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Integration and Tax Competition: An Empirical Study of OECD Countries

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Abstract: This paper studies the effects of integration on capital taxation in a number of OECD countries. Unlike most previous papers on the subject, we combine key features from the new economic geography theory with the standard tax competition framework. We consider effective as well as statutory corporate tax rates and include several measures of agglomeration forces in the analysis. Our empirical findings provide some support for both models. We find that increased integration has a negative effect on corporate tax rates while agglomeration forces influence tax rates positively, though the latter result is sensitive to how agglomeration is measured.

Key words: tax competition; new economic geography; economic integration

JEL classification: F12; F15; H72

I. Introduction

Recent decades have witnessed a deepening of economic integration worldwide that has removed many obstacles to international trade and investment. Alongside this globalization, there has been a surge in the number of regional integration areas. In some areas – the European Union being the most prominent so far – national borders have begun to lose economic importance. These trends, however, have been accompanied by a growing concern that increased integration may jeopardize the welfare state (Sinn (2002), Tanzi (2002)). That is, since free factor mobility allows both firms and workers to locate where tax rates are lowest, countries may feel pressured to lower tax rates in order to retain and to attract dynamic firms and able workers, which may ultimately spark a "race to the bottom". Indeed, an extensive literature has arisen that suggests that tax competition may lead to inefficiently low tax rates and sub-optimal levels of public spending (Wilson (1999)).

Tax rates are not the only determinants of the location of firms and workers, however. Factors such as market access, infrastructure, national stocks of "know-how", experience and technology generate externalities that are also likely to be important. These factors often lead to concentrations of economic activity, which has become the main focus of the relatively new field of economic geography. This research area emphasizes the importance of so-called agglomeration forces that tend to concentrate industrial location. Countries or regions that benefit from these forces may be able to retain and attract mobile factors in spite of high tax rates, and their presence may have a dampening effect on the "race to the bottom".

Most empirical studies of integration and taxation have focused on the effects of tax competition but have failed to address the implications stemming from the new economic geography. These studies find little evidence for the main implication of tax competition, namely that increased integration leads to lower tax rates. The purpose of this paper is to investigate whether taxes on mobile factors can be better explained by including variables that

are related to agglomeration in addition to conventional variables measuring tax competition. The analysis focuses on the determinants of corporate tax rates and includes such economic geography variables as membership in regional integration areas, trade costs, GDP per capita, closeness to markets, and the importance of industrial linkages in production, using data from a number of OECD countries over the last decades. This paper, thus, attempts to meet the need for an empirical analysis that takes into account explanatory variables from both settings.

Our empirical findings provide some support for both models. We find that increased integration has a negative effect on corporate tax rates while agglomeration forces influence tax rates positively, though the latter result is sensitive to how agglomeration is measured.

The potential policy implications from a study of this kind are obvious in light of the ongoing liberalization and increasing economic dependency among countries. The results may be of specific importance with respect to European integration and the need for tax harmonization between existing as well as with new members. In particular, if agglomeration forces affect the ability to tax mobile factors, the need for harmonization may be less acute than previously thought and the fear of harmful tax competition exaggerated.

The paper is organized as follows. The next section outlines the theoretical implications of the standard tax competition literature, together with the main findings of the new economic geography literature. Section III summarizes previous empirical studies on integration and taxation while our own statistical analyses are presented in sections IV. Sections V and VI provide a discussion of the results and some concluding remarks.

II. Theoretical background

The public finance literature has long analyzed tax competition (e.g. Zodrow & Mierzkowski (1986), Wildasin (1988) and Wilson (1991, 1999); see also Schulze & Ursprung, (1999), and

Haufler (2001) for surveys of the literature).[1] Recently, however, the relationship between integration and taxation has gained attention by researchers in the new economic geography field (Andersson & Forslid (1999), Haufler & Wooton (1999), Ludema & Wooton (2000), Kind *et al* (2000), Baldwin *et al* (2003)), and Baldwin & Krugman (2004)). This section presents, in a non-technical way, the basic insights from the two frameworks.

The Standard Tax Competition Model

In the basic setting, there are two factors of production: (physical) capital and labor. While capital can move freely across countries, labor is immobile. Governments provide a public good financed by levying taxes on capital and labor employed within their national borders, i.e. taxes are source-based. For simplicity, assume that tax rates on capital and labor are identical. When maximizing the utility of a representative consumer, government equates the marginal social benefits (MSB) of an increase in the provision of the public good with the marginal social costs (MSC). If capital were immobile, MSC would be the tax revenue increase needed to finance the additional supply of the public good. When capital is mobile, however, an increase in tax rates leads to an outflow of capital which reduces the tax base and the income of the representative consumer. Hence, marginal social cost must be higher and the tax rate below the optimal rate. This is illustrated in Figure 1 where the downward sloping MSB curve reflects the benefits of public goods and MSC and MSC′ are constant marginal social costs of raising tax revenues when capital is immobile and perfectly mobile, respectively. Comparing the tax rates and the implicit amount of public spending, the lower tax rate t' implies a sub-optimal supply of the public good and the figure indicates a negative relationship between factor mobility and tax rates. In other words, due to increased factor

[1] In addition, integration and tax rate determination have received interest from the public choice theory, though this perspective has recently been incorporated in the tax competition literature. According to public choice proponents, however, tax competition need not be particularly harmful as it serves to discipline wasteful governments (see e.g. Edwards & Keen (1996), Eggert (2001) and Sato (2003)).

mobility, continuing integration will be associated with ever-decreasing tax rates, the race to the bottom case.

When taxes on capital and labor are allowed to differ, it can be shown that the immobile factor will face a greater tax burden as countries attempt to retain their tax bases. The model also suggests that larger countries, as measured by the stock of labor, will be able to maintain higher tax rates than smaller countries since the negative effect of capital outflows of higher taxes is smaller in per capita terms when labor is assumed to be immobile. However, smaller countries may be better off since they will have higher capital to labor ratios and there is an incentive for them to play the role of tax havens and thereby achieve higher welfare than larger countries (Schulze & Ursprung (1999)).

The New Economic Geography Framework

In contrast to most traditional tax competition models, economic geography models focus on scale economies, imperfect competition and trade costs (see e.g. Krugman (1991) and Krugman & Venables (1995)). In addition, the existence of linkages between producers (e.g. between suppliers of intermediates and producers of final goods) as well as between producers and consumers are thought to create tendencies for agglomeration of production. Integration, as reflected by reductions in trade costs, increases the importance of the agglomeration forces and leads to a concentration of production in certain countries or regions. As the agglomeration forces within a region tend to "lock in" industries in a particular area, they decrease the mobility of factors. Those countries where industries choose to locate – i.e. the countries that gain the "core" – will experience increased tax bases and will be able to raise tax rates in general.[2]

[2] As pointed out by Baldwin *et al* (2003), concentration of the mobile factor in the standard tax competition model reduces factor rewards (due to diminishing returns), thereby reversing the tendencies toward concentration.

The main implications of agglomeration forces on tax policy can easily be illustrated. For simplicity, we assume all capital is concentrated in one country so that we have a core and periphery pattern. Figure 2 depicts the relationship between the ratio of real returns to the mobile factor in the core vs. the periphery, and the degree of trade openness (see Baldwin *et al* (2003)). Initially, due to agglomeration forces, the ratio of real returns is positively related to the degree of openness. These returns will decline as integration continues since the locational advantage for the core country diminishes when trade becomes sufficiently free.[3] The gap between real returns in the core and in the periphery creates an agglomeration rent that gives an opportunity for the government in the core to tax mobile factors. Thus, as long as this rent is positive, it will be possible for the core country to have higher taxes than the peripheral country without experiencing an outflow of capital (Baldwin *et al* (2003)).[4] In Figure 2, the agglomeration rent is positive as long as the ratio of real return is greater than 1 which suggests that the core country can maintain higher taxes on capital for the whole interval between ? and 1.[5] The negative return at very low levels of integration, i.e. below ?, implies that the core must have a lower tax rate on capital since the locational advantage here is less pronounced.

There are several interesting features of the new economic geography framework. First, the non-monotonic relationship between integration and tax policy described above does not occur in the basic tax competition model. Second, the larger country has higher capital to labor ratios and thus higher welfare in equilibrium. For our purpose, it is important to take into account the interaction between trade costs, capital mobility and agglomeration. If agglomeration forces are weak – as they might be at high levels of trade costs – the primary

[3] At zero trade costs location is irrelevant. In addition, the new economic geography framework generally finds that the benefits of being in the core are highest at intermediate levels of trade costs.
[4] In this model, it is assumed that agglomeration is complete in the sense that all capital is located in one place. Borck & Pflüger (2004), however, show that tax differentials can remain even with partial agglomeration.

effect of integration is to increase the mobility of factors.[6] However, as integration deepens, the agglomeration forces tend to grow stronger and thereby reduce factor mobility. This U-shaped relationship between trade costs and tax rates is pointed out by Ludema & Wooton (2000). In particular, they suggest that the insights provided by the new economic geography are consistent with the possibility of fiscal autonomy since deeper integration may reduce the degree of tax competition. Starting from high levels of trade costs, reductions in trade barriers will, in line with the traditional tax competition literature, intensify tax competition, while further integration tends to increase the importance of agglomeration forces and, thus, prevent a race to the bottom.

