Torfinn Harding

Empirical analyses of productivity and international linkages

Thesis for the degree of Philosophiae Doctor

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Norwegian University of Science and Technology
Faculty of Social Sciences and Technology Management
Department of Economics

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Norwegian University of
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Preface

This thesis consists of an introductory chapter and four essays. The essay in chapter 2 is written with my supervisor Jørn Rattsø, Professor of economics at the Norwegian University of Science and Technology (NTNU). The essay in chapter 4 is written with Beata Smarzynska Javorcik, Reader in economics at University of Oxford.

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In the period September 2005 – March 2007 I was at leave from Statistics Norway and worked with Beata Smarzynska Javorcik in the Development Economics Research Group of the World Bank. I would like to thank her for her supervision and for her persistence in the work we did and are doing together. On the technical side I am very must indebted to her emphasis on clean econometrics and careful identification. Her friendship and her inspiring curiosity and ambitions are greatly valued. I would also like to thank my colleagues in the trade group for their hospitality.

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My family has combined encouragement with autonomy and intellectual curiosity with warmth as long as I can remember. I want to thank my mother Laila and my father Tor for all the opportunities I was given to be active and to learn. Their involvement has been immensely important. My sister Lene has always been one of my closest friends and I deeply thank her for her willingness to support, understand and challenge me.

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This thank-you page reminds us that development is generally not achieved in isolation.

Torfinn Harding,
June 2008

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Chapter 1

Introduction, summaries and future research

1.1 Introduction

The dissertation sheds light on linkages between emerging economies and the international economy. Economic development is not achieved in isolation, but in interaction with more successful economies.

A consensus view in modern growth literature suggests that, due to international spillovers, all countries grow at a common rate in the long run. Income level differences are therefore permanent (Acemoglu and Ventura, 2002; Klenow and Rodriguez-Clare, 2005; Parente and Prescott, 2005). Differences in growth rates across countries are only transitory, but open up for improvement or worsening of countries' position in the world income distribution. A crucial question to developing countries is how to achieve improvements and catching up to income levels of developed countries.[1]

The "barrier model" of economic growth is consistent with the pattern described above. Removing barriers hindering spillovers from abroad can generate catching up towards the technology frontier. We can think of barriers in three categories: factors influencing the basic functioning of the economy (i.e. market structure, regulations, government institutions, and availability and quality of production factors), factors directly important for adoption of foreign technology (i.e. human capital and capital equipment), and factors "transporting" the technology across international borders (i.e. import, export, foreign direct investment).

The dissertation focuses on the first and the third type of barriers. The interplay between the two is of special interest. The first type can typically be influenced by policy and facilitate the functioning of the vehicles of the third. .

Trade reform in terms of tariff liberalization is a policy regarded as removal of a barrier to imports. Imports, for instance through embodied technology in production inputs, is believed to have potential of raising productivity. Interaction with competitors and demanding customers abroad through exports is also hypothesized as a vehicle of productivity spillovers. Two chapters in the thesis are devoted to investigate the links between trade and productivity in South Africa.

[1] Productivity differences is the main factor to explain income differences between nations (Hall and Jones, 1999). Lucas (2007) suggests that international transfers of production-related knowledge is the main mechanism to reduce income inequalities between nations. Vehicles with proposed potential to carry such knowledge between countries are imports, exports and foreign direct investments.

Investment promotion and reforms of infrastructure policy are discussed in the two last chapters. The investigations - both in cross-country settings – suggest these policies to fuel linkages to the world economy.

1.2. Methodology

The main methodological challenge in analyses of effects of openness on productivity and outcomes of policy reforms is to handle the simultaneity of the measures intended to make a difference. Is the implementation of tariffs liberalization affected by productivity? Do productive exporters drift to sophisticated markets with attractive technology, rather than exports brining technology improving exporter-productivity? Is a positive association between investment promotion and investments driven by something else than investment promotion? These are methodological challenges the dissertation aims to tackle through its econometric methodology. Exploitation of panel data – offering comparability across units and within units over time – in combination with variation generated outside the units studied is key.

1.3. Summary of the essays

Chapter 2 (with Jørn Rattsø, NTNU): "Industrial labor productivities and tariffs in South Africa: Identification based on multilateral liberalization reform"
Productivity growth in South African manufacturing sectors is found to be consistent with a growth model where productivity is driven by adoption of technology developed abroad. The catch up to the international frontier is disturbed by barriers to international openness.

The IMF-study of Jonsson and Subramanian (2001) finds that that openness can explain most of the productivity growth in South Africa in the period 1970-97.[2] Their openness measure is the outcome variable of foreign trade's share of GDP and the analysis therefore suffers from simultaneity bias. Fedderke (2003) finds more support for the importance of domestic factors for the productivity growth in South Africa. Also Fedderke's analysis rests on potentially endogenous explanatory variables. For instance, sector specific R&D investments are used as a measure of innovation. While being a nice direct measure of innovation, it is not clear if innovating sectors become productive or if productive sectors spend relatively larger resources on R&D. We contribute to the literature on South Africa's productivity growth by employing more exogenous drivers of productivity.

[2] These studies focus on total factor productivity, while we here focus on labor productivity. Harding and Rattsø (2004) and Harding and Rattsø (2007) find the barrier model to be consistent also with TFP-developments in South Africa.

The chapter focuses on sector specific tariffs as measure of barrier to openness. A massive trade-liberalization – to a large extent the result of negotiations between countries in for instance WTO – during the nineties induced large changes in tariffs in many of the sectors. Our identification strategy is to compare sectors with large tariff reductions to sectors with little tariff changes over time. Negotiated multilateral-liberalization is in itself a fairly exogenous change in tariffs, since different economies need to agree on a broad basis. On the other hand, there is some room for negotiations and economies may try to protect certain sectors. If economies for instance protect sectors with low international competitiveness (low productivity), this will turn up as a negative correlation between tariff levels and productivity levels. This could wrongly be interpreted as high tariff levels causing low productivity levels. To deal with this challenge we use the fact that the tariff phase down was a result of negotiations across economies and instrument the tariff changes in South Africa with tariff changes in similar economies. A qualified instrument should affect the potentially endogenous explanatory variable, but not the dependent variable beyond the effect through the potentially endogenous variable. To instrument the tariff level in sector i in South Africa we use the average level of tariffs in sector i among lower middle income economies in Latin America and the Caribbean, North Africa and the Middle East and South Asia. It seems reasonable that these tariff levels affected the South African tariff levels through the multilateral negotiations, while it is hard to make the case that tariffs level in, for instance, the automotive sector in Brazil should affect productivity in the South African automotive sector.

A second innovation in the setting of South Africa is to use sector specific technology frontiers. Since the technology levels and gaps are different across sectors, it is logical to allow for sector specific catch ups. We let labor productivity in corresponding sectors in U.S. represent the technology frontier.

The results suggest a robust and statistically significant negative relationship between tariffs and labor productivity growth. A 10 percent higher tariff level is estimated to reduce the productivity growth by about 1 percentage point. The quantitative effect is quite large and the economic interpretation is that tariff reductions stimulate the transition growth of labor productivity.

Chapter 3: "Does it matter to whom you export? "

Is observed higher productivity among exporters than non-exporters due to productivity spillovers from export-destinations to exporters, or are exporters more productive than non-exporters already before they become exporters? Despite intense research efforts the literature presents mixed evidence and does not seem to have settled for a consensus answer.

Chapter 3 investigates the link between exposure to productivity through exports and total factor productivity. The idea is that if export is a channel of productivity spillovers from export markets to exporters, such spillovers should be higher from exports markets with high productivity than from exports markets with low productivity. Such a mechanism suggests a positive association between the productivity level of the exporter and the productivity level met in export markets. To measure the exposure to productivity through export we let us inspire by Hausmann et al. (2007). They launch a measure, EXPY, which classifies an export basket according to the "inherent" productivity level of *products* exported. We define a measure, EXCY, which classifies an export basket according to the weighted average productivity level of the *importers* served by the exporter in question.

Exports may be a channel for productivity spillovers from the export destination to the exporter. Exporters may also be the ones able to overcome fixed costs associated with exporting because they are productive (Melitz, 2003). Causal effects of productivity on international interaction may therefore exist, and a hypothesized causal relationship of international interaction on productivity could be overestimated. We implement a two-stage least squares estimation (2SLS) attempting to handle such potential endogeneity bias. The instrument suggested is imports to South Africa's export destinations from groups of other exporting countries. The common variation in imports from South Africa and imports from other countries is interpreted as demand shocks in the importers.

Trade data from Feenstra et al. (2005) are combined with a panel data set of 25 South African manufacturing sectors, data on total factor productivity for US manufacturing sectors and GDP per capita data on the export-destinations. We exploit variation across 161 importers, 25 sectors and 24 years in the first stage and the 25 sectors and 24 years in the second stage.

The OLS-results suggest a link between the productivity of export destinations and export-sector productivity. The effect is robust to sector and year fixed effects, measures of the international technology frontier, export value at the sector level and different functional forms. Comparison between OLS-estimates and 2SLS-estimates indicate, however, that the OLS-estimates are severely biased upwards. We do not find support for the existence of productivity spillovers through exports when endogeneity of export markets is accounted for.

Finally, the chapter addresses a competing hypothesis proposed by Hausmann et al. (2007). Growth is in their paper found to be positively associated with the inherent product characteristics measured by EXPY. For EXPY we do not find support for a positive link either in OLS or in 2SLS. We suggest that more research is needed on the relative importance of exporting sophisticated products versus exporting to sophisticated destinations.

Chapter 4 (with Beata Smarzynska Javorcik , Oxford University): "Developing economies and international investors: Do investment promotion agencies bring them together?"

Despite its importance for public policy choices, little is known about the effectiveness of investment promotion efforts. Our analysis employs data collected through a recent Census of Investment Promotion Agencies around the world. The Census contains information on investment promotion efforts in 109 countries, representing all income groups and geographic regions. About three quarter of responses pertain to developing countries. A unique feature of the Census is that it includes time-varying information on the existence of an IPA, its status and reporting structure, sector targeting and incentives offered to foreign investors.

Our identification strategy relies on the fact that the majority of IPAs target particular sectors in their efforts to attract FDI. Sector targeting is considered to be best practice by investment promotion professionals (Loewendahl, 2001, Proksch, 2004). Sector targeting allows us to identify the effect of investment promotion using the difference-in-differences approach. We compare FDI inflows into targeted sectors, before and after targeting, to FDI inflows into non-targeted sectors, during the same time period.[3] Our analysis is based on US FDI data, disaggregated by host country and sector and available for the period 1990-2004, provided by the US Bureau of Economic Analysis. We control for changes in host country business environment by including country-year fixed effects, for heterogeneity of sectors in different locations by including country-sector fixed effects and for shocks to supply of FDI in particular sectors by adding sector-time fixed effects. We also perform an exercise on aggregate data, which partially provide robustness checks and partially is complementary since some of the investment promotion variables available are only available at the aggregate level.

Our results suggest that investment promotion efforts lead to higher FDI inflows to developing countries. We find that targeted sectors receive more than twice as much FDI as non-targeted sectors. This magnitude is plausible, given that many sectors receive small amounts of FDI in absolute terms. For instance, the median sector-level inflow of US FDI to developing countries in our sample that received some US investment was 11 million dollars. Thus, the increase of 155 percent estimated in our analysis would translate into additional 17 million dollars of FDI.

[3] Charlton and Davis (2006) use a similar identification strategy in their analysis of FDI inflows into OECD countries.

Chapter 5: "Export upgrading through infrastructure policy reforms: evidence from 10 new EU members"

It is widely believed that infrastructure is an integrated part of economic development (Duflo and Pande, 2007). The World Development Report 1994 of the World Bank emphasized the importance of the quality of such services for development. In this chapter, we argue that better infrastructure policies, leading to improved infrastructure (quality and quantity), can increase unit values of export products as well as make a country's export basket more diversified. We have two mechanisms in mind. Better infrastructure may increase manufacturing productivity. Higher manufacturing productivity may increase product quality and unit values. Better infrastructure may also reduce trade costs. Shorter delivery time to buyers, for instance, can be as valued as increased product quality and can result in higher unit values.

There is a growing interest in the relation between characteristics of countries' export baskets and economic performance. For instance, unit values of exports seem to vary greatly across countries. Schott (2004) and Hummels and Klenow (2005) present evidence suggesting a positive association between countries' level of development and the unit values of their export products. The fact that export product quality seem to go together with the level of development poses an interesting question: how can developing countries upgrade their export baskets to rich country levels? The results of chapter 4 indicate that infrastructure reforms have potential to be part of the answer.

To analyze the effects of infrastructure improvements on export diversification and unit values, we exploit data on infrastructure services reforms in 10 Eastern European countries. In the period studied, 1989–2000, these economies went from being governed by central planning to become open market economies. Service industries were not regarded as important during the era of central planning (Eschenbach and Hoekman, 2006), and since 1989 the countries studied have massively reformed these sectors.

We estimate reduced form equations for diversification and unit values of exports. The variables of which we seek to estimate the effects are infrastructure reforms in the electric power, roads and telecommunications services sectors. The assumption we make is that reforms lift the quality and/or quantity of infrastructure services available to exporters. We do not think this is a controversial assumption as it is well know that bottlenecks—also in infrastructure—were common in centrally planned economies. Measures of infrastructure as such are not in our possession, and it is a task for future research to evaluate the exact channels through which the different infrastructure policies may affect the

export characteristics in question. We interpret these infrastructure policies as instruments for infrastructure services and use them directly in the estimations.

Our findings are consistent with higher export unit values due to infrastructure sector reforms, as reforms of all three sectors—electric power, roads and telecommunications—are significantly positively correlated with unit values. The results for diversification need more careful justification.

1.4. Future research

In the light of the "barrier model" of economic growth, barriers to the spread of production-related knowledge across countries should be at the center stage of analyses of growth. The three categories of barriers mentioned above – "institutions", production factors and vehicles – can independently and jointly affect catch-up to higher technology and income levels. International linkages can affect all of these different aspects and it is hard to separate out the different channels of effects from the global to the national economy. Future research should seek to clarify the different roles of, and the interplay between, these different aspects.

An econometrically especially challenging area is the role of domestic factors. These are typically endogenous to the growth process, making it hard to identify their effects. That does not, of course, mean they are not important and it is a challenge for future research to include domestic factors in an econometrically satisfying way. More specifically, the dissertation is in the productivity analyses concerned with barriers to international spillovers. Import and export allows for instrument strategies exploiting variation abroad to identify the relationships of interest. Domestic factors likely to affect technology adoption, like domestic institutions, policies and economic variables are often outcomes as well as causes of the growth process. Randomization or other ways to control variation is typically not viable research strategies in the macro settings concerned.

More research is specifically needed on the transmission channels of technology spillovers. Currently, policies like export promotion and investment promotion is justified partly because of positive externalities of internationalization. A better understanding of which vehicles that brings technology and under which setting such technology is attached to and develop the economy in question carry the potential of better targeting of the polices.

Concerning exports and productivity, more research is needed to understand the positive correlation typically observed. Is it only about self selection? Is it about a process of self-discovery – being

relatively domestic in nature – or is it also about technology spillovers from abroad? Understanding the deeper causes of the positive productivity premium of exporters is a challenge for future research.

Within the area of investment promotion, there is a need for more research on investment incentives. Many countries spend scarce resources on such – often expensive – incentives. To target them correctly or perhaps abandon them completely may be of fiscal importance for many developing countries. Also, a better understanding of what is driving such incentives could suggest ways of reducing outlays to them. If, for instance, competition among countries creates a situation where countries spend huge amounts on incentives, coordination should probably be high on the agenda. Data constraints and challenging policy simultaneity has created excess demand for empirical investigations on investment incentives.

As the debate on exports and growth is turning away from exports as such, and towards quality and sophistication of export products, identification of policy measures available to developing and transition countries capable of raising export product quality appear to us as an important task for research. Infrastructure reforms seem to work differently in different sectors. To understand why this is the case could be important for improving policy designs. The role of FDI and other factors accommodating infrastructure reforms is another interesting avenue for future research. The latter reminds us about the simultaneous character of the economic mechanisms studied in this thesis.

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Chapter 2

Industrial labor productivities and tariffs in South Africa: Identification based on multilateral liberalization reform

With Jørn Rattsø, NTNU

Industrial labor productivities and tariffs in South Africa: Identification based on multilateral liberalization reform

Torfinn Harding, Statistics Norway and Norwegian University of Science and Technology (NTNU) torfinn.harding@ssb.no and Jørn Rattsø, Norwegian University of Science and Technology jorn.rattso@svt.ntnu.no.

Abstract

The analysis of the effect of tariffs for labor productivity faces the challenge of tariff policy endogeneity. Tariff policy is designed to promote economic development and the industrial sector tariff structure may reflect characteristics of the industries protected. We take advantage of the multilateral tariff liberalization and seek to identify the effect of tariffs using reductions in industrial sector tariffs in other world regions as instruments for sectoral tariff reductions in South Africa. Employing an industrial sector panel for the period 1988-2003 and various dynamic formulations we find that tariff reductions have stimulated labor productivity.

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JEL – codes: F13, F43, O11, O33, O55, Key words – Trade policy, policy evaluation, barriers to growth, technology adoption, South Africa, labor productivity

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1. Introduction

Do tariffs affect labor productivity? We investigate this relationship using data for industrial sector development and tariffs for South Africa. The main challenge for any policy evaluation is to take into account the endogeneity of policy. Trade policy typically is part of industrial policy and the sectoral tariff rates are designed to promote sectoral policy goals. Correlations between tariffs and productivity may reflect political responses to sectoral productivity development. We take advantage of multilateral tariff reform and use industrial sector tariffs of countries in other world regions as instruments for tariff reductions in South Africa. The development of industrial sector tariffs predicted by the industrial sector tariff development in other world regions is assumed to be independent of domestic policy priorities.

We apply the Trade and Industry Policy Studies (TIPS, 2004) industrial sector panel data for the period 1988-2003 covering 28 manufacturing industries in South Africa. The panel data allows for calculation of labor productivity and this is related to sectoral tariff rates. The tariff rates are instrumented using sectoral tariff rates for similar countries in three world regions, Latin-America, Middle-East and South Asia. Various model specifications are investigated to check the robustness of the results and reveal the dynamics of adjustment. The results consistently show that reduced industrial sector tariffs have contributed to higher labor productivities.

The effect of trade policy for productivity and growth is a classic issue in policy evaluation and has been analyzed in an enormous literature including case studies, country time series and cross-country econometric analysis. The literature has exploited data at the plant/firm level, industrial sector level and country aggregates. The industrial sector level has the advantage of long panel data. Recent country studies, using industrial sector data and with ambition to capture causal effect of trade policy, include Ferreira and Rossi (2003) and Muendler (2004) for Brazil, Fernandes (2007) and Karacaovali (2006) for Columbia, and Amiti and Konings (2005) for Indonesia. All these authors apply instruments to represent changes in tariffs, and the instruments are typically constructed from other industrial sector characteristics than productivity. A related literature

addresses tariffs and productivity at the firm level (Pavcnik, 2002). While this approach certainly represents an improvement compared to the earlier literature, there are potential simultaneities involved in using sectoral characteristics to predict sectoral tariff policies. Alternative contributions are offered by Trefler (2004) and Romalis (2007). Trefler studies trade policy reform in the context of the Canada – US free trade agreement. Romalis uses US tariff barriers to predict the openness of developing countries in a cross country study. We suggest to use other countries sectoral tariffs to predict tariffs in South Africa and thereby avoid the dependence on internal industrial characteristics.

The dominating understanding of productivity growth in middle income countries like South Africa is 'catching up'. This approach has historical roots in Gerschenkron's (1962) analysis of development out of backwardness and was formalized by Nelson and Phelps (1966) as technology adoption. They assume that individual country productivity growth is determined by the gap to the world technology frontier and factors affecting the technology adoption. Caselli and Coleman (2006) offer an application of the world technology frontier in a cross-country analysis using aggregate data. Recent theoretical advances are discussed by Klenow and Rodriguez-Clare (2005) in an overview of the literature on international externalities and economic growth. Aghion and Howitt (2005) elaborate various appropriate growth frameworks and their 'Schumpeter meets Gerschenkron' covers catching up to the world frontier. In this context tariffs affect the international spillover of technologies. Our analysis includes the world technology frontier described by sectoral labor productivities in the U.S.. The results indicate that the catching up model is relevant to understand productivity growth in South Africa.

The econometric challenges are discussed in section 2, and section 3 offers a first look at the data. The econometric analysis is presented in section 4, and section 5 gives concluding remarks.

2. Econometric challenges

Trade liberalization may or may not improve labor productivity. Trade policy is controversial because strong economic interests and ideological views are involved, but also because the effects of trade policy are unclear. In theory two strong arguments are in conflict, infant industry versus technology adoption. Protecting industries while they are fostered and made ready for international competition has for long been the main argument for import substitution policies. Such trade policy easily ends up protecting low-productivity industries, but can also be used to stimulate high-productivity sectors. Learning from international technological spillovers in an open economy has been the opposite strategy. Theoretically there are many potential linkages between trade policy and productivity. Empirical analyses have not solved the controversy as case studies always are open for interpretation and econometric studies have run into serious methodological problems of policy endogeneity. Rodrik (1995) offers a nice overview of the literature on the political economy of tariff protection, and his discussion shows how trade policy is part of industrial policy.

Besley and Case (2000) present a simple model of political decision making in the context of policy evaluation with endogenous policy as right hand side variable in regressions. The endogeneity can be understood as an omitted variables story. In our setting policy output is measured as labor productivity, the policy is tariffs, and a set of economic variables explain labor productivity. The tariff policy is a function of economic and political variables typically not controlled for in the estimation of labor productivity equations. Given this broad understanding of the problem, the Besley and Case arguments imply that the probability limit of the OLS estimate of the coefficient for the tariff variable has two sources of bias:

1. Bias due to the presence of unobservable variables that may determine both the tariff policy and the labor productivity.
2. Omitted variable bias caused by observable variables that determine tariff policy and that have independent influence on labor productivity. Political preferences

for industrial sector production and imployment may influence sectoral tariffs over time. Controlling for such variables in practice is hard to do, in particular since they are themselves endogenous.

When governments protect low productivity industries, high sectoral tariffs will be associated with low sectoral productivity growth. A simple econometric analysis assuming that tariffs affect productivity will conclude that tariffs hold back productivity. OLS will overestimate the effect of tariffs. When governments protect high productivity industries OLS will underestimate the tariff effect.

The relationship between industrial characteristics and trade policy has been investigated recently. Ferreira and Facchini (2005) show that more concentrated industries are more protected. Karacaovali (2006) offers a two-way analysis of tariffs and productivity for Columbia. He finds that sectors with high productivity are liberalized less. Trade liberalization is used to increase foreign exposure for low productivity industries. These studies support the understanding that the design of trade policy takes into account industrial characteristics. The endogeneity of policy is a serious challenge for policy evaluation.

The recent analyses of trade policy and productivity instrumenting trade policy represent an attempt at correcting for the endogeneity. Ferreira and Rossi (2003) discuss the endogeneity, but concludes that 'endogeneity is not a problem with respect to tariff determination' in Brazil. They base this conclusion on the observation that tariffs were reduced proportionally across industries. Muendler (2004) applies domestic and foreign price and exchange rate components as instruments. Fernandez (2003) control for endogeneity by using lagged tariff rates in Columbia. Karacaovali (2006) uses among other variables capital to output ratios and material prices to instrument the import ratio as determinant of tariffs in his analysis of Columbia. Amiti and Konings (2005) use old tariffs to instrument for present tariffs in a study of Indonesia. The studies referred to above all use instruments that are unlikely to be independent of productivity and therefore are not well suited to identify the tariff effect.

An alternative approach is to look for tariff reform. Trefler (2004) makes use of the Canada - U.S. free trade agreement as an experiment of trade policy shift. We study a more continuous trade liberalization process and must look for exogenous background factors driving trade reform. In the broader literature of applied political economy, characteristics of the political system are typically used to instrument policies. This is hard to do properly in a disaggregated analysis of industrial sectors. If disaggregated political factors relevant at the sectoral level are observed, such as lobbying, they are themselves endogenous to sectoral productivity. Romalis (2007) use U.S. tariff barriers as instruments for the openness of developing countries. Our use of other countries tariff liberalization as instruments shares the view that good instruments can be found abroad. Overseas tariff changes are correlated with South African ones and are expected to be uncorrelated with South African industry productivity.

South Africa is one of many countries participating in multilateral liberalization of import tariffs under the coordination of GATT and later WTO. We use the fact that the tariff phase down was the result of international negotiations and therefore harmonized across countries. It should be noticed that the tariff negotiations have affected the bound tariffs, but actual tariffs that we use have broadly followed the course set by the bound tariffs. It is an empirical question whether actual South African tariffs have followed the harmonized pattern of actual tariffs and we show that they do. As will come clear, most of the world wide tariff reductions, and also in South Africa, came during the 1990s. Industry-specific shocks may have driven industry tariff rates across countries and will be a concern for the validity of the instrument. We use time dummies to account for such shocks. Data and econometric tests presented below confirm that international industrial sector tariff reductions can serve as identification of tariff policy effects in South Africa. The robustness of the identification strategy is further investigated and discussed below.

3. A first look at the data

The analysis is based on the 3-digit panel data set of manufacturing industries in South Africa provided by TIPS (2004).[1] Labor productivity, y, is simply sector value added, measured in 1995 Rand, divided by number of people employed (including casual and seasonal workers) in the sector. Appendix Table 1 documents the data, and the average South Africa labor productivity in our sample is 140 000 Rand per worker. The average logarithmic growth rate of labor productivity is 4 percent.

We use applied tariffs, rather than applied and most favored nation (MFN) tariffs. As explained by Nicita and M. Olarreaga (2006), applied rates take into consideration the available data for preferential schemes.[2] The tariff data are disaggregated at 3-digit international manufacturing sector level and classified according to ISIC Rev. 2.[3] Appendix Table 2 shows the matching of the sectors. We apply sectoral tariff changes in countries in other world regions as instruments for tariff changes in South Africa. We focus on similar middle income countries and look at three regions – Latin-America and Caribbean (LAC), Middle-East and North Africa (MENA) and South Asia (SA).[4]

Beyond the analysis of tariffs and labor productivity we add the world frontier labor productivity represented by industrial sectors in the U.S.. Consistent with the above South African data we apply 3-digit U.S. data to calculate manufacturing sector labor productivities. The U.S. data are published by Bureau of Economic Analysis (BEA) and are classified according to SIC 87.[5] Labor productivity for the US, y*, is defined as value added in 2000 USD, and is found by deflating value added measured in millions of current USD with the published corresponding price indices. These indices are 100 in 2000. As a measure of number of workers per sector we use the published full time and

[1] The data are now available at: http://www.quantec.co.za/
[2] MFN rates are those granted to all WTO members to whom no preferential access is granted.
[3] The data are available at http://go.worldbank.org/EQW3W5UTP0
[4] The relevant countries in these regions with tariff data that are included in the analysis: 9 countries in LAC (Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Peru and Suriname), 6 countries in MENA (Algeria, Arab Rep. Egypt, Islamic Rep. Iran, Jordan, Morocco and Tunisia) and 1 country in SA (Sri Lanka).
[5] The classification has been changed over time from SIC72 to SIC87 to NAICS97. We first merge the U.S. data according to SIC87 and then merge the U.S. data with the South African data. For access to and description of the data, see: http://www.bea.gov/bea/dn2/iedguide.htm#GPO

part time employees, measured in thousands of employees. As shown in Appendix Table 1, the mean U.S. labor productivity is 95 000 USD per worker in our sample. The average logarithmic growth rate of labor productivity in the U.S. is 2 percent, and consequently the raw data indicate catching up productivity growth in South Africa.

The development of selected sectoral tariffs in South Africa is shown in Figure 1. The sectors shown are basic chemicals, basic iron and ore, basic non-ferrous metals, motor vehicles parts and accessories, other transport equipment, and textiles. The tariffs have been reduced for almost all industrial sectors during the period studied. The size of the full period reduction varies, but is about 50% on average. Tariffs have been reduced over the whole period, but with particular sharp reductions around 1995-96, consistent with the multilateral reform promoted by the Uruguay round. The sharp reduction for 1995-96 in particular is pronounced for basic chemicals and basic metals.[6] The broad tariff policy of South Africa is analyzed by Edwards (2005).

Figure 1 about here.

The development of tariffs for the same selected industries in the three regions (LAC, SA and MENA) is also shown in Figure 1. Broadly the tariff reductions in South Africa are consistent with the tariff development in the three mentioned regions. World tariff reductions during the 1990s, certainly in the regions we look at, seem to have moved in tandem and then as a part of world-wide reform. The diagrams indicate that other regions sectoral tariff development may predict South African tariffs.

The tariffs are related to labor productivity. The development of labor productivities for the same selected industries in South Africa and the U.S. during 1988-2003 are shown in Figure 2. Overall South Africa has had positive labor productivity growth in manufacturing industries, but across industries the performance is quite heterogeneous. The diagrams broadly confirm the strong catching up to the U.S.. Productivity growth in South Africa has been higher in basic iron and steel, basic non-ferrous metals and motor

[6] Also electrical machinery, metal products, non-metallic minerals, plastic products, and other industries experienced such sharp reductions (not shown).

vehicles parts and accessories, similar to the U.S. in basic chemicals and other transport equipment, and below in textiles. The time paths differ, but many of the growth sectors have a take off around 1996-97.

Figure 2 about here.

Graphical observation of the raw data supports the understanding that the development of labor productivity in South Africa and the U.S. is linked and that a period of rising labor productivity has been associated with reduced tariff levels. The interaction between the three factors needs to be investigated econometrically.

4. Econometric analysis

The econometric analysis seeks to reveal a relationship between sectoral labor productivities and tariffs. Given the dataset for 28 industrial sectors during 1988-2003 we have all in all about 400 observations for South Africa. The two basic variables of the analysis are the growth rate of sectoral labor productivity $\Delta \ln y_{it}$ (sector i, year t) and tariff rate tr_{it}. The econometric specification investigates alternative dynamics of the response of labor productivity to tariffs. The adjustment process towards long run equilibrium is expected to be much longer than the observation period. In this case we are primarily able to identify the transition effect of tariff reform. This motivates estimation of the effects of tariffs on labor productivity growth. Sectoral fixed effects take into account time-invariant variation in labor productivity across sectors. Year fixed effects control for common shocks and trends over time. In the benchmark relationship we assume one-period lag of the tariff effect:

$$\Delta \ln y_{it} = \alpha_i + \alpha_t + \beta tr_{it-1} \qquad (1)$$

The main econometric challenge in estimating the relationship is the endogeneity of tariffs with respect to labor productivity. To handle the endogeneity we apply a standard two stage least square method with instrument variables to predict the sectoral tariff

levels. In the first stage sectoral tariffs are predicted by sectoral tariff levels in three world regions assumed to capture the multilateral liberalization that South Africa was part of. In the second stage the predicted sectoral tariffs are included as independent variables in the analysis of sectoral labor productivities.

In the first stage the one-year lagged South African sectoral tariff rates tr-1 are related to the two-year and three-year lagged sectoral tariff rates of the three regions LAC (Latin America and the Caribbean), MENA (Middle East and South Africa) and SA (South Asia). The first stage estimation also includes sector and year fixed effects. Column 1 in Table 1 shows the first stage regression for the basic model of equation (1). The sectoral tariff developments in all three regions seem to have predictive power for the sectoral tariff developments in South Africa. Columns 2 - 5 report first stage estimates of extended models presented in Table 2.

Table 1 about here.

Shea R-square and the F-test, reported in the second stage tables, indicate the predictive power of the instruments. Shea R-square above 0.10 and p-values of the F-test below 0.10 is generally regarded as support of predictive power.[7] We also report p-values of a Sargan test in the second stage tables. An insignificant Sargan-test, Sargan p-value above 0.10, is taken as indication of a valid exclusion restriction, making us more confident that our instruments should not be included directly in the second stage. Our Sargan-tests are generally insignificant and supports our intuition: the South African productivity level in sector i in year t is unlikely to be endogenous to the average tariff level in the corresponding sectors in these geographically distant regions in year t-2 or t-3.

The first column in Table 2 presents the second stage estimation of equation (1) and suggests a negative and, at the 5%-level, statistically significant relationship between tariffs and labor productivity growth. The estimated coefficient of -0.8 implies that 10 percent higher tariff level reduces the productivity growth about 1 percentage point. The

[7] See Shea, J. (1996) for an explanation of Shea R-square.

quantitative effect is quite large and the economic interpretation is that tariff reductions stimulate the transition growth of labor productivity.

Table 2 about here

This basic relationship between tariffs and productivity growth using year and sector fixed effects and instrumentation of tariffs represents the core of our analysis. Two specification issues are worth pursuing: the relationship between domestic and international productivity growth and dynamics. Discussions of the methodology and alternative specifications are offered by Griffith, Redding and Van Reenen (2004) and Rattsø and Stokke (2003).

Productivity growth in the open economy is understood as 'catching up' to the world technology frontier and involving international productivity spillover. The barriers to growth model originated by Nelson and Phelps (1966) assumes a long run equilibrium where individual country productivity is proportional to the world technology frontier. The proportionality factor is affected by barriers such as tariffs and tariff-reduction may allow catching up to world technology. This is investigated in relationships expanded to take into account the role of the world sectoral labor productivity frontier, y_{it}^*, measured as the labor productivities in corresponding US industrial sectors. This variable takes out all global time-varying sector-specific shocks. Alternative dynamic formulations are investigated, first expanding the benchmark model with the world frontier and interaction with tariffs, then in an error-correction formulation and finally using the productivity gap as dependent variable.

The extension of the basic model including the world frontier and interaction looks like this:

$$\Delta \ln y_{it} = \alpha + \beta tr_{it-1} + \gamma \ln y_{t-2}^* + \delta tr_{it-1} \ln y_{t-2}^* \qquad (2)$$

Column 2 in Table 2 adds the world frontier sectoral labor productivity level. The world frontier has no independent effect on the labor productivity growth in South Africa in this specification. This is still true when we in column 3 add interaction between the tariff level and the world frontier. Our understanding of the lack of a world frontier effect is that time dummies already take care of the trend growth represented by the world frontier. Exclusion of time dummies does not provide robust and stable results. Table 3 reports an alternative formulation of equation (2) as the world frontier is included on growth form. Again the world frontier has no separate effect on the productivity growth. The tariff effect is robust across the alternative model formulations, both in terms of quantitative size and statistical significance.

Table 3 about here.

To check for the robustness of the relationship we investigate alternative dynamic specifications. The error correction model separates between short and long run adjustments and excludes time dummies. The length of the time series allows for specification with lagged endogenous variable and sector fixed effects. The dependent variable is still the growth rate of sectoral labor productivity, and the full model is:

$$\Delta \ln y_{it} = \alpha_i + \alpha_1 \ln y_{it-1} + \beta_1 \Delta tr_{it-1} + \beta_2 tr_{it-2} + \gamma_1 \Delta \ln y_{it-2}{}^{*} + \gamma_2 \ln y_{it-3}{}^{*} + \gamma_2 tr_{it-2} \ln y_{it-3}{}^{*}$$

We start out in the first column of Table 4 with only the tariffs on level and first difference form. The coefficient of the tariff level effect is basically the same as the results in Table 2 and Table 3 above, about -0.8, and with the same statistical significance. The coefficient of the lagged endogenous variable is statistically significant at the 1% level and shows slow adjustment of labor productivity over time. The implied long run negative tariff effect on labor productivity is quite high, and our understanding is that the data sample is too short to identify the long run effect. The strong transition effect of tariffs is translated into an even stronger long run effect, but in a dataset that cannot show the true long run implications. The extension of the error correction

specification to include the world frontier on level and first difference form in column 2 does not add new effects. When interaction between tariffs and frontier is added in the full error correction model, column 3 in Table 4, the world frontier emerges with statistically significant effect. The quantitative effect of the tariff rate is similar to above, and again understood as a transition effect. An increase in the world frontier labor productivity level raises the labor productivity growth in South Africa.

Table 4 about here.

An alternative specification sets the focus directly on the catching up towards the world frontier. The effect of tariffs on the productivity gap y/y* is investigated directly. In Table 5 different lags of the tariff effect on the productivity gap is shown. The results show a consistent negative effect of tariffs on the productivity gap. Higher tariffs increase the distance to the world frontier labor productivity, and 10% higher tariffs increases the gap by about 2%. Columns 1 and 2 include different lags with both sectoral and year fixed effects. When time dummies are excluded in columns 3 and 4 basically the same results come out.[8]

Table 5 about here.

To investigate the potential bias we report OLS estimates corresponding to Table 2 in Table 6. The negative association between tariffs and productivity across industrial sectors is less robust in the OLS estimates. The tariff effects are in general much smaller than in the instrument variable estimation. The OLS estimates are biased downwards. First it should be noticed that bias confirms the need for instruments to control for endogenous determination of tariffs. Then the downward bias supports the understanding that the government has given priority to tariff reductions in sectors with slow productivity growth. The government has attempted to open up for international spillover

[8] In Table 5 the Sargan-test is significant and it may point to invalid exclusion of the instruments from the second stage. Given our other results, a strict interpretation could be that labor productivity in the U.S. is affected by the tariff levels in these countries. We are interested in South Africa's catch up to the frontier and we interpret the results of Table 5 to be consistent with our overall findings.

in sectors that needed this most. When we control for this endogeneity we increase the productivity enhancing effect of tariff reductions.

Table 6 about here.

To investigate the validity of the instruments further we have estimated the relationship between South African industrial productivity growth and the tariff rates of the three regions. The econometric formulation reported in Table 7 includes sector and year fixed effects. The effect of the productivity growth rates is investigated with 1 and 2 lags and with and without the world frontier variable. As seen from the Table, there is no statistically significant relation between sectoral productivity growth in South Africa and the tariffs used as instruments.

Table 7 about here.

5. Conclusion

We have evaluated the effect of tariff policy on labor productivity in industrial sectors in South Africa using other countries sectoral tariffs as instruments. The tariff liberalization in South Africa has been part of a multilateral process, and other countries' sectoral tariff developments work as good predictors of tariffs in South Africa. In this way we circumvent the methodological challenge of tariff policy endogenity in estimating the tariff effect on productivity.

The industrial sectors in South Africa have generally experienced increasing labor productivities during the period investigated, 1988-2003. Our analysis confirms that the productivity growth has been linked to tariff reductions. Industrial sector tariff changes instrumented by other regions tariff development are significantly related to industrial labor productivity. It should be noticed that the dataset covers both increases and decreases of sectoral tariffs and both improvements and setbacks in sectoral labor

productivities. Overall the period can be seen as gradual tariff reductions associated with improvements in labor productivity.

The results are consistent with an understanding of tariff rates as barriers to technology adoption. It seems realistic to assume that domestic factors also serve as barriers to learning from abroad. It is a challenge for future research to capture such domestic barriers, but it will be hard to overcome the endogeneity of such barriers and identify the causal effects of them for spillovers and productivity.

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Table 1: First stage estimation of sectoral tariffs -- corresponding to Table 2

	1	2	3	4	5
Dependent variable	tr-1	tr-1	tr-1 x ln y*-2	tr-1	tr-1 x ln y*-2
tr-2 LAC	-0.132	-0.156	-0.013	0.367***	0.044
	[0.194]	[0.194]	[0.315]	[0.130]	[0.207]
tr-2 MENA	0.120**	0.121**	-0.106	0.168***	-0.092
	[0.057]	[0.057]	[0.092]	[0.045]	[0.072]
tr-2 SA	0.131**	0.258***	0.758***	0.375***	0.717***
	[0.063]	[0.097]	[0.157]	[0.081]	[0.130]
tr-3 LAC	0.303***	0.295***	0.124	0.015	0.141*
	[0.103]	[0.103]	[0.167]	[0.052]	[0.082]
tr-3 MENA	0.007	-0.007	0.045	-0.085*	0.004
	[0.056]	[0.056]	[0.092]	[0.045]	[0.072]
tr-3 SA	-0.017	-0.112	-0.870***	-0.219**	-0.762***
	[0.073]	[0.091]	[0.148]	[0.085]	[0.135]
ln y*-2		-0.027*	0.277***	-0.041***	0.274***
		[0.016]	[0.026]	[0.014]	[0.022]
Year FE	Yes	Yes	Yes	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes
Observations	305	305	305	305	305
Number of group(code sector)	28	28	28	28	28
R-squared	0.36	0.37	0.70	0.31	0.68
R-squared overall	0.56	0.62	0.57	0.67	0.64

Note: Column 1 corresponds to column 1 in Table 2, column 2 to column 2 and 3 in table 2, column 3 to column 3 in table 2 and column 4 and 5 to column 4 in table 2. tr-X means average applied tariffs among lower middle income countries in region Z, lagged X periods. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). All models include contemporaneous capacity utilization.

Table 2: First difference of log of labor productivity, labor productivity level of world frontier --IV estimation

	1	2	3	4
Dependent variable	dln y	dln y	dln y	dln y
Second stage				
tr-1	**-0.840****	**-0.948****	**-0.830****	0.087
	[0.419]	[0.411]	[0.412]	[0.263]
ln y*-2		0.015	0.082	**0.158***
		[0.022]	[0.077]	[0.085]
tr-1 x ln y*-2			-0.194	**-0.458***
			[0.214]	[0.238]
Year FE	Yes	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes
First stage tr-1:				
Shea partial R2	0.10	0.11	0.14	0.22
Partial R2	0.10	0.11	0.11	0.30
F	4.95	5.38	5.38	19.54
F, p-value	0.00	0.00	0.00	0.00
First stage tr-1 x ln y*-2:				
Shea partial R2			0.19	0.13
Partial R2			0.15	0.17
F			7.52	9.35
F, p-value			0.00	0.00
Df	6	6	6	6
df_r	260	259	259	269
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
Sargan statistics	1.85	1.65	1	3.96
Sargan P-value	0.87	0.89	0.91	0.41
F-value	4.95	5.38	2.57	3.13
Fdf1	260	259	259	269
Fdf2	6	6	6	6

Note: Instruments are as shown in table 1. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 3: First difference of log of labor productivity, labor productivity growth of world frontier -- IV estimation

	1	2	3
Dependent variable	dln y	dln y	dln y
Second stage			
tr-1	**-0.848****	**-0.841****	-0.140
	[0.420]	[0.418]	[0.212]
dln y*-2	-0.004	0.136	**0.593***
	[0.037]	[0.356]	[0.322]
tr-1 x dln y*-2		-0.396	**-1.704***
		[1.009]	[0.913]
Year FE	Yes	Yes	No
Sector FE	Yes	Yes	Yes
First stage tr-1			
Shea partial R2	0.10	0.10	0.29
Partial R2	0.10	0.10	0.29
F	4.93	4.93	18.09
F, p-value	0.00	0.00	0.00
First stage tr-1 x dln y*-2			
Shea partial R2		0.07	0.08
Partial R2		0.07	0.08
F		3.15	3.95
F, p-value		0.01	0.00
Df	6	6	6
df_r	259	259	269
Observations	305	305	305
Number of group(code sector)	28	28	28
Sargan statistics	1.84	1.71	4.31
Sargan P-value	0.87	0.79	0.37
F-value	4.93	3.14	3.93
Fdf1	259	259	269
Fdf2	6	6	6

Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 4: First difference of log of labor productivity, error correction model -- IV estimation

	1	2	3
Dependent variable	dln y	dln y	dln y
Second stage			
ln y-1	**-0.162*****	**-0.171*****	**-0.250*****
	[0.033]	[0.033]	[0.051]
dtr-1	-0.333	-0.309	0.280
	[0.387]	[0.393]	[0.485]
tr-2	**-0.746*****	**-0.824*****	**-0.677*****
	[0.264]	[0.247]	[0.251]
dln y*-2		-0.001	0.038
		[0.036]	[0.040]
ln y*-3		0.016	**0.241****
		[0.023]	[0.116]
tr-2 x ln y*-3			**-0.629****
			[0.319]
Year FE	No	No	No
Sector FE	Yes	Yes	Yes
First stage dtr-1			
Shea partial R2	0.16	0.16	0.10
Partial R2	0.13	0.13	0.13
F	6.45	6.40	6.40
F, p-value	0.00	0.00	0.00
First stage tr-2			
Shea partial R2	0.21	0.24	0.28
Partial R2	0.17	0.19	0.19
F	8.81	10.67	10.67
F, p-value	0.00	0.00	0.00
First stage tr-2 x ln y*-1			
Shea partial R2			0.08
Partial R2			0.10
F			4.94
F, p-value			0.00
Df	6	6	6
df_r	267	265	265
Observations	304	304	304
Number of group(code sector)	28	28	28
Sargan statistics	4.78	5.05	1.48
Sargan P-value	0.31	0.28	0.69
F-value	4.98	5.35	2.38
Fdf1	267	265	265
Fdf2	6	6	6
R-squared centered	0.02	-0.01	0.05

Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include one period lagged and contemporary first differenced capacity utilization as control variables. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 5: Relative productivity--IV estimation

	1	2	3	4
Dependent variable	y/y*	y/y*	y/y*	y/y*
Second stage				
tr-1	**-1.242*****	0.386	**-0.771*****	-0.006
	[0.403]	[0.783]	[0.186]	[0.378]
tr-2		**-1.881****		**-1.030****
		[0.743]		[0.438]
Year FE	Yes	Yes	No	No
Sector FE	Yes	Yes	Yes	Yes
First stage tr-1				
Shea partial R2	0.10	0.06	0.29	0.15
Partial R2	0.10	0.10	0.29	0.29
F	4.95	4.95	18.15	18.15
F, p-value	0.00	0.00	0.00	0.00
First stage tr-2				
Shea partial R2		0.05		0.10
Partial R2		0.10		0.20
F		4.71		11.02
F, p-value		0.00		0.00
Df	6	6	6	6
df_r	260	260	270	270
Observations	305	305	305	305
Number of group(code sector)	28	28	28	28
Sargan statistics	65.78	46.77	77.33	65.51
Sargan P-value	0.00	0.00	0.00	0.00
F-value	4.95	2.28	18.15	5.04
Fdf1	260	260	270	270
Fdf2	6	6	6	6

Note: Instruments are as shown in table 1. All are included in second and third lag. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable. df and df_r give degrees of freedom in the F-test for the instruments' prediction power in the first stage. These numbers are the same for all first stages within the same column.

Table 6: First difference of log of labor productivity--OLS estimation

	1	2	3
Dependent variable	dln y	dln y	dln y
tr-1	-0.128	-0.129	**-0.231****
	[0.095]	[0.095]	[0.111]
ln y*-2		0.005	0.047
		[0.017]	[0.030]
tr-1 x ln y*-2			**-0.128***
			[0.073]
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Observations	409	409	409
Number of group(code sector)	28	28	28
R-squared	0.13	0.13	0.14
R-squared overall	0.13	0.13	0.10

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include contemporary capacity utilization as control variable.

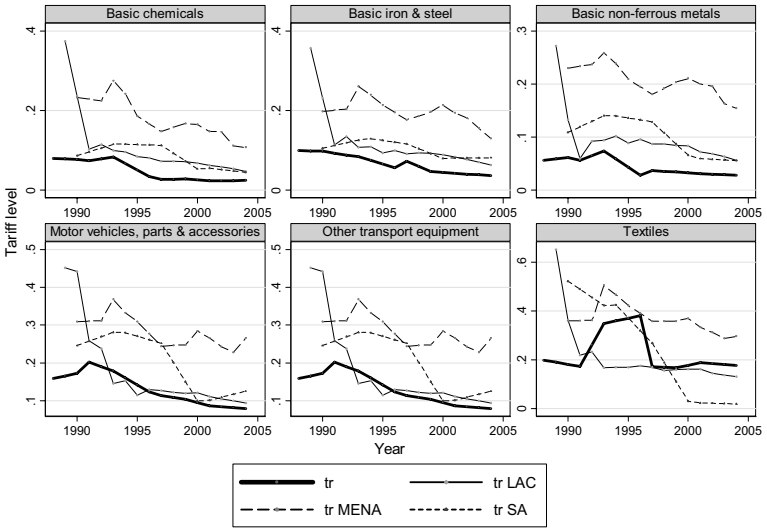
Table7: Instrument validity, the effect of productivity growth for instrument tariffs

	1	2	3	4	5	6
	LAC	LAC	MENA	MENA	SA	SA
dln y-1	0.021	0.020	0.005	0.009	0.047	0.023
	[0.031]	[0.031]	[0.042]	[0.042]	[0.057]	[0.046]
ln y*-2		0.005		-0.032**		0.192***
		[0.009]		[0.013]		[0.014]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	413	413	386	386	386	386
Number of group(code sector)	28	28	28	28	28	28
R-squared	0.82	0.82	0.31	0.33	0.46	0.66

	7	8	9	10	11	12
	LAC	LAC	MENA	MENA	SA	SA
dln y-2	0.031	0.031	0.028	0.029	-0.006	-0.015
	[0.031]	[0.031]	[0.042]	[0.042]	[0.056]	[0.045]
ln y*-2		0.005		-0.032**		0.192***
		[0.009]		[0.013]		[0.014]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	413	413	386	386	386	386
Number of group(code sector)	28	28	28	28	28	28
R-squared	0.82	0.82	0.31	0.33	0.46	0.66

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is average applied tariffs among lower middle income countries in the region indicated. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). All models include contemporaneous capacity utilization.

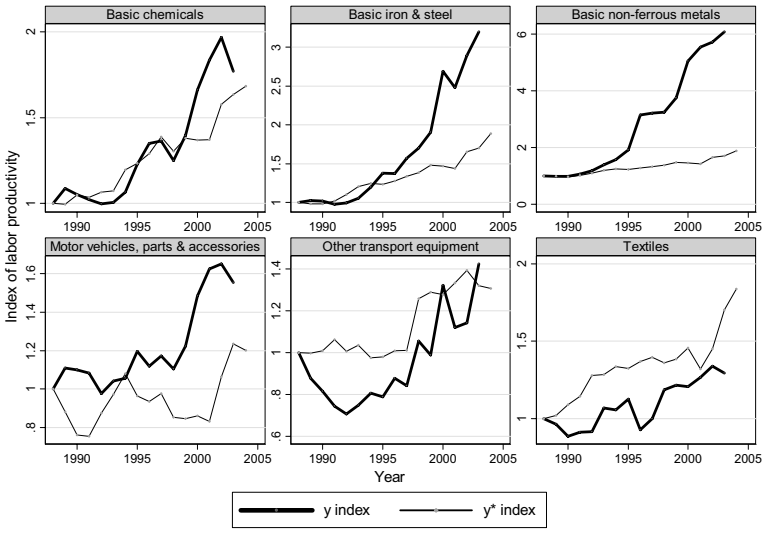
Figure 1: Tariffs in South Africa, LAC, MENA and SA



Graphs by s1

Note: tr and tr Z measure interpolated tariffs in South Africa and region Z respectively. The regional measures are simple averages of the specific sectors' tariff level in year t, across the countries in region Z.

Figure 2: Labor productivity in South Africa and US



Graphs by s1

Note: y and y* measure sectoral labor productivities in South Africa and the U.S. respectively. The indexes are scaled relative to the level of 1988.

Appendix Tables

Appendix Table 1: Descriptive Statistics

Variable	No. of observations	Mean	Std. Dev.	Min	Max
Y	305	0.14	0.15	0.02	0.83
ln y	305	-2.39	0.83	-3.88	-0.19
dln y	305	0.04	0.10	-0.40	0.50
y*-2	305	0.95	1.42	0.23	12.46
ln y*-2	305	-0.34	0.59	-1.47	2.52
dln y*-2	305	0.02	0.17	-2.59	0.43
tr-1	305	0.14	0.12	0.00	0.74
tr-1 x ln y*-2	305	-0.05	0.21	-0.91	1.21
tr-2 LAC	305	0.14	0.05	0.06	0.38
tr-2 MENA	305	0.34	0.15	0.13	1.21
tr-2 SA	305	0.27	0.32	0.03	2.28
tr-3 LAC	305	0.17	0.10	0.06	0.85
tr-3 MENA	305	0.34	0.15	0.13	1.21
tr-3 SA	305	0.29	0.33	0.05	2.28
Total	305	0.81	0.06	0.65	0.97

Note: The sample corresponds to Table 2. tr-X means average applied tariffs among lower middle income countries in the particular region. The regions, defined as World Bank regions as of July 2006, are: LAC (Latin America and the Caribbean), MENA (Middle East and North Africa) and SA (South Asia). X denotes the number of lags. Scale: average tr-1 is 14%, average y is 140 000 1995 Rands per worker, average y* is 95 000 2000 USD per worker.

Appendix Table 2: Sector concordances

SA Code	SA Name	ISICRev2 Code	ISICRev2 Name	SIC87 Code	SIC87 Name
12101	Food [301-304]	311	Food products	20	Food and kindred products
12102	Beverages [305]	313	Beverages	20	Food and kindred products
12103	Tobacco [306]	314	Tobacco	21	Tobacco products
12111	Textiles [311-312]	321	Textiles	22	Textile mill products
12112	Wearing apparel [313-315]	322	Wearing apparel except footwear	23	Apparel and other textile products
12113	Leather & leather products [316]	323	Leather products	31	Leather and leather products
12114	Footwear [317]	324	Footwear except rubber or plastic	31	Leather and leather products
12121	Wood & wood products [321-322]	331	Wood products except furniture	24	Lumber and wood products
12122	Paper & paper products [323]	341	Paper and products	26	Paper and allied products
12123	Printing, publishing & recorded media [324-326]	342	Printing and publishing	27	Printing and publishing
12131	Coke & refined petroleum products [331-333]#	353	Petroleum refineries	29	Petroleum and coal products
12132	Basic chemicals [334]	351	Industrial chemicals	28	Chemicals and allied products
12133	Other chemicals & man-made fibers [335-336]	352	Other chemicals	28	Chemicals and allied products
12134	Rubber products [337]	355	Rubber products	30	Rubber and miscellaneous plastics products
12135	Plastic products [338]	356	Plastic products	30	Rubber and miscellaneous plastics products
12141	Glass & glass products [341]	362	Glass and products	32	Stone, clay, and glass products
12142	Non-metallic minerals [342]##	369	Other non-metallic mineral products	32	Stone, clay, and glass products
12151	Basic iron & steel [351]	371	Iron and steel	33	Primary metal industries
12152	Basic non-ferrous metals [352]	372	Non-ferrous metals	33	Primary metal industries
12153	Metal products excluding machinery [353-355]	381	Fabricated metal products	34	Fabricated metal products
12154	Machinery & equipment [356-359]	382	Machinery except electrical	35	Machinery, except electrical
12160	Electrical machinery [361-366]	383	Machinery electric	36	Electric and electronic equipment
12171	Television, radio & communication equipment [371-373]	383	Machinery electric	36	Electric and electronic equipment
12172	Professional & scientific equipment [374-376]	385	Professional and scientific equipment	38	Instruments and related products
12181	Motor vehicles, parts & accessories [381-383]	384	Transport equipment	37	Motor vehicles and equipment
12182	Other transport equipment [384-387]	384	Transport equipment	37	Other transportation equipment
12191	Furniture [391]	332	Furniture except metal	25	Furniture and fixtures
12193	Other industries [392]	390	Other manufactured products	39	Miscellaneous manufacturing industries

Note: Data on tariffs are classified according to ISIC Rev. 2, while BEA-data necessary for calculating labor productivity in the US was merged in according to the SIC87 classification. #Represented by 353 rather than 354, since 353 is the largest (more than ten times the output). ##Represented by 369 rather than 361 since 369 is the largest (more than six times the number of employees).

Chapter 3

Does it matter to whom you export?

Does it matter to whom you export?

Torfinn Harding*

20 June 2008

Abstract

To obtain credible estimates on existence of productivity spillovers through exports one needs to account for endogeneity of exports. Studies that attempt to do so offer mixed evidence. By combining data on South African manufacturing sectors with bilateral trade data we investigate the link between productivity exposure through exports and total factor productivity (TFP). Ordinary least squares (OLS) estimates suggest a positive correlation between productivity levels of importers served by South Africa and South African total factor productivity. A two-stage least squares (2SLS) estimation is implemented to account for potential endogeneity of export market exposure. Exports from groups of other countries are used to instrument exports from South Africa aiming to isolate variation in exports caused by demand shocks abroad. The 2SLS-results suggest the OLS-estimates to be biased upwards and the effect of destination-productivity on TFP to be negligible. Finally, the paper contrasts the link between export *destinations* and productivity to the link between exported *products* and productivity.

* Norwegian University of Science and Technology and Statistics Norway, P.O.B. 8131 Dep., N-0033 Oslo, Norway, Email: torfinn.harding@ssb.no. I would like to thank my advisor Jørn Rattsø for important discussions, endorsements and notes on this paper. Thanks also to Joshua D. Angrist, Erik Biørn, Ådne Cappelen, Jon Fiva, Monica Hanssen, Magne Mogstad, Marte Rønning, Terje Skjerpen, Joseph E. Stiglitz, Hildegunn Ekroll Stokke, seminar participants at Statistics Norway and members of the group on trade and technology at the Advanced Graduate Workshop on Poverty, Development and Globalization in Manchester 2008 for helpful comments and suggestions. The project is financed by the Norwegian Research Council.

1. Introduction

A much researched question the last decade is whether exports is a vehicle of productivity spillovers across international borders. Intuition and theory suggest potential for such a role. Interaction with customers and competitors abroad can open up a range of learning possibilities for exporters, as export markets often offer demanding customers and competitors that operate close to international best practices. These mechanisms are typically labeled learning-by-exporting in the large, and growing, micro literature on the association between exports and productivity.[1] Despite intense efforts, a consensus on the existence of productivity spillovers through exports seems not to have been reached. Keller (2004) surveys the literature and appears to find little support for learning-by-exporting effects. Some recent contributions, on the other hand, seem to challenge such a conclusion by claiming supporting evidence of learning-by-exporting effects in developing and transition countries (Biesebroeck, 2005; Blalock, and Gertler, 2004; Loecker, 2007; Fernandes and Isgut, 2007).

The debate on exports and growth has recently gained momentum in a more macro oriented literature focusing on links between *characteristics* of countries' export baskets and their level of economic development or growth. Characteristics that have received attention are quality, diversification, implied potential for structural change and sophistication of products.

Self-evidently, the quest for successful strategies creating economic development is of great importance and channels for productivity spillovers between countries may be of particular interest. Productivity differences account for most of the differences in GDP per capita levels across countries (Hall and Jones, 1999). Lucas (2007) argues that flows of production related knowledge from successful to less successful economies is the main mechanism by which income inequalities across countries can be reduced.

The current paper contributes to the debate on exports and growth by investigating the link between exposure to productivity through exports and total factor productivity. The idea is that if exports provide a channel of productivity spillovers from export markets to the exporter, such spillovers should be higher from export markets with high productivity than from export markets with low productivity. Such a mechanism suggests a positive association between the productivity level of the exporter and the productivity level met in export markets. To measure the exposure to productivity through exports we let us inspire by Hausmann et al. (2007). They launch a measure, EXPY, which classifies an export basket according to the "inherent" productivity level of *products* exported. We

[1] See Greenaway and Kneller (2007) and Wagner (2007) for surveys.

define a measure, EXCY, which classifies an export basket according to the weighted average productivity level of the *importers* served by the exporter in question.

We study exports from South Africa. To measure the productivity level of export destinations we follow Hausmann et al. (2007) and employ GDP per capita level (measured at PPP-exchange rates). EXCY is defined as a weighted average of the GDP per capita levels of the export destinations served by a particular sector in a particular year. The weights are value shares of the export destinations. South Africa export to 161 different destinations in the data used. The purpose of the paper is to test if higher EXCY is associated with higher sectoral total factor productivity (TFP) in South Africa. Firm level studies have started to investigate the role of heterogeneity across export destinations (Loecker, 2007), but we are not aware of any macro oriented studies focusing on heterogeneity across export destinations and productivity.

The paper more generally contributes to a literature that assigns technology spillovers to specific channels. Foreign direct investment, imports and exports are the typical channels tested (see referenced central contributions in Keller, 2004). As Keller (2004) points out, the single largest problem in this literature is likely to be endogeneity of the explanatory factors employed. For instance, exports may facilitate productivity spillovers from the export destination to the exporter. Exporters may also be the ones able to overcome fixed costs associated with exporting because they are productive (Melitz, 2003). Causal effects of productivity on international interaction may therefore exist, and a hypothesized causal relationship of international interaction on productivity could be overestimated.

We seek to handle such potential endogeneity by a two-stage least squares estimation (2SLS). The instrument suggested is imports to South Africa's export destinations from groups of other exporting countries. The common variation in imports from South Africa and imports from other countries is interpreted as demand shocks in the importers.

Trade data from Feenstra et al. (2005) are combined with a panel data set of 25 South African manufacturing sectors (TIPS, 2004), data on total factor productivity in US manufacturing sectors (NBER, 2000), and GDP per capita from the *World Development Indicators* (WDI). We exploit variation across 161 importers, 25 sectors and 24 years in the first stage, and 25 sectors and 24 years in the second stage.

The OLS-results suggest a link between the productivity of export destinations and export-sector productivity. The effect is robust to sector and year fixed effects, measures of the international

technology frontier, export value at the sector level and different functional forms. Comparison between OLS-estimates and 2SLS-estimates indicates that the OLS-estimates are severely biased upwards and we do not find support for the existence of productivity spillovers through exports in our setting.

Finally, the paper addresses the competing hypothesis proposed by Hausmann et al. (2007). In their paper, growth is found to be positively associated with the inherent product characteristics measured by EXPY. For EXPY we do not find support for a positive link either in OLS or in 2SLS. We suggest that more research is needed to conclude on the relative importance of exporting sophisticated products versus exporting to sophisticated destinations.

2. Spillovers through exports

Keller (2004) refers early case studies – written since the 1960s – expressing enthusiasm about learning-by-exporting effects in East Asian countries. By now a rather large literature, offering econometric evidence mainly at the micro level, has investigated the existence of such learning-by-exporting effects. The findings seem to be mixed. Exports are found to be associated with higher productivity. Two competing hypotheses could explain such a correlation: self-selection and learning-by-exporting. Keller's (2004) reading of this literature suggests that learning-by-exporting effects are hard to come by (se references within Keller, 2004).[2] Some recent findings, on the other hand, support learning-by-exporting effects in developing and transition countries (see for instance Biesebroeck (2005) on Sub-Saharan Africa, Blalock, and Gertler (2004) on Indonesia, Loecker (2007) on Slovenia, Fernandes and Isgut 2007 on Colombia).

A more macro oriented literature on links between exports and development and growth has been concerned with different characteristics of countries' exports. Export product quality – typically measured as unit values per product category – seems to vary systematically with the level of development across countries (Schott, 2004; Hummels and Klenow, 2005). Diversification of export baskets in terms of avoiding dependence on a few product markets is seen to be important as it reduces the volatility of foreign exchange income (Bertinelli et al., 2006; Levchenko and di Giovanni, 2006). The type of products in the export basket across countries is found to vary in terms of how applicable the production technology necessary to produce and export them is for other products. Investing in knowledge and capital with relevance for a broad set of products enhances capabilities of structural change (Hausmann and Klinger, 2006a and 2006b). Hausmann et al. (2007) find support for faster

[2] López (2005) seeks to reconcile the findings of self-selection of exporters with macro-literature suggesting positive productivity effects of exports.

growth in countries exporting more sophisticated products. In their analysis, sophisticated products are defined as products exported intensively by economies with high levels of GDP per capita.

The current paper investigates heterogeneity across export destinations. To our knowledge empirical evidence on the role of heterogeneity in export destination characteristics is currently scarce, but there is a growing interest.[3] Loecker (2007) exploits cross-sectional information on export destinations in a firm-level panel of Slovenian manufacturing firms. His findings lend support to higher instantaneous productivity gains for firms exporting to more developed regions. He argues that this is consistent with learning from interactions with buyers and competitors in export markets. We build on the same argument. If productivity spillovers through exports exist interactions with more productive export destinations should induce more productivity spillovers than exports to less productive destinations.

A challenge is that the choice of export destinations may not be random but a function of exporter productivity. If, for instance, the competition met by exporters is more intense in developed (i.e. more productive) countries, we would expect only the more productive ones to survive in those markets. Other factors correlated with export-destination productivity (like purchasing power and market size) can also influence the exporters eager to serve the export destination in question. There are in other words reasons to worry that exporters' choice of export markets is driven by factors correlated with both exporter productivity and export destination productivity. Loecker (2007) and Eaton et al. (2008) suggest positive correlation between number of markets served by a firm and the firm's productivity. The background understanding is destination specific fixed costs of exporting. Intuitively, if a firm has something great going on it would manage to spread its products to many markets.

As will become clear, our sector data offer an opportunity to test spillovers through exports in a more credible way than what have so far been done in the micro literature. Long time series of export destinations can be matched to exporters (sectors) for which we can calculate productivity. The long time dimension in our data makes it possible to compare the same units across different destination-exposures. Moreover, we take advantage of the fact that also other countries export the same type of goods (we choose three-digit sector level) to the same destinations to control for self-selection into the different destinations.

There are several mechanisms through which exports to more productive economies can enhance productivity. First, export is hypothesized as a vehicle of foreign technology diffusion. Interaction with demanding customers and competitors employing better organization and production techniques

[3] Arora and Vamvakidis (2005) find in a cross-country panel links between relative income levels and growth of trading partners and domestic growth.

is believed to represent forces making exporters improving their organization and technology. Chuang (1998) explains in some detail how this process might take place. In his theoretical model both imports and exports are important sources for learning and with whom one trade is a key factor for the trade induced technology spillover, as it determines the level of technology of which one can learn. A testable implication of the model is that a larger technology gap implies a larger potential for learning and growth.[4]

In our setting of sector level data, productivity changes at the sector level can be caused by structural change within sectors in addition to within-firms productivity changes. López (2005) reports how resource reallocation towards more productive firms can have considerable productivity effects at the sector level. For instance, Bernard and Jensen (1999) find structural change within US manufacturing sectors to account for more than 40 percent of total factor productivity growth. Sector productivity can in other words increase, even though exports do not increase within-firm productivity.

3. Empirical strategy and data

To test the existence of productivity spillovers through exports we take advantage of the productivity level met in export destinations. As the choice of which export destinations to serve can be endogenous to the productivity level of exporters we need to control for such potential endogeneity. Below we explain our strategy to measure productivity exposure through exports, the relationship between spillovers and domestic productivity that is of our ultimate interest and how we attempt to control for the mentioned potential endogeneity via a two-stage least squares estimation.

3.1. Measuring trade partners productivity

Technology has in the spillover literature been measured as R&D efforts, number of patents, or as Productivity (TFP). Strategies in the literature to measure international spillovers has been to associate R&D efforts of neighbors to TFP or patents in the country of study, to include channels like import as in the seminal paper of Coe et al (1995), or to relate TFP to other measures than R&D of foreign activity. Lumenga-Neso et al. (2005) argue that as a source of spillovers it is the total available stock of technology, rather than the narrower domestically produced stock of R&D, that is the relevant measure of the spillover source. This means that spillovers to the source from its other trading partners is also relevant, and not only the domestically produced technology in the source. Taking this

[4] In addition to technology spillovers, higher scale can be a source of higher exporter productivity compared to non-exporters. Biesebroeck (2005) finds that about half of the productivity premium of exporters is associated with higher scale. Credit constraints in combination with contractual problems together with small domestic markets make it hard to exploit economies of scale domestically, he argues. In this paper the focus is on the technology spillover channel. We have in robustness checks controlled for economies of scale effects by exporters due to larger markets by including export value in the regressions. It does not change our results.

argument seriously an appropriate measure of the learning potential from trading partners should be rather broad. We choose to use GDP per capita as such a broad productivity measure. In addition to the obvious strength of being available for all trading partners, it is the broadest measure of productivity we can think of. Technology embodied both in physical and organizational capital is covered. Institutional factors such as the degree of competition, losses due to corruption or expropriation and efficiencies of the public bureaucracy will also all be taken up in GDP per capita.

Inspired by the measure EXPY defined by Hausmann et al. (2007), we define EXCY as a weighted average of the GDP per Capita level of export destination c from sector i in year t. First we define destination c's share of the total export from sector i in year t:

$$s_{cit} = \frac{x_{cit}}{\sum_{c} x_{cit}} \quad (1)$$

$$EXCY_{it} = \sum_{c} s_{cit} GDPPC_{ct} \quad (2)$$

We choose to use GDPPC measured at real PPP-exchange rates as it is productivity in terms of real resources that is of interest, and not measured productivity differences caused by under- or over-valued market exchange rates or prices. In our baseline measure EXCY, GDPPC is time-varying.[5].

Alternative ways of including export destinations' GDP per capita in the regressions below could be to include $s_{cit} GDPPC_{ct}$ for each country or groups of countries directly in the regressions. With EXCY we impose the same coefficient for all $s_{cit} GDPPC_{ct}$.

3.2. Relationship of interest

The question investigated in this paper is whether exposure to productive countries through exports leads to productivity spillovers to the exporting country. In the literature on economic growth there seems to be broad agreement that differences in growth rates across countries are only transitory. Countries grow at a common rate in the long run due to international spillovers, making income level differences permanent (Acemoglu and Ventura, 2002; Klenow and Rodriguez-Clare, 2005; Parente and Prescott, 2005). Our panel data covering 28 years suggest that we should look for a long run relationship between EXCY and TFP. We believe the appropriate specification is to let the level of

[5] Our data for GDP at PPP-exchange rates start in 1975. In the appendix we show results of EXCY based on the average GDP per capita at PPP-exchange rates for the years 1998, 1999 and 200. The results hold.

TFP in South Africa be a function of the level of EXCY. Exposure to higher productivity *levels* in the trading partners should be associated with higher productivity *levels* in South Africa, rather than higher growth rates. The estimated specification is as follows:[6]

$$A_{it} = \alpha_0 + \beta_0 EXCY_{it} + Z_{it}\gamma_0 + \eta_{0i} + \lambda_{0t} + \varepsilon_{0it} \quad (3)$$

A is total factor productivity defined in the standard way (see below), EXCY is the variable of interest indicating the productivity level in the export destinations of the sector, Z is a vector of controls, and η_{0i} and λ_{0t} are sector and year fixed effects, respectively.

To control for unobserved heterogeneity we include sector and year fixed effects in all specifications. Sector fixed effects take out all TFP-differences across sectors that are due to time-invariant characteristics and the estimated coefficients are therefore estimated based on only within sector variation over time. Year fixed effects control for all time-variant macro shocks affecting TFP in all sectors the same way. Capacity utilization is in all estimations included in Z since our interest is change in technology rather than demand driven productivity fluctuations. Z is varied by including the international technology frontier, measured by TFP-level of the corresponding sector in the US.[7] In our preferred specification Z includes capacity utilization and US TFP.

3.3. Identification: 2SLS

As emphasized in the learning-by-exporting literature, a potential self-selection bias is expected to occur as the most productive firms are the ones that manage to export. To us, the most relevant self-selection bias is that only the most productive exporters may be able to sell to sophisticated markets.. Running a plain OLS-regression with productivity on the left hand side and EXCY on the right hand side is likely to give an upward biased estimate. At least part of the estimate could reflect that firms and sectors serving markets with high GDP per capita levels chose and manage to do so because they are productive.

To address the possibility that exports to specific destinations may correlated with exporter productivity, a two-stage least squares estimation is implemented. Exports from high-income countries and low-income countries (not middle income countries) to country c are suggested as instrument for shares of South African exports to country c, s_{cit}. The idea behind is that the correlation between the

[6] We postulate the function form to be in levels. We choose the level-form as this implies the simplest transformation of the predicted outcomes of the first stage regression to the EXCY-variable based on predicted values. We have also estimated the relations imposing a log-linear functional form (not shown to save space). Our impression is that the functional form – level or logs – does not seem to matter much for the results.

[7] We have in robustness checks (not shown to save space) also varied Z by including export value by sector to control for the scale effects described by Biesebroeck (2005). We find it to not affect our results.

two will capture demand shocks in country c. A demand shock in country c should allow all sellers of that good to sell more of the good.[8] A demand shock in destination c, given unchanged exports to other destinations, should increase the destination c's share of total exports. We are not worried that GDP per capita in destination c is endogenous in our estimation. As will be explained below we include it at the left hand side of our first stage estimation to make the transition from the first stage predictions to the second stage estimation as clear as possible. The estimated first stage equation is:

$$s_{cit}GDPPC_{ct} = \alpha_1 + \delta_1^{HI} x_{cit}^{HI} + \delta_1^{L} x_{cit}^{L} + \pi_1 GDPPC_{ct} + \mu_{1c} + Z_{it}\gamma_1 + \eta_{1i} + \lambda_{1t} + \varepsilon_{1cit} \quad (4)$$

Where $s_{cit}GDPPC_{ct}$ is the share of exports from sector i to country c in year t multiplied by GDP per capita in country c in year t. We include the GDP per capita on the left hand side to make the transformation to our second stage more straightforward. Our instruments assumed to satisfy the exclusion restriction (i.e. they are assumed to affect productivity only through EXCY) are x_{cit}^{HI} and x_{cit}^{L}, GDPPC_{ct} and μ_{1c}. The two former are exports to country c from sector i in year t from hi-income countries (HI) and low income countries (L), respectively. GDPPC_{ct} is GDP per capita in country c in year t. μ_{1c} is importer fixed effects. Then we include the controls that will be included in the second stage: Z is a vector of time varying sector controls, η_{1i} and λ_{1t} sector and year fixed effects, as explained for equation (3) above. We use the estimated equation (4) to predict the EXCY to be included in the second stage:

$$EXCY_{it}^{pred} = \sum_c (s_{cit}GDPPC_{ct})^{pred} \quad (5)$$

The estimated second stage equation is:

$$A_{it} = \alpha_2 + \beta_2 EXCY_{it}^{pred} + Z_{it}\gamma_2 + \eta_{2i} + \lambda_{2t} + \varepsilon_{2it} \quad (6)$$

The first stage equation (4) is estimated at the country-sector-year level, as the construction of EXCY and our instruments demand an aggregation level capturing bilateral trade. Our second stage equation

[8] This could be seen as an income effect in the demand. In principle, regressing the sales of South Africa on the sales of others as we here do, could induce a negative correlation if a substitution between different suppliers were present. We do find traces of such a negative correlation for middle income countries.

is estimated at the sector-year level. Our proposed EXCY measure is simply the sum of the predicted values from the estimated first stage model.

Our first stage equation is close to a model for predicting trade across countries. s_{cit} contains the variation we believe it is important to instrument. For given exports to other destinations, explaining s_{cit} is like explaining bilateral trade flows from South Africa to destination c. The standard empirical framework to predict bilateral trade flows seems to be gravity models.[9] One finding in the vast literature employing gravity models is that unobservable time-invariant factors in country-pairs are important to predict bilateral trade flows. Possible interpretations of such unobservables are geographic or cultural distance. Based on this we include importer fixed effects.[10] We treat them as excludable instruments.[11] We are in the second stage interested in changes in EXCY and TFP within sectors. Time-invariant sector characteristics do not play a role in our estimations as we include sector fixed effects. Importer fixed effects affect only the average EXCY-level over time per sector and the exclusion restriction should therefore be satisfied.

Our underlying instrument idea is to take advantage of demand shocks in export destinations as a source of variation to identify sectoral export shares across destinations. Could we think of other variables that would reveal demand shocks? GDP, wages or GDP per capita are obvious candidates. The latter is already in the analysis and we take it to represent productivity. Identification of destination-shares demands an instrument at the sector-year-destination level. This if offered by exports from other countries. Given included controls we believe it alos offers variation orthogonal to South African TFP.

What about global supply shocks? These could be correlated with productivity in South Africa and our time-varying instruments. We include the international frontier to control for such shocks. Also global sector-specific demand shocks should be captured by this variable. Worldwide shocks should be present in US as well as in South Africa.

3.4. EXPY

Hausmann et al. (2007) launch a measure to classify how sophisticated countries' export baskets are. First they establish PRODY, which is a weighted sum of the GDP per capita of the countries exporting a product. The weights are the revealed comparative advantage of each country in the product in

[9] See Baldwin (2006) for a discussion of the gravity-model methodology.
[10] Through extensive exploration of different alternative specifications of the first stage we have found that the prediction model gives plausible second stage result when importer- or importer-year fixed effects are included.
[11] See Pettersson-Lidbom (2001, p.576) for an application with fixed effