times that of public investment. We performed the usual Hausman test to test the endogeneity of trade, and both in Mexico and in Spain we cannot reject the hypothesis of endogeneity of trade, even when lagged income was withdrawn from the model. When the endogeneity of trade was corrected for, the differential effect of private and public investment declined although the Arellano and Bond (1991) estimates suggest that these effects might be associated with possible bias associated with the income lag.

The effect of exports is significant both for Mexico and for Spain although they display opposite effects. Even when the effect of trade is corrected by endogeneity, this still remains a significant predictor of regional income in Mexico. Nonetheless, in Spain, exports enhance a negative effect. These feature results from the fact that Spanish regions that increased their export propensity did not experience equivalent increases in per capita income. This implies that, in the light of our results, regional inequalities in Spain were not significantly driven by regional export capacity as they were in Mexico, but that other variables such as public investment, private investment and schooling still explain a large share of regional income disparities. In fact, when no correction for endogeneity of trade is undertaken, this variable displayed a negative coefficient, contrary to those for private investment and schooling. In particular, this feature can be explained, taking into account the existing fiscal imbalances in the distribution of public investment in Spain (Costa and Tremosa, 2003).

As expected, when correcting for possible endogeneity, as well as when the Arellano-Bond (1991) estimator was employed, the effect of education becomes a significant predictor of economic performance in Mexico, whereas this is not the case in Spain. This might be explained by the differential degrees of economic development. Furthermore, human capital exerted a very strong influence on regional inequalities. However, this variable may be problematic as it

is highly correlated with the lag of per capita GDP.[22] Thus, to reduce collinearity we also estimate the regression without the income lag. Schooling has a highly positive and significant effect on regional income in Mexico, even when correcting for endogeneity, but not in Spain. This suggests that human capital has a significant impact on enhancing regional disparities in Mexico.[23] Nonetheless, one should bear in mind the long-run effects of human capital investment. In Spain, unlike in Mexico, education levels are more homogeneous across regions.[24]

Geographical dummy variables provide some significant results. Dummy variables measuring concentration of economic activity in Mexico DF in the Mexican case and Northern border region in the Spanish case. Interestingly we find that Mexico DF displays a positive coefficient, the effect of being a northern region in Spain is significant and negative, even using the Arellano and Bond (1991) estimation method. As expected, per capita GDP lagged five years has a positive and significant effect on regional disparities both in Spain and in Mexico. The larger the regional income at the beginning of the period of analysis, the more likely the region is to remain at the top of the income distribution scale during the period, which is congruent with the plots presented in Figure 2. Similarly, this variable is consistent with the data displayed in Figure 1 that showed that richer regions seem to benefit most from regional integration (Costa and Tremosa, 2003). Given that richer regions are also more open ($\sigma = 0.36$, $p < 0.01$), lagged GDP captured the variability that would correspond to openness if the former variable was excluded from the analysis.

Finally, Table 5 reports the estimates of the auxiliary equations used to instrument the effect of trade which refer to all possible variables as is common practice when performing 2SLS. As expected, lagged income places a significant and positive effect on regional trade. Furthermore, trade was positively explained by private investment and education in Spain and Mexico, while public investment did just exert some significant effect in Spain although just at the 10 per cent significance level. Finally, as expected according to the discussion in Section 2, geographical dummies did exert some effect. Indeed, in Mexico, being a centre region (centre) was a significant predictor of regional exports. Consistently, in Spain the border effect displayed a positive covariate in explaining trade intensity, while being an island displayed an opposite coefficient.[25]

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[22] The Spearman correlation is 0.79 for Mexico and 0.37 for Spain.
[23] The ratio that accounts for the distance between the maximum and the minimum regions in terms of educational achievement terms has fallen from a value of 2 to 1.8 in the period under analysis.
[24] The average range between average years of schooling falling between the maximum and the minimum is only 1.3, and the average years of schooling are higher than in the Mexican regions.
[25] We also tested for the endogeneity of public investment and trade, although this was rejected using a Hausman test both for Spain and Mexico.

TABLE 5
Regional Trade (Export) Propensity Determination
(Dependent variable: regional export/GDP)

	Mexico		Spain	
Intercept	−1.234***	−1.165**	−2.672***	−2.634***
	(0.352)	(0.298)	(0.37)	(0.379)
y_{it-5}	0.462***		0.115**	
	(0.092)		(0.048)	
g_{it}	0.001	0.002	0.030*	−0.013
	(0.020)	(0.020)	(0.016)	(0.02)
k_{it}	0.081*	0.092**	0.133***	0.060**
	(0.05)	(0.04)	(0.039)	(0.021)
S_{it}	0.345***	0.569***	0.175***	0.0142***
	(0.102)	(0.123)	(0.020)	(0.012)
Centre	0.172***	0.221***		
	(0.03)	(0.04)		
Oil	0.080	0.067		
	(0.06)	(0.043)		
Island			0.53**	0.130**
			(0.06)	(0.059)
North border			0.185***	0.184**
			(0.045)	(0.045)
Wald test χ^2	354	346	209	204

Notes:
Hubert/White/Sandwich standard error. Standard errors in parentheses. ***, ** and * denote significance at 1, 5 and 10 per cent, respectively. Diagnostic tests refer to the hypothesis that all parameters are zero.

6. CONCLUSION

This paper has examined the impact of the allocation of public investment on regional disparities in Mexico and Spain. Our main contribution refers to testing whether the effects of public investment were likely to be conducted through regional trade, in combination with private investment and human capital. Our first notable finding suggests that regional inequalities are sensitive to the effects enhanced by trade propensity. We find that trade displayed a significant effect on channelling part of the effect of public investment on growth and income. However, whereas in Mexico trade is positively associated with regional income and growth at the regional level, in Spain fiscal redistribution mechanisms interact in such a way that those regions that exhibit a higher propensity to trade are not necessarily those that have experienced larger levels of economic growth. Furthermore, public investment itself appears to make an individual contribution towards increasing trade. These results may be explained in light of Hirschman (1958) whereby Mexico might be understood to be in the first stage of the public investment process while Spain might be in a superior stage of development. Furthermore, we find evidence of a differential impact of public and private

investment in both countries. Whilst in Mexico public and private investments do not have an independent effect on income, in Spain they seem to show appreciable independent effects. This is explained by the mechanisms of internal redistribution as well as the fact that regions that experience higher levels of trade propensity are less likely to receive public funds.

Geographical determinants, such as being a border region, exert a negative effect in regional income and growth. In Mexico, the significance of the variable measuring concentration of economic activity in Mexico DF suggests that there are significant concentration effects although they seem to be sensitive to the effects of trade. Furthermore, the role of education in explaining income inequalities once accounting for the endogeneity of trade was only significant in Mexico. This might be explained by the lower levels of educational achievement that tend to encourage industrial localisation in those regions where a skilled labour force is more readily available. In the Mexican case, the lack of the so-called 'backward and forward linkages' would not attract manufacture to the less developed regions (Fujita, Krugman and Venables, 1999), and equalisation of income would come from the migration effect and education levels. Therefore, in light of these results Mexico should re-address its public investment policies towards reducing disparities in human capital which in turn might end up in reducing regional income disparities at a national level. Human capital may be less explanatory of regional disparities in Spain, since differences in educational achievement are smaller.

Overall, these results suggest that the stage and the development of regional trade integration arrangements experiences matter in explaining the regional distribution of economic activity. When trade channels economic activity and private investment – as in the case of Mexico – one might argue in favour of promoting policies to counteract the effects that trade integration has on economic activity. On the other hand, in Spain it is found that regional income and growth are negatively associated with trade when accounting for public and private investment determinants. In this setting, one might question the sustainability of a system of regional redistribution through public investment that penalises those regions that experience a higher trade propensity. Finally, in Mexico, internal trade policies should guarantee that all regions participate in the regional integration process if regional disparities are to be reduced.

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