III. Earlier empirical studies on integration and taxation

Most previous empirical studies of the relationship between integration and taxation have focused on the standard tax competition model. The results in many of these studies, however, do not corroborate the model's theoretical predictions, i.e. the hypothesis of a negative correlation between integration and capital taxation (Bucovetsky (1991) and Wilson (1991)). For example, using corporate tax revenues, positive relationships between capital taxation and trade liberalization are found by Garrett (1995) and Quinn (1997). Similarly, Swank (1998) obtains a positive relationship between capital taxation and three different measures of capital mobility using panel data on 17 OECD countries over the time period 1966 to 1993.[7]

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[5] However, at high levels of integration (i.e. when agglomeration rents starts to fall in figure 2) the scope for taxing mobile factors declines in the core country and tax rates between the core and periphery will tend to narrow

[6] Strictly speaking, the agglomeration forces should be weighted against dispersion forces. While the dispersion forces tend to outweigh the agglomeration forces at high trade costs, the opposite is true at low levels of trade costs (Baldwin *et al*, 2003).

[7] It should be noted that all three studies used corporate tax revenues as a share of GDP to proxy for capital taxation. This proxy has been criticized as being vulnerable to spurious relationships because the share of

Researchers using alternative measures of tax policy – typically based on the average effective tax rates suggested by Mendoza *et al* (1994) – have not been much more successful in achieving consensus. Rodrik (1997), for instance, performs a pooled cross-section, time-series analysis based on average effective tax rates over the time period 1965 to 1992 for 18 OECD countries. He finds a negative correlation between openness, measured as the sum of exports and imports over GDP, and capital taxation and support for the hypothesis that taxation shifted from capital to labor. Similarly, Bretschger & Hettich (2002) find a negative relationship between international capital mobility and average effective corporate tax rates in a panel study of 12 OECD countries over the time period 1967 to 1996. Kirchgässner & Pommerehne (1996), however, provide only weak evidence of increased tax competition between fiscally autonomous cantons in Switzerland, which is surprising since these cantons are much more economically integrated than the samples of OECD or EU countries observed in other studies. The results in Adserà & Boix (2002), though, support a positive relationship between tax rates and the degree of openness in a study of 65 countries between 1950 and 1990. A more recent study by Slemrod (2004), however, finds that measures of openness are negatively and statistically significant correlated with statutory tax rates, although not with his measure of effective corporate taxes (revenues collected as a fraction of GDP).

In short, the results of previous studies are mixed, and provide only weak empirical support for the predictions of the tax competition theory. Schulze & Ursprung (1999) survey a large number of studies and conclude "… many of these studies find no negative relationship between globalization and the nation's ability to conduct independent fiscal policy". This may be attributable to various statistical problems including, among other things, the difficulty of determining a suitable model specification and of quantifying tax policy. Moreover, it may be an indication that there exist other factors that enable countries to

operating profit in GDP has generally risen since the early 1980s while effective capital tax rates have generally fallen.

conduct independent fiscal policy despite globalization. Krogstrup (2003) is an example of a recent empirical study that explicitly analyzes the potential problem of omitted new economic geography variables in earlier works. The study starts by testing the main hypotheses in the standard tax competition literature but gets mixed results for the effects of capital mobility on corporate taxes. When turning to the impact of agglomeration economies, Krogstrup finds GDP per capita – her measure of agglomeration forces – positively and significantly related to corporate tax rates. Although it is difficult to draw any far-reaching conclusions when GDP per capita is the only measure of agglomeration forces, Krogstrup's point that new economic geography variables are important determinates remains valid.[8]

IV. Tax Competition and New Economic Geography – the effects on corporate tax rates

Background

Many observers have noticed that corporate tax rates have declined dramatically over the last decades (e.g. Bond & Chellens (2000), and Devereux *et al* (2002)). As shown in Figure 3 the average statutory corporate tax rate in the OECD has declined by almost one quarter, from around 45 percent in the early 1970s to under 35 percent in 2002. Figure 3 also presents the development over time of two measures of average effective corporate income tax rates. The implicit tax rate based on the Mendoza *et al* (1994) definition (henceforth referred to only as Mendoza) generally increased from 1965 to a peak early in the 1980s, and appears to decline thereafter, but the variation is considerable. One reason that this average effective tax rate has not decreased in line with the statutory rate may be a corresponding broadening of tax bases. This possibility is pointed out by Devereux *et al* (2002), who suggest an alternative measure

[8] As the author points out, there are problems with multicollinearity in the empirical testing.

of average effective tax rates based on a hypothetical investment (henceforth referred to as DGK) in Figure 3.[9] These rates show a declining pattern more in line with the statutory tax rates.

During the same period, many obstacles to trade and investment between OECD countries were removed. As seen in Figure 4, the average trade volume (the sum of exports and imports as a share of GDP) in the OECD has risen from around 55 percent in the early 1970s to almost 80 percent in 1999. This development goes hand in hand with the decrease in trade costs (measured as the ratio of cost, insurance, and freight (c.i.f.) valued imports in relation to free on board (f.o.b.) valued imports) which has declined steadily during the observed period, from 1.08 in 1965 to 1.04 in 2000.

The trend toward increased integration is corroborated by two additional indices in Figure 5. The left axis shows a qualitative index of capital account regulations – measured as values between 0 to 4 where a higher values mean the less restricted capital flows – which has increased from 2.5 in 1965 to 3.75 in 1997.[10] On the right axis, a broader measure of financial integration is presented, including inward and outward capital and current account restrictions as well as international agreements constraining restrictions of exchange and capital flows. This index, whose range takes values between 0 and 14, increased from 9 to 13 between 1965 and 1997.[11]

Clearly, the decline in the statutory and the DGK tax rates is at least superficially correlated with increased integration. However, while prior to 1990 the annual reduction of these tax rates was 2.2 percent and 2.5 percent, respectively, the corresponding figures after 1990 are almost one percentage unit lower (1.3 percent and 1.6 percent, respectively). Thus, the slower decrease in these tax rates as well as the absence of a clear downward trend in the Mendoza based rates might indicate increases in forces mitigating a race to the bottom.

[9] See appendix for definitions of the different tax rates.
[10] For details, see the description in Quinn (1997).

Figure 6 shows the average development of two new economic geography measures. Linkages in production, measured as the use of intermediates, declined sharply in the 1970s but seem to have regained importance since mid 1980s. During the observed period we also observe an increase in potential market access, i.e. the economic size of trade partners discounted by geographic distance.[12] Taken together with the decline in trade costs, this suggests an increase in actual market access.

Econometric Approach

To examine whether these relationships are coincidental or whether they support one or both of the two explanations, we estimate the relationship statistically using country-specific data on a number of OECD countries. Specifically, we regress corporate tax rates on variables capturing each of the two explanations as well as variables known to affect tax rates generally. Because many important factors are not measurable or are unobservable, and therefore impossible to include in regressions, and in order to control for trends over time, we use the panel nature of the data to control for country- and time-specific factors explicitly using fixed and random effects regression.

We analyze corporate income tax rates, as corporate income is usually considered more mobile than most other capital tax bases since it does not include immobile property (Bretschger & Hettich (2002)). Most countries, though, tax international capital streams according to the residence principle. Hence, it can be argued that the scope is limited for tax competition because incomes are taxed in the country of residence regardless of where the profits were made. Control, administration problems, and lack of international treaties, however, make it hard to enforce the residence principle in practice. In reality corporate profits are often taxed closer to the source than the residence principle (Tanzi & Bovenberg

[11] Ibid.
[12] The construction of these variables is described in the next section and in the appendix.

(1990), Sørensen (1995), and Keen (1997)), which makes corporate income the most natural tax base to study. We would expect, based both on the tax competition and new economic geography literatures, the effect of integration to be largest on this tax base.

Measuring the left-hand-side variable, corporate tax rates, is problematic. As we have seen, the three measures of corporate tax rates presented in Figure 3 follow different trends and it is not obvious which measure to use. Statutory rates have the advantage that they are one of the more visible instruments that politicians have available for attracting capital. In addition, statutory rates have been found to be important determinants of firms' decision to shift income between countries as well as localization decisions made by multinational firms (DGK (2002)). On the other hand, it is well known that statutory tax rates give an incomplete picture because they neglect depreciation rules, inventory valuation, and loss-offset provisions. This argues in favor of effective rates. The drawback with effective rates, however, is that they are hard to measure accurately and, as shown in Figure 3, different measures vary greatly. Effective rates based on the Mendoza definition, as used in many earlier studies, are based on actual tax revenues collected and, hence, are relatively easy to obtain over time and across countries. It is questionable, however, whether tax rates derived from collected tax revenues are appropriate for studying investment decisions. Investment decisions depend on current and expected future tax rules while tax measures based on tax revenues collected generally depend on the history of investments as well as on historical tax rates. The alternative rates from DGK, in contrast, are forward looking and hence theoretically more appealing, but based on a hypothetical investment project that requires a number of assumptions and simplifications which makes them imperfect as well. In addition, these rates, as opposed to tax-revenue based rates, do not take into account the effects of tax planning, tax relieves provided by lax or discretionary administration practice, nor non-compliances. Since all above tax rate measures suffer from shortcomings we analyze both

measures of effective tax rates as well as statutory corporate tax rates which enables us to compare and contrast their respective results.[13]

Adequately specifying the econometric model is complicated by a generally poor understanding of the determinants of tax structure. In addition to integration, numerous other factors such as political views and values, market shares, indicators of the macro economy, national culture, legal-political institutions, and historical background are also probable determinants, though some of these are hard to quantify and therefore difficult to include in empirical analyses. We control explicitly for as many of these factors as possible in the regression to limit the effect of confounding factors. The fixed effects regression framework, moreover, controls for any other time-invariant country-specific factor that might otherwise confound the estimates.

Specifically, we estimate the following equation

$$y_{it} = a + X_{it}b + Z_{it}g + m_i + t_t + n_{it} \qquad (1)$$

where y_{it} is the corporate tax rate for country i in year t (either statutory or average effective); X_{it} is a vector of variables such as trade volume, labor force size, and the macro economy (growth and government size) that are theoretically motivated and have been found to explain tax rates in the tax competition literature; and Z_{it} is a vector of measures capturing the new economic geography context, such as market access (domestic as well as foreign), linkages between firms, trade costs and membership in preferential trade arrangements. m_i is a vector of country-specific fixed effects, t_t is a vector of time-specific fixed effects, and n_{it} is an idiosyncratic disturbance term that varies by country and year and is assumed to be

[13] Sørensen's (2004) volume show that different rates are typically not even broadly comparable (especially regarding capital taxes) and considerable care should be taken when choosing appropriate tax measures for empirical work.

independently and identically distributed with mean zero and variance s_e^2.[14] The standard errors are corrected for heteroscedasticity and are assumed to be normally distributed.

In addition, as tax rates generally change slowly over time and are likely to be correlated with past tax rates we estimate the regression using a dynamic GMM estimator as suggested by Arellano and Bond (1991) as well. This estimator first-differences the estimating equation to remove unobservable time-invariant country-specific effects.[15] We also use instruments as some of the explanatory variables in the estimating equation likely are endogenous.

In regression equation (1) and in the dynamic GMM estimation, the explanatory variables are divided into two categories: tax competition and new economic geography. This division is to some extent artificial since there are variables that lend support to both frameworks. It could be argued, though, that most variables are closer to one of the two categories or reflect some specific aspects that are more in line with one than the other. For instance, several measures of integration are used but we consider variables reflecting the degree of capital mobility as tax competition variables, while variables of the level of trade costs are more in line with new economic geography.[16] Thus, starting with tax competition, we consider three measures of integration: trade, financial openness and liberalization of capital restrictions. The capital restrictions variable is directly linked to the mobility of capital and the expected sign of the estimated coefficient on corporate tax rates are therefore negative. This is true for trade and openness as well in so far they measure capital mobility. However, as these variables are at the same time likely to reflect the degree of openness and vulnerability to economic disturbances, the tax competition literature also supports a positive effect and the expected signs are therefore ambiguous. Country size in terms of the labor

[14] We estimated the equation under the assumption that the error term is heteroskedastic across the panels, using panel corrected standard errors (pcse) as well. In general, using pcse results in smaller standard errors. The fixed-effect model, however, is generally preferred.
[15] In addition, taking first-difference may mitigate the possible problem of unit roots.

force is anticipated to be positively related to tax rates since smaller countries have greater incentives to play the role of tax havens. The relation between labor taxes and capital taxes is uncertain. On the one hand, if integration increases capital mobility we would expect labor taxes to substitute for capital taxes. On the other hand, in larger countries where capital supply is less elastic[17], or in high-tax countries, both types of tax bases could face high tax rates. In addition, the corporate tax rate may serve as a backstop (Slemrod (2004)) to income shifting from labor income to business income in order to obtain lower effective tax rates implying that corporate tax rates may be higher in countries with high top individual tax rates. Thus, the expected sign is ambiguous.

Turning to the new economic geography variables, it should be emphasized that the variables suggested by this framework are hard to measure and quantify over time and across countries. Furthermore, the empirical proxies are much less refined in comparison to the tax competition literature. As the main integration variable, we use trade costs measured as c.i.f.-f.o.b. ratios.[18] In addition, we include dummy variables of memberships in EU, EFTA or other preferential trading arrangements (PTAs) to see how these regionally deeper integration areas affect tax rates. With respect to the agglomeration forces, several measures are considered and, at sufficiently high levels of integration, these variables are expected to have a positive effect on corporate tax rates. To begin with, we use real GDP per capita as countries that benefit from agglomeration are likely to have higher GDP per capita.[19] As another measure, we create a market potential variable, reflecting a country's access to foreign markets. This variable takes into account the market size (in terms of GDP) of all other countries in the sample weighted by distance. Thus, a country that has a short distance to a

[16] This division has no bearing on the results.
[17] See Bucovetsky (1991) and Wilson (1991).
[18] See, e.g. Baier & Bergstrand (2001).
[19] This is the measure of agglomeration used in the study by Krogstrup (2003). However, since the demand for public spending increases (and therefore the need for tax revenues) with growing incomes (in per capita terms), GDP per capita could equally well pick up this effect (known as Wagner's law).

large market will have a large market potential.[20] Finally, we include linkages in production and the variable is constructed in two steps. First, based on an OECD input-output table for ten OECD countries, we calculate each industry's average use of domestic intermediates.[21] Second, we rank industries according to their use of intermediates and measure the importance of the ten highest ranked industries by calculating their share of total manufacturing production for each country. This, we believe, is the most direct measure of linkages between firms and, hence, agglomeration forces. The variable has its limitations, however, as the identification of agglomeration industries economies is based on only those ten countries for which input-output tables are available and as the decision to only consider the top-ten industries are arbitrarily chosen. In addition, there are only data for a subset of countries.[22]

Finally, we also control for a number of factors that have been identified as important determinants of corporate tax rates but are not tied directly to either the tax competition or the new economic geography model. Political views and values, for instance, are likely to affect corporate tax rates. To investigate this, the number of conservative party legislative seats is included, and the variable is expected to have a negative effect on capital taxes. We also control for government size and growth rates. The effect of government size is assumed to have a positive sign since larger government expenditures is generally associated with higher tax rates. The growth rate, finally, is expected to have a negative impact as governments trying to balance their budget will cut taxes if the country experience economic expansion.[23]

Results

[20] Again, it should be emphasized that the categorization of variables is not definite. Hence, a tax competition variable such as labor force could in some cases also be treated as a new economic geography variable. This is commented on as the results are discussed.
[21] The use of intermediates as a measure of agglomeration forces is used by Middelfart-Knarvik *et al* (2002).
[22] Data are not available for Australia, Belgium, Ireland, Norway and Switzerland.
[23] For this argument, see Bretschger & Hettich (2002).

WE start by estimating the standard tax competition model. Table 1 reports the results of regressing statutory and the two average effective corporate income tax rates on the tax competition variables as well as the control variables. We present only the results from the fixed-effects regression since this specification was generally favored by specification tests.

In general, the effect of integration on corporate tax rates varies depending on the measure of integration and the measure of corporate tax rates. Trade, for instance, has a negative effect when average effective rates are used (although this is only statistically significant for the Mendoza data), but positive (although insignificant) for the statutory tax rate.[24] Openness, however, is positively correlated with tax rates in all regressions. On the other hand, and in line with expectations, liberalization of capital restrictions has a negative and statistically significant coefficient in almost all regressions.[25] We find some empirical support for the anticipated positive relationship between the size of the labor force and corporate tax rates, at least for the effective tax rates. There seems to be no empirical support for the notion that lower corporate taxes are offset by higher labor taxes; rather, they seem to move in the same direction supporting the backstop theory. The results for conservative party legislative seats are uncertain as the coefficient is mainly insignificant, while government size in general is negatively correlated with corporate tax rates. Consistent with the empirical tax competition literature, economic growth is important for corporate tax rates, with a negative coefficient. Interestingly, these regressions provide some support for the role of tax competition, i.e. that increased integration (particularly in terms of capital mobility) leads to lower corporate tax rates, perhaps more so than in the previous literature.

[24] The differences between the statutory and the average effective corporate tax rate regressions found are in some cases remarkable. Since the data included are different when statutory and average effective tax rates are used, respectively, we re-estimate our regressions using a sample restricted to those countries and years that coincide to establish whether the differences are due to the use of different observations. The results are quite similar suggesting that the differences in results and explanatory powers are not caused by the different data.

[25] There is of course a risk that these integration variables, together with trade costs, are highly correlated. However, the exclusion of one or more integration measure in each specification do not change the results noticeably.

We next incorporate factors proposed by new economic geography including trade costs, measures of agglomeration forces and membership in different types of regional integration areas. The results are presented in Table 2 and, again, we report estimates for statutory and the two average effective corporate tax rates. When these variables are included, the effect of trade on corporate tax rates is somewhat reduced. However, the results for openness and liberalization of capital restrictions are confirmed, at least for the statutory and DGK tax rates. Interestingly, EU membership has a negative effect on statutory corporate tax rates while the effect is positive (and significant in the Mendoza case) on average effective tax rates. This might suggest that EU members have experienced lower statutory rates with increased tax bases. The impact of the trade cost variable is uncertain as the coefficient is insignificant and the sign varies across regressions. The results for the GDP per capita variable are in favor of new economic geography as the coefficient is positive in all regressions, and highly significant in two cases (for the statutory and DGK rates). On the other hand, less support is provided by the remaining measures of agglomeration forces. While market potential has a positive effect in one of the estimations, linkages seem to be negatively correlated with tax rates. In general, however, the explanatory power is higher when agglomeration forces are included and the effect of tax competition is to some extent reduced.[26]

As discussed in the theoretical background, the presence of agglomeration forces would provide very different outcomes for a core country compared to a peripheral country. In addition, therefore, Table 2 reports regression results for a core and peripheral sub-sample, respectively.[27] The division is based on geographical location and economic importance, and depending on data availability the core includes Belgium, France, Germany, Italy,

[26] We have considered a country's *relative* market potential as well as alternative measures of linkages suggested by Middelfart-Knarvik *et al* (2002). These measures, however, do not seem to provide any clearer results.

[27] An alternative sub-samples based on market size (measured as real GDP) has been tested for in addition.

Netherlands, Switzerland, United Kingdom and the US, while the periphery consists of Australia, Austria, Canada, Denmark, Finland, Ireland, Japan, Norway, Portugal, Spain and Sweden. Again, the results vary widely for different tax rates. However, there are some interesting observations. For the tax competition variables, the positive effects of trade and openness appear to mainly occur in the peripheral sample. At the same time, the capital liberalization coefficient is significantly negative in two cases for this group, while the effect is less pronounced in the core. Thus, it seems as if reductions in capital restrictions have primarily increased tax competition in the periphery, although increased integration with the international market, measured by trade and openness, have an opposite effect. Furthermore, there is a clear difference between the core and periphery when it comes to the effect of the size of the labor force on corporate tax rates, where the variable has a positive sign in the periphery but a negative in the core. The results for GDP per capita are upheld for both sub-samples but with lower significance. In contrast, the impact of market potential varies and, in particular, the variable has a clear negative effect on tax rates in the core. In addition, a negative effect of linkages was found in all estimations. Finally, a negative effect of growth could mainly be attributed to the peripheral countries.[28]

Theoretically, the impact of agglomeration forces on taxes depends on trade costs. The simple inclusion of the economic geography variables may not fully capture the essence of the new economic geography framework and could explain the mixed results of Table 2. Therefore, we estimate the model including interaction terms between our trade costs variable and the different measures of agglomeration forces. The interaction terms measure the impact of agglomeration forces on corporate tax rates as a function of trade costs. Since the effect of agglomeration on tax rates is assumed to increase as trade costs decline, we expect a negative sign of the coefficient. In particular, we consider the interaction effect of trade costs, on the

[28] As liberalization of international capital markets mainly took place in the end of the 1980s, we have estimated (1) for two sub-periods, one prior to and one after 1990 as well. In these estimations, the economic geography

one hand, and GDP per capita, market potential and industrial linkages, respectively, on the other. Table 3 shows the results when these interaction terms are added. In most regressions, though, the interaction terms are either insignificant or positive, failing to support the hypothesis. A somewhat different picture occurs if the total effect of each agglomeration variable is considered. The total effect, expected to be positive, is obtained by adding the direct effect of the agglomeration variable in question and the indirect effect given by the interaction term multiplied with the level of trade costs. Focusing on those interaction terms that are significant at least at the 0.10 significance level in Table 3 we find that on average, with trade costs of 1.06, GDP per capita and linkages have a total positive effect on statutory as well as DGK tax rates, while linkages is still negative for the Mendoza measure.[29] To test whether this result is sensitive to our choice of interaction terms we use the interaction between the agglomeration factors and alternative measures of integration, such as our trade and openness variable (not reported). This does not change the positive overall effect GDP per capita and linkages have on statutory and DGK tax rates.

Results from Dynamic Specification

Turning to the dynamic specification we find that the p-values of the Sargan tests (not reported) are generally very high and do not reject the hypothesis that the model is correctly specified. In addition, the lagged corporate tax rate variables are all highly significant further supporting the use of a dynamic model. When allowing for endogeneity the p-values increase further, making it even more difficult to reject the null hypothesis of a valid specification and, hence, indicating that the endogenous specification may be a better specification. The variables found to be endogenous are labor force, growth and GDP per capita in the specification using statutory tax rates; labor force and growth in the Mendoza specification

variables in general turn out negative, although they become statistically insignificant in the second period

and; labor force, labor tax, and growth in the DGK specification. We use the difference of the endogenous variables lagged three periods as instruments in addition to the exogenous variables.[30] Table 4 reports the results of the dynamic GMM estimations using these instruments. Since several cross-sections are consumed by taking first difference and by constructing lags the sample size is noticeably reduced in the dynamic specification. To compensate for this, we also estimate the regression without linkages, which greatly increases the sample size. In the first column (i) for each tax rate linkages in production are included, while the second column (ii) for each tax rate omits linkages. Omitting linkages does affect the results somewhat. For instance, GDP per capita has a positive and significant impact on statutory tax rates when linkages are included while insignificant omitting linkages, the opposite holds for the Mendoza tax rates. Re-estimating the regressions without linkages and constraining the sample to include the same observations as in column (i) regressions shows that differences between columns (i) and (ii) are due to the use of different data coverage and not to the inclusion of linkages, however.[31] While many of the results from Table 2 still hold – liberalization of capital restrictions remains negative and significant (at least at a 10 percent significance level) for statutory and DGK tax rates, GDP per capita continues to have a positive effect on tax rates in many of the specifications, and market potential is positive and statistically significant for DGK tax rates when linkages are omitted – some change. For instance, openness is no longer positively and statistically correlated with statutory and DGK tax rates, labor force size loses its significance in all specifications, and membership in the EU is now insignificantly correlated with all tax rates.

Table 4a also reports regression results for a core and peripheral sub-sample based on the same division as in Table 2a. Here, however, we only report results from regressions

[29] The average total effects of GDP per capita and linkages are 0.002 and 573.1, respectively, on the statutory tax rate and 0.002 and 765.4, respectively, on the DGK rate. The effect of linkages on the Mendoza rate is -4418.
[30] Using the variables lagged four periods as instruments does not change the result noticeably.

including linkages. Unlike the regressions in Table 4, omitting linkages alters the result suggesting a structural difference between the core and the peripheral countries. As in Table 2a the explanatory variables impact corporate tax rates quite differently depending on geographical location. For instance, trade and openness tend to have a more positive (negative) impact on corporate tax rates in the peripheral (core) countries, while liberalization of capital restrictions have a tendency to be more negatively correlated with tax rates in the peripheral countries. In addition, the labor force size variable has a negative and significant coefficient in the core sub-sample, while positive and significant in the peripheral sub-sample. Moreover, the labor tax variable impact effective corporate tax rates positively in the peripheral countries, while there seem to be no correlation between the tax on labor and capital in the core countries. Turning to the new economic geography variables, GDP per capita, for instance, is positive and significant for the peripheral sub-sample using statutory tax rates while positive and significant for the core countries using DGK tax rates. Also, international market access is more inclined to have a positive impact on corporate tax rates in the peripheral countries than in the core countries, where the effect is insignificant or negative.

Finally, Table 5 presents GMM estimates that include interaction terms. Compared to the results in Table 3, the dynamic setting lends less support for including these variables. The coefficients are insignificant in all but one regression and the significant coefficient of trade costs and linkages on statutory tax rates has an unanticipated sign. Furthermore, even the total effect of linkages in this particular specification has a contradictory negative effect.

V. Discussion

[31] The only significant difference is that openness becomes positively and significantly correlated with statutory tax rates when linkages in production are omitted.

In contrast to many previous studies, we find some support for the tax competition view, i.e. that increased integration has led to lower corporate tax rates. In most specifications, we find that at least one of our measures capturing increased integration (trade, openness or liberalization of capital restrictions) is negatively correlated with corporate tax rates. There are, however, interesting differences across the tax rates. For instance, the variable most closely linked to capital mobility, liberalization of capital restrictions, seems mainly to have a negative effect on the statutory and the DGK effective tax rates though a less clear impact on the Mendoza tax rate.

The weak influence of capital restriction liberalization on Mendoza tax rates could be because these rates are backward–looking and therefore generally poor tax measures for studies of this kind. The common use of Mendoza tax rates in earlier studies could then help explain why many of these have failed to find a correlation between tax rates and increased integration.

When we add variables from the new economic geography framework several interesting outcomes emerge that support the framework. First, just like Krogstrup (2003), we find that when controlling for agglomeration forces the positive and statistically significant correlation between openness and corporate tax rates often found in earlier studies (and puzzling to proponents of the traditional tax competition view) weakens or vanishes. In Table 1, where only traditional tax competition variables are included, the openness variable was positively and significantly correlated with corporate tax rates. In the dynamic estimations, however, openness had no statistically significant impact on corporate tax rates. One interpretation of this, as Krogstrup suggests, is that openness may capture agglomeration forces and that the positive correlation commonly found results from the openness variable picking up the influence of agglomeration forces. Second, in general, GDP per capita has a positive impact on our preferred tax measures, DGK and statutory tax rates. This result is

probably not due to Wagner's law since we find no or negative correlation between the corporate tax rate and government size (i.e. revenues from corporate tax rates are not an important source for government spending). Third, it seems that what determines corporate tax rates differ between countries located in a geographical and economical core versus in the periphery. Admittedly, conclusions drawn from the division of the sample into a core and periphery should be cautious as the sample size is small and the division of countries somewhat arbitrary. Nevertheless, this subdivision indicates that the traditional tax competition variables may explain corporate tax rates in the peripheral countries better than in the core. For instance, capital account liberalization has a clear negative impact on corporate tax rates in countries situated in the periphery but no impact in the core. Likewise, the labor force variable has a positive and significant effect on corporate tax rates in the periphery, as opposed to negative and significant in the core. With respect to the agglomeration forces, international market access also seems to be more important in peripheral countries while negligible (at least as an agglomeration force) for countries situated in a geographical and economical core.

At the same time as we find some support for new economic geography some of our variables measuring agglomeration forces fail to corroborate this framework. For instance, linkages in production, which we believe is the most direct measure of agglomeration, are negative in all the specifications where the variable is significant. As pointed out earlier, though, this variable has its limitations, primarily due to data availability. This also emphasizes the problem of finding a general measure of agglomeration forces that is applicable to all countries and is sufficiently aggregated to affect tax policy on a national level. Thus, although GDP per capita and market potential are rather indirect as measures of agglomeration, they are at least aggregated enough to show an impact on national tax rates. On the other hand, the linkage variable is both more difficult to measure and may be

constructed at a too disaggregated level. In addition, it is noteworthy that we find little support for the interaction terms, as least not in the dynamic estimations. Thus, we are unable to capture the precise interplay between agglomeration forces and trade costs.

VI. Conclusions

This paper seeks to identify the effect of economic integration on statutory and average effective corporate tax rates. Most previous studies have focused on the effects of tax competition between countries or regions, with mixed results. Economic geography offers an alternative, not mutually exclusive, explanation of tax rates, with potentially contradicting predictions. Rather than limiting the effect of economic integration to arise strictly via tax competition like most earlier attempts, we have opened the analysis to control for the effects of new economic geography factors as well.

In the empirical analysis, we include several measures of agglomeration forces in addition to the standard tax competition variables. We also take into account other features of the new economic geography model, such as the interaction between agglomeration forces and trade costs, and the core and periphery pattern. Our results provide support for both explanations. Hence, we find that increased integration has a negative effect on corporate tax rates while, although to a lesser extent, agglomeration forces influence tax rates positively.

We see this analysis as a starting point for research in this emerging area. First, alternative measures of agglomeration forces are needed in combination with increased coverage to further test the implications of the new economic geography framework for tax rates. This could require regional analyses using more disaggregated data in order to detect agglomeration forces. Second, the relationship between agglomeration forces and integration should be further investigated. The present analysis, combining two different models, has

focused on the hypothesis that agglomeration forces will grow stronger as trade costs decrease, thereby dampening a race to the bottom. However, an appropriate test of the new economic geography framework should allow for a hump-shaped correlation between trade costs and agglomeration. Finally, in order to be able to say something about the dynamics, differences across countries of different size and geographical location as well as across different time periods should be explored.

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Appendix

Data description

Variable	Definition	Source	Mean	Standard Deviation
Statutory corporate tax rate	Top statutory tax rate on corporate income	World Tax Data base, Office of Tax Policy Research	36.53	9.20
Average effective tax rate on corporate income	Taxes on income from profits, capital gains of corporations over operating surplus of the economy minus surplus of private unincorporated enterprises	Mendoza *et al* (1994), and Volkerink & Haan (2000)	32.65	15.37
Average effective tax rate on corporate income	NPV of tax payments as share of NPV of total pre-tax income	Devereux *et al* (2002)	34.43	11.17
Trade	Import and export as a share of GDP	PWT6.1	65.60	40.74
Openness	Qualitative index of restrictions on trade and capital accounts	Quinn (1997)	9.63	3.39
Capital	Qualitative index of capital account restrictions	Quinn (1997)	2.71	1.03
Labor force	Number of persons in labor force	OECD Economic Outlook	16.7 millions	25.4 millions
Statutory tax rate on labor income	Top statutory tax rate on labor income	OECD, Taxing Wages, various years	54.09	12.32
Average effective tax rate on labor income	See text below	Mendoza *et al*.	33.38	10.36
Right party legislative seats	Conservative party legislative seats as percentage of all legislative seats	Swank (1998)	37.99	20.06
Government size	Total government expenditures as share of GDP	PWT6.1	44.37	9.4
Growth	Annual growth in real GDP	PWT6.1	2.24	2.5
Trade costs	Ratio of c.i.f.-valued imports to f.o.b.-valued imports	IMF International Statistics	1.06	0.3
GDP per capita	Real GDP per capita in dollars	PWT6.1	14264.6	6066.6
Marketpotential	For country *j*: $\sum_{k \neq j} realGDP_k / Distance_{jk}$	Own calculations based on data from PWT6.1 and Jon Haveman's international trade data	7.58 billons of US$	5.34 billions of US$
Linkages	Importance, based on production shares, of the ten manufacturing industries with highest use of intermediates from other sectors in own country	Own calculations based on OECD input-output tables and OECD STAN databases	0.011	0.003

Statutory and average effective corporate tax rate data do not coincide exactly by countries and years so the samples included in the various regressions vary somewhat. Statutory corporate tax rate data are available for Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK and the US for the time period 1980 to 1997. Average effective tax rates using Mendoza *et al* (1994) are available for the above except Austria, Germany, and Ireland for the time period 1971 to 1996. Average effective tax rates using Devereux *et al* (2002) are available for the same countries as the statutory data with exceptions of Australia, Denmark, Norway, and Switzerland and cover the years 1982 to 1997.

The average effective tax rates on corporate income by Mendoza *et al* (1994) are calculated as the ratio of tax revenues from taxes on income, profits, and capital gains of corporations to operating surplus of the economy minus the operating surplus of private unincorporated enterprises. Since figures on operating surplus are not available for all countries and are not always reliable, average effective tax rates must be interpreted with care. In our sample, three observations are either negative or exceed several hundred percent and are therefore omitted.

Average effective tax rates from Devereux *et al* (2002) are defined as the net present value (NPV) of tax payments as a proportion of the NPV of total pre-tax capital income. The average effective tax rates are calculated for a mature manufactory firm and for a particular investment, in this case an investment in plant and machinery earning expected real rate of economic profit of 10 percent and financed by equity or retained earnings. In addition to these assumptions, additional are required for the real discount rate, inflation, and depreciation rate, in this case of 10 %, 3.5 %, and 12.25 %, respectively.

Two labor tax measures are used. In the estimations on statutory corporate tax rates, top statutory labor tax rate is employed, while average effective tax rates on labor income

based on Mendoza are used in the estimations on average effective tax rates. The average effective tax rates on labor income are defined as the ratio of the personal income tax (defined as the ratio of revenues from taxes on income, profits and capital gains of individuals to the base consisting of wages and salaries, operating surplus of unincorporated enterprises and the property and entrepreneurial income of households) multiplied by wages and salaries plus total social security contributions and taxes on payroll and workforce over the sum of wages and salaries plus employers' social security contributions.

Figure 1.

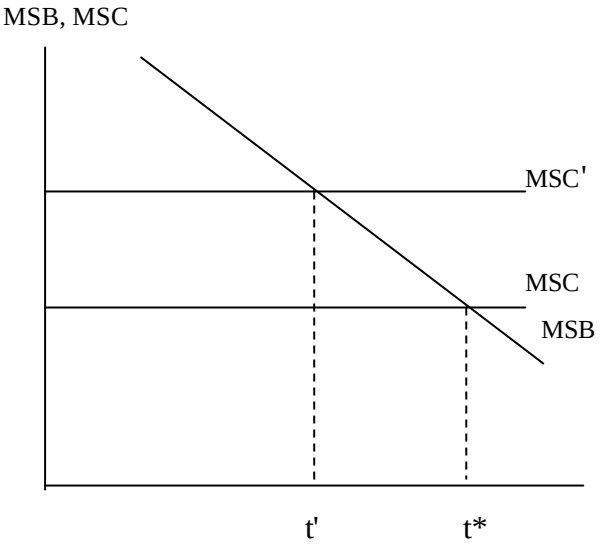

Figure 2.

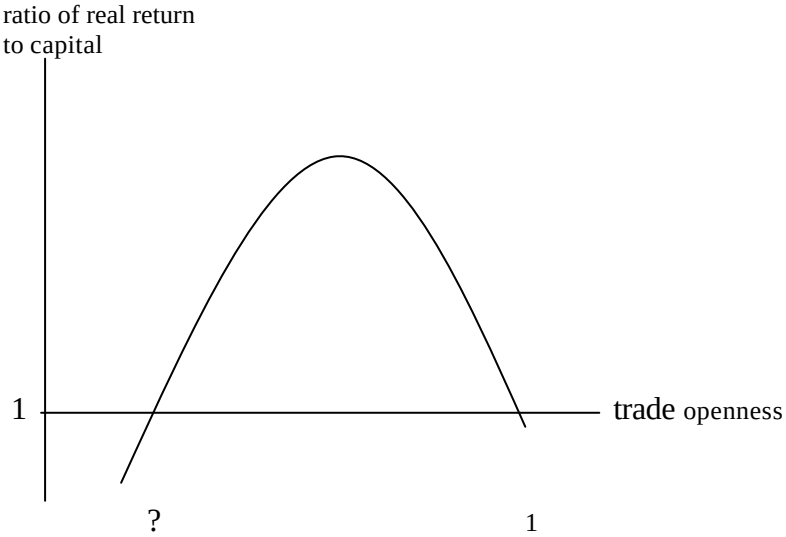

Figure 3.

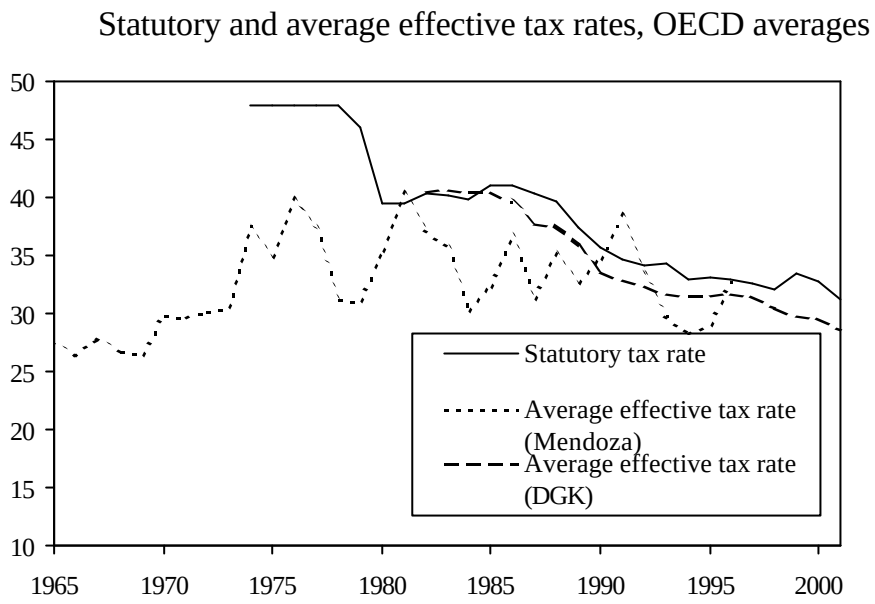

Figure 4.

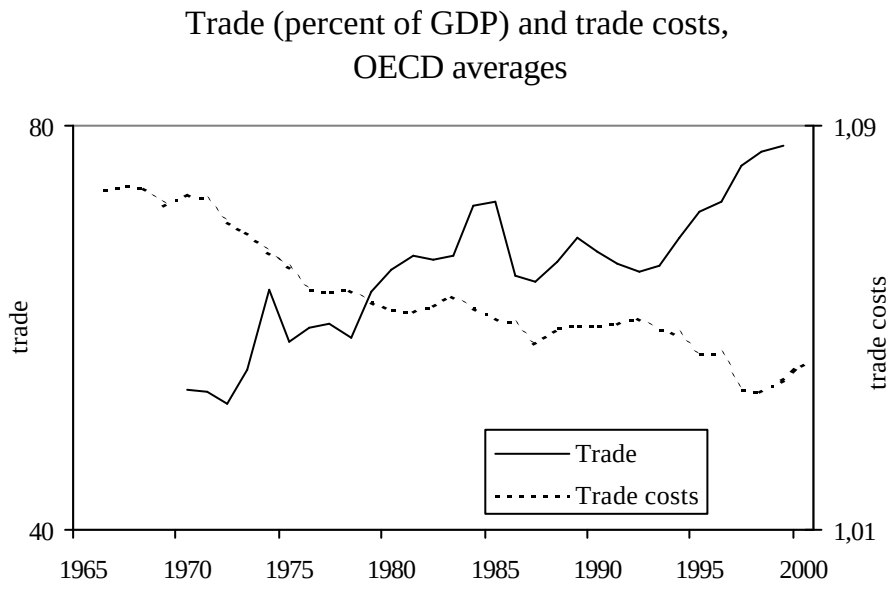

Figure 5.

Openness and capital account liberalization, OECD averages

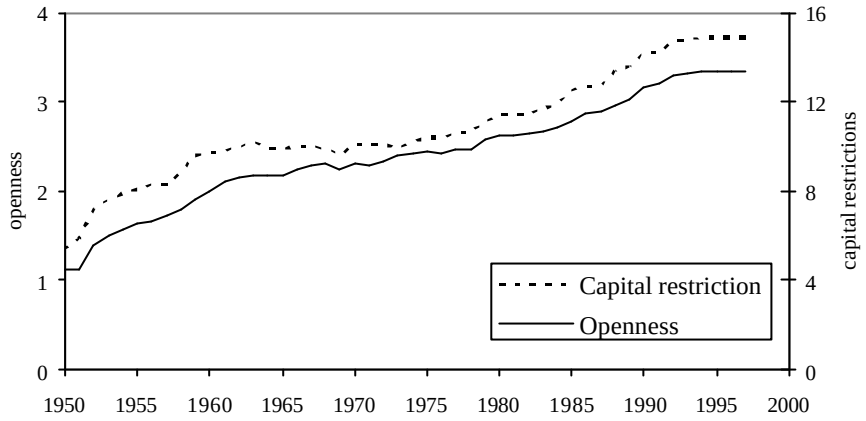

Figure 6.

Linkages in production and potential market access, OECD averages

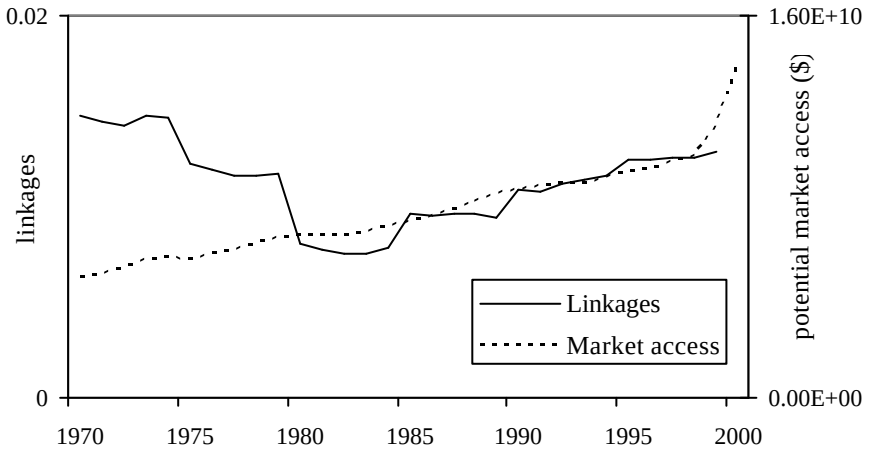

Table 1. Corporate tax rates and ”tax competition” variables*

	Statutory Tax Rate	Average Effective Tax Rate	
		Mendoza	DGK
Trade	0.02 (0.30)	-0.68 (-5.83)	-0.06 (-0.65)
Openness	2.16 (5.82)	2.49 (3.01)	2.24 (5.65)
Capital	-4.02 (-3.04)	-7.78 (-2.91)	-9.23 (-6.06)
Labor force	$-7.52 \cdot 10^{-8}$ (-0.59)	$1.42 \cdot 10^{-7}$ (1.24)	$2.08 \cdot 10^{-7}$ (1.66)
Labor tax	-0.04 (-0.58)	0.58 (2.16)	0.80 (3.99)
Right party legislative seats	-0.04 (-1.03)	-0.12 (-1.94)	0.05 (1.12)
Government size	-0.19 (-1.83)	0.08 (0.37)	-0.48 (-3.72)
Growth	-0.13 (-0.63)	-1.94 (-3.78)	-0.29 (-1.23)
Number of countries	19	16	15
n	342	338	208
R^2	0.32	0.27	0.55

*Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.

Table 2. Corporate tax rates, ”tax competition” variables and agglomeration variables*

	Statutory Tax Rate	Average Effective Tax Rate	
		Mendoza	DGK
Trade	0.20	-0.44	0.08
	(1.73)	(-1.45)	(0.67)
Openness	3.46	-2.32	2.65
	(5.23)	(-1.01)	(3.10)
Capital	-6.72	-8.99	-9.79
	(-3.00)	(-1.45)	(-4.96)
Labor force	$1.31 \cdot 10^{-6}$	$-6.22 \cdot 10^{-7}$	$5.33 \cdot 10^{-7}$
	(3.08)	(-0.58)	(1.07)
Labor tax	-0.10	2.52	0.81
	(-1.40)	(3.15)	(2.55)
EU	-8.90	21.55	1.46
	(-2.78)	(1.91)	(0.32)
EFTA	-5.01	22.12	9.05
	(-1.41)	(1.59)	(1.73)
Other PTAs	-2.70	-0.43	6.39
	(-1.08)	(-0.07)	(2.52)
Trade costs	39.68	-160.8	-33.09
	(1.09)	(-1.79)	(-0.85)
GDP per capita	0.003	0.001	0.004
	(3.05)	(0.42)	(4.72)
Market potential	$-4.13 \cdot 10^{-10}$	$-2.83 \cdot 10^{-9}$	$3.12 \cdot 10^{-9}$
	(-0.29)	(-0.91)	(1.76)
Linkages	-384.0	-3511.6	-311.5
	(-1.15)	(-3.36)	(-0.88)
Right party legislative seats	-0.12	-0.14	0.005
	(-2.79)	(-1.61)	(0.09)
Government size	0.14	0.08	0.40
	(0.64)	(0.14)	(1.36)
Growth	-0.64	-2.57	0.39
	(-2.25)	(-2.62)	(1.43)
Number of countries	14	12	13
n	202	188	152
R^2	0.55	0.47	0.67

*Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.

Table 2a.

	Statutory Tax Rate		Average Effective Tax Rate			
			Mendoza		DGK	
	C	P	C	P	C	P
Trade	-0.04	0.38	-0.94	-0.33	-0.12	0.10
	(-0.20)	(2.50)	(-1.97)	(-0.81)	(-0.50)	(0.63)
Openness	-1.74	4.45	2.79	-5.46	-1.11	1.25
	(-1.40)	(6.01)	(0.80)	(-1.80)	(-1.20)	(1.48)
Capital	-1.91	-7.91	-17.31	3.20	-2.76	-9.65
	(-0.55)	(-2.85)	(-2.13)	(0.48)	(-1.44)	(-4.51)
Labor force	$-2.32\cdot10^{-7}$	$2.45\cdot10^{-6}$	$-3.04\cdot10^{-6}$	$3.38\cdot10^{-6}$	$-1.61\cdot10^{-6}$	$2.55\cdot10^{-6}$
	(-0.31)	(3.26)	(-2.53)	(2.08)	(-3.48)	(3.98)
Labor tax	-0.51	0.07	0.61	0.53	-0.10	0.66
	(-2.09)	(0.83)	(0.73)	(0.50)	(-0.34)	(2.04)
EU	Dropped	-13.29	Dropped	26.19	Dropped	8.59
		(-3.29)		(1.82)		(1.86)
EFTA	Dropped	-10.87	Dropped	15.09	Dropped	10.80
		(-2.48)		(0.84)		(1.87)
Other PTAs	-10.03	-0.22	-9.39	-10.55	-0.55	4.85
	(-1.93)	(-0.06)	(-1.45)	(-1.00)	(-0.19)	(1.52)
Trade costs	0.09	48.34	-31.40	-274.9	-23.23	-54.29
	(0.00)	(1.35)	(-0.13)	(-2.60)	(-0.25)	(-1.21)
GDP per capita	0.004	0.001	0.04	-0.003	0.003	0.003
	(1.83)	(0.58)	(0.71)	(-0.82)	(1.46)	(2.18)
Market potential	$-8.20\cdot10^{-9}$	$-5.15\cdot10^{-9}$	$-2.03\cdot10^{-8}$	$3.94\cdot10^{-9}$	$-1.09\cdot10^{-8}$	$5.99\cdot10^{-9}$
	(-3.10)	(-1.89)	(-3.29)	(0.70)	(-4.52)	(2.56)
Linkages	-161.3	-966.7	-2590.7	-4222.3	-293.2	-922.6
	(-0.41)	(-2.13)	(-2.25)	(-1.93)	(-0.65)	(-1.49)
Right party legislative seats	0.02	-0.09	-0.01	-0.18	0.05	-0.01
	(0.22)	(-2.08)	(-0.04)	(-1.27)	(0.64)	(-0.12)
Government size	0.14	-0.08	-1.64	0.27	-0.01	0.43
	(0.42)	(-0.28)	(-1.38)	(0.36)	(-0.02)	(1.58)
Growth	-0.53	-0.83	-2.21	-2.51	-0.40	-0.60
	(-0.81)	(-2.79)	(-1.43)	(-2.47)	(-0.68)	(-2.08)
Number of countries	6 [a]	8 [b]	5 [c]	7 [d]	6 [e]	7 [f]
n	71	131	70	118	63	89
R^2	0.80	0.66	0.91	0.56	0.80	0.91

*Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.

[a] incl. France, Germany, Italy, Netherlands, UK, US

[b] incl. Austria, Canada, Denmark, Finland, Japan, Portugal, Spain, Sweden

[c] incl. France, Italy, Netherlands, UK, US

[d] incl. Canada, Denmark, Finland, Japan, Portugal, Spain, Sweden

[e] incl. France, Germany, Italy, Netherlands, UK, US

[f] includes Australia, Canada, Finland, Japan, Portugal, Spain, and Sweden.

Table 3. Corporate tax rates, "tax competition" variables and agglomeration variables*

	Statutory Tax Rate			Average Effective Tax Rate Mendoza		
	i	ii	iii	i	ii	iii
Trade costs × GDP per capita	0.01			-0.002		
	(1.97)			(-0.23)		
Trade costs × Market potential		$-1.01 \cdot 10^{-8}$			$1.78 \cdot 10^{-9}$	
		(-1.49)			(-0.17)	
Trade costs × Linkages			57398.6			-39397.3
			(4.42)			(-1.82)
Trade	0.14	0.07	0.19	-0.57	-0.62	-0.56
	(2.09)	(1.13)	(1.83)	(-4.37)	(-4.66)	(-2.03)
Openness	2.71	2.81	3.18	0.22	0.43	-2.97
	(5.06)	(5.02)	(5.23)	(0.14)	(0.28)	(-1.19)
Capital	-6.54	-5.68	-6.99	-2.54	-3.92	-8.09
	(-3.92)	(-3.37)	(-3.14)	(-0.64)	(-0.96)	(-1.30)
Labor force	$-1.77 \cdot 10^{-7}$	$-1.97 \cdot 10^{-7}$	$1.45 \cdot 10^{-6}$	$-4.13 \cdot 10^{-7}$	$-1.93 \cdot 10^{-7}$	$1.93 \cdot 10^{-7}$
	(-1.10)	(-1.28)	(5.99)	(-2.47)	(-1.31)	(0.33)
Labor tax	0.01	0.02	-0.10	0.62	0.67	2.55
	(0.17)	(0.39)	(-1.51)	(2.21)	(2.15)	(3.30)
EU	-5.24	-6.60	-7.42	20.75	17.33	22.69
	(-1.92)	(-2.25)	(-2.36)	(2.62)	(2.19)	(1.88)
EFTA	-2.00	-2.59	-2.99	8.24	8.09	23.11
	(-0.61)	(-0.73)	(-0.86)	(0.90)	(0.87)	(1.77)
Other PTAs	-3.53	-4.96	-2.79	0.79	-1.91	-2.56
	(-2.12)	(-2.81)	(-1.30)	(0.28)	(-0.64)	(-0.45)
Trade costs	-86.87	177.3	-562.9	-105.9	-114.7	383.2
	(-1.06)	(4.70)	(-3.65)	(-0.86)	(-2.32)	(1.14)
GDP per capita	-0.01			0.01		
	(-1.53)			(0.56)		
Market potential		$6.98 \cdot 10^{-9}$			$1.13 \cdot 10^{-9}$	
		(1.02)			(0.10)	
Linkages			-60280.9			37504.1
			(4.44)			(1.64)
Right party legislative seats	-0.13	-0.12	-0.10	-0.14	-0.14	-0.14
	(-3.83)	(-3.65)	(-2.62)	(-2.07)	(-1.93)	(-1.50)
Government size	0.04	-0.38	-0.10	-0.02	-0.24	0.18
	(0.33)	(-2.52)	(-0.62)	(-0.06)	(-0.92)	(0.36)
Growth	-0.35	-0.19	-0.52	-2.49	-2.33	-2.42
	(-1.64)	(-0.97)	(-1.92)	(-4.64)	(-4.33)	(-2.55)
Number of countries	19	19	14	16	16	12
n	316	316	202	329	329	188
R^2	0.45	0.46	0.57	0.32	0.31	0.49

*Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.

Table 3. ***continued***

	Average Effective Tax Rate DGK		
	i	ii	iii
Trade costs × GDP per capita	0.02 (2.14)		
Trade costs × Market potential		$5.89 \cdot 10^{-9}$ (0.89)	
Trade costs × Linkages			66312.0 (3.98)
Trade	0.01 (0.10)	-0.08 (-0.88)	0.08 (0.64)
Openness	1.77 (2.85)	1.51 (2.23)	2.27 (2.57)
Capital	-8.15 (-4.93)	-8.17 (-4.54)	-9.29 (-4.24)
Labor force	$-3.68 \cdot 10^{7}$ (-2.22)	$-9.29 \cdot 10^{-10}$ (-0.01)	$3.07 \cdot 10^{-7}$ (1.10)
Labor tax	0.83 (4.39)	0.93 (4.13)	0.72 (2.13)
EU	5.08 (1.29)	6.17 (1.41)	3.18 (0.65)
EFTA	16.45 (4.22)	18.08 (4.42)	12.55 (2.31)
Other PTAs	4.88 (2.48)	3.27 (1.89)	7.33 (3.38)
Trade costs	-388.8 (-2.43)	-1.40 (-0.03)	-755.3 (-4.02)
GDP per capita	-0.02 (-1.79)		
Market potential		$6.53 \cdot 10^{-9}$ (0.94)	
Linkages			-69599.3 (-3.99)
Right party legislative seats	-0.002 (-0.06)	0.03 (0.66)	0.05 (1.37)
Government size	-0.28 (-1.97)	-0.43 (-2.39)	-0.33 (-1.47)
Growth	-0.34 (-1.66)	-0.16 (-0.72)	-0.11 (-0.39)
Number of countries	15	15	13
n	200	200	152
R^2	0.69	0.63	0.72

Table 4. GMM estimates of corporate tax rates, "tax competition" variables, and agglomeration variables*

	Statutory Tax Rate [1]		Average Effective Tax Rate			
			Mendoza [2]		DGK [3]	
	i	ii	i	ii	i	ii
Corporate tax rate lagged	0.52 (5.79)	0.83 (10.42)	0.43 (6.24)	0.45 (8.11)	0.46 (3.22)	0.56 (4.34)
Trade	0.23 (1.55)	0.10 (1.23)	-0.40 (-1.60)	-0.26 (-1.60)	0.08 (0.60)	0.11 (1.11)
Openness	0.04 (-0.12)	0.17 (0.41)	2.48 (1.23)	1.77 (1.14)	-0.47 (-0.55)	-0.09 (-0.14)
Capital	-3.71 (-1.74)	-2.22 (-1.64)	-3.68 (-0.81)	-2.45 (-0.47)	-2.36 (-1.76)	-3.46 (-2.65)
Labor force	$2.46\ 10^{-7}$ (0.99)	$1.76\ 10^{-7}$ (0.83)	$-2.55\cdot10^{-7}$ (-0.27)	$-2.57\cdot10^{-7}$ (-0.68)	$3.87\cdot10^{-7}$ (1.13)	$3.66\cdot10^{-8}$ (0.23)
Labor tax	0.12 (1.24)	0.12 (1.03)	1.56 (2.99)	0.40 (1.77)	0.31 (1.57)	0.35 (1.85)
EU	6.03 (1.24)	2.38 (0.85)	-1.06 (-0.17)	12.85 (1.22)	6.17 (1.45)	4.73 (1.56)
EFTA	3.15 (0.67)	2.33 (0.89)	3.01 (0.45)	12.94 (1.27)	6.57 (1.68)	6.93 (2.20)
Other PTAs	-2.67 (-1.43)	-0.27 (-0.16)	-0.11 (-0.02)	-0.58 (-0.17)	3.91 (3.98)	5.83 (3.99)
Trade costs	-30.79 (-1.29)	-29.24 (-1.47)	-19.70 (-0.39)	-68.78 (-1.27)	-48.68 (-1.90)	-29.26 (-1.91)
GDP per capita	$2.56\cdot10^{-3}$ (2.09)	$3.06\cdot10^{-4}$ (0.37)	$9.05\cdot10^{-4}$ (0.43)	$2.03\ 10^{-3}$ (2.05)	$2.38\cdot10^{-3}$ (2.13)	$1.86\cdot10^{-3}$ (1.87)
Market potential	$-1.96\cdot10^{-10}$ (-0.15)	$3.47\cdot10^{-10}$ (0.45)	$-5.92\cdot10^{-10}$ (-0.15)	$-1.51\cdot10^{-9}$ (-1.39)	$1.93\cdot10^{-9}$ (1.64)	$2.44\cdot10^{-9}$ (2.14)
Linkages	-527.31 (-2.02)		-1221.00 (-1.28)		234.1 (1.48)	
Right party legislative seats	-0.03 (-0.98)	0.03 (0.97)	-0.17 (-1.84)	-0.11 (-2.33)	0.02 (0.83)	0.03 (1.27)
Government size	0.34 (1.43)	0.11 (0.50)	-0.57 (-1.35)	-0.35 (-0.96)	0.23 (0.92)	0.04 (0.19)
Growth	-0.38 (-1.33)	0.01 (0.07)	-1.90 (-1.86)	-2.17 (-3.14)	-0.57 (-2.52)	-0.40 (-2.34)
Number of countries	14	19	12	16	13	15
n	168	259	164	281	117	155

* Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.
[1] Labor force, growth rate, and real GDP per capita treated as endogenous
[2] Labor force and growth rate treated as endogenous
[3] Labor force, labor tax rate and growth rate treated as endogenous

Table 4a.

	Statutory Tax Rate [1]		Average Effective Tax Rate			
			Mendoza [2]		DGK [3]	
	C	P	C	P	C	P
Corporate tax rate lagged	0.81 (8.70)	0.37 (6.18)	0.39 (3.78)	0.22 (4.36)	0.84 (8.19)	0.31 (2.75)
Trade	-0.15 (-0.98)	0.34 (2.02)	-0.72 (-2.04)	-0.34 (-2.32)	-0.04 (-0.54)	0.09 (0.50)
Openness	-1.41 (-1.99)	1.72 (1.63)	3.70 (1.57)	3.44 (1.87)	0.03 (0.08)	0.41 (0.53)
Capital	-1.37 (-1.37)	-6.66 (-1.54)	-15.20 (-2.81)	-1.56 (-0.39)	1.66 (1.58)	-6.57 (-5.32)
Labor force	$-5.56\cdot10^{-7}$ (-1.99)	$2.23\cdot10^{-6}$ (1.82)	$-1.52\cdot10^{-6}$ (-1.61)	$2.66\cdot10^{-6}$ (5.09)	$-1.53\cdot10^{-8}$ (-0.05)	$2.00\cdot10^{-6}$ (4.41)
Labor tax	0.21 (1.70)	0.04 (0.33)	0.63 (0.94)	1.38 (4.21)	-0.04 (-0.36)	0.63 (2.93)
EU	Dropped	-5.58 (-1.09)	Dropped	-7.90 (-1.42)	Dropped	6.72 (1.56)
EFTA	Dropped	-6.92 (-1.32)	Dropped	-0.70 (-0.14)	Dropped	9.47 (2.27)
Other PTAs	4.10 (2.73)	5.85 (0.97)	-7.36 (-0.83)	-20.89 (-12.75)	Dropped	4.59 (2.03)
Trade costs	-18.38 (-0.43)	-0.73 (-0.03)	-131.72 (-0.67)	-140.18 (-1.71)	-89.00 (-2.97)	-43.86 (-2.17)
GDP per capita	$2.36\cdot10^{-3}$ (1.43)	$2.07\ 10^{-3}$ (2.44)	$2.72\ 10^{-3}$ (0.63)	$-1.50\ 10^{-3}$ (-0.94)	$1.55\cdot10^{-3}$ (2.32)	$3.65\ 10^{-4}$ (0.40)
Market potential	$-7.87\cdot10^{-10}$ (-0.48)	$-3.36\cdot10^{-9}$ (-1.15)	$-1.05\cdot10^{-8}$ (-1.94)	$1.00\cdot10^{-8}$ (7.58)	$1.39\ 10^{-9}$ (0.64)	$4.02\cdot10^{-9}$ (2.55)
Linkages	-172.96 (-0.67)	-1218.17 (-3.00)	-1984.27 (-2.20)	129.30 (0.13)	-125.58 (-1.08)	-217.26 (-0.43)
Right party legislative seats	0.09 (1.48)	-0.09 (-0.29)	-0.02 (-0.14)	-0.15 (-3.29)	0.01 (0.45)	0.04 (0.68)
Government size	0.42 (2.59)	0.28 (1.62)	-1.12 (-2.16)	0.43 (-1.47)	0.49 (2.82)	-0.14 (-0.77)
Growth	0.22 (0.72)	-0.44 (-1.41)	-1.36 (-1.10)	-2.38 (-2.28)	-0.37 (-1.78)	-0.54 (-2.01)
Number of countries	6 [a]	8 [b]	5 [c]	7 [d]	6 [e]	7 [f]
n	61	107	63	101	49	68

* Notes: Numbers in parentheses are t-statistics. Time dummies are included but not reported.

[1,2,3] See Table 4.

[a] incl. France, Germany, Italy, Netherlands, UK, US, [b] incl. Austria, Canada, Denmark, Finland, Japan, Portugal, Spain, Sweden, [c] incl. France, Italy, Netherlands, UK, US, [d] incl. Canada, Denmark, Finland, Japan, Portugal, Spain, Sweden, [e] incl. France, Germany, Italy, Netherlands, UK, US, [f] includes Australia, Canada, Finland, Japan, Portugal, Spain, and Sweden

Table 5. GMM estimates of corporate tax rates, "tax competition" variables and agglomeration variables including interaction terms*

	Statutory Tax Rate [1]			Average Effective Tax Rate Mendoza [2]		
	i	ii	iii	i	ii	iii
Corporate tax rate lagged	0.82 (10.41)	0.84 (10.87)	0.51 (4.98)	0.46 (8.22)	0.45 (7.10)	0.43 (5.35)
Trade costs × GDP per capita	0.01 (1.71)			-0.005 (0.39)		
Trade costs × Market potential		$-2.18\cdot10^{-10}$ (-0.06)			$3.99\cdot10^{-9}$ (0.45)	
Trade costs × Linkages			23563.8 (2.35)			-16352.5 (-1.02)
Trade	0.09 (1.14)	0.10 (1.24)	0.16 (1.38)	-0.32 (-1.97)	-0.33 (-1.88)	-0.46 (-1.96)
Openness	0.10 (0.22)	0.17 (0.40)	-0.28 (-0.37)	1.95 (1.31)	1.62 (1.06)	-2.06 (1.03)
Capital	-2.17 (-1.58)	-2.11 (-1.54)	-2.45 (-1.17)	-3.02 (-0.62)	-2.09 (-0.40)	-3.24 (-0.65)
Labor force	$-2.23\cdot10^{-7}$ (-1.03)	$2.04\cdot10^{-7}$ (1.13)	$4.54\cdot10^{-7}$ (1.58)	$-9.23\cdot10^{-8}$ (-0.27)	$-1.66\cdot10^{-8}$ (-0.05)	$4.33\cdot10^{-8}$ (0.10)
Labor tax	0.12 (1.10)	0.11 (1.01)	-0.19 (1.27)	0.38 (1.74)	0.40 (1.55)	1.64 (3.03)
EU	2.46 (0.89)	2.35 (0.84)	6.51 (1.25)	12.17 (1.19)	11.25 (1.12)	-0.01 (-0.00)
EFTA	2.35 (0.94)	2.44 (0.85)	4.60 (0.89)	10.38 (1.04)	13.58 (1.39)	4.77 (0.83)
Other PTAs	-0.27 (-0.18)	-0.36 (-0.22)	-2.45 (-1.42)	-0.68 (-0.21)	-1.77 (-0.50)	-1.05 (-0.42)
Trade costs	-173.7 (-2.11)	-27.35 (-0.99)	-281.5 (-2.50)	-175.7 (-0.75)	-60.9 (-0.81)	200.5 (0.86)
GDP per capita	-0.01 (-1.82)			-0.003 (-0.21)		
Market potential		$4.48\cdot10^{-10}$ (0.12)			$-6.12\cdot10^{-9}$ (-0.70)	
Linkages			-25056.3 (-2.40)			15757.8 (0.91)
Right party legislative seats	0.03 (0.95)	0.03 (0.92)	$-9.73\ 10^{-4}$ (-0.03)	-0.13 (-2.59)	-0.10 (-2.08)	-0.17 (-1.71)
Government size	0.15 (0.65)	0.06 (0.47)	0.06 (0.61)	-0.14 (-0.48)	-0.51 (-1.60)	-0.60 (-3.47)
Growth	0.01 (0.04)	0.02 (0.21)	-0.16 (-0.78)	-2.10 (-3.10)	-1.88 (-2.79)	-1.84 (-1.75)
Number of countries	19	19	14	16	16	12
N	259	259	168	281	281	164

*Notes: Numbers in parentheses are *t*-statistics. Time dummies are included but not reported.
[1,2,3] See Table 4.

Table 5. ***continued***

	Average Effective Tax Rate DGK [3]		
	i	ii	iii
Corporate tax rate lagged	0.53 (4.97)	0.58 (4.88)	0.45 (3.92)
Trade costs × GDP per capita	0.004 (0.59)		
Trade costs × Market potential		$-1.90 \cdot 10^{-9}$ (-0.61)	
Trade costs × Linkages			4975.9 (0.33)
Trade	0.11 (1.06)	0.06 (0.61)	0.03 (0.24)
Openness	-0.11 (-0.17)	-0.19 (-0.26)	-1.00 (-0.99)
Capital	-3.45 (-2.55)	-2.92 (-2.59)	-1.82 (-1.23)
Labor force	$-1.20 \cdot 10^{7}$ (-0.59)	$2.82 \cdot 10^{-7}$ (1.50)	$3.54 \cdot 10^{-7}$ (1.35)
Labor tax	0.31 (1.71)	0.39 (2.05)	0.40 (2.53)
EU	4.62 (1.52)	4.52 (1.38)	7.98 (1.60)
EFTA	7.57 (2.33)	7.39 (2.34)	10.42 (2.21)
Other PTAs	5.63 (3.93)	4.50 (3.15)	4.25 (3.49)
Trade costs	-105.4 (-0.79)	-13.3 (-0.77)	-98.76 (-0.58)
GDP per capita	-0.003 (-0.37)		
Market potential		$3.66 \cdot 10^{-9}$ (0.97)	
Linkages			-5047.3 (-0.32)
Right party legislative seats	0.03 (0.99)	0.03 (1.29)	0.02 (0.48)
Government size	-0.07 (-0.36)	-0.25 (-1.25)	-0.22 (-1.03)
Growth	-0.40 (-2.29)	-0.34 (-2.11)	-0.44 (-2.22)
Number of countries	15	15	13
N	155	155	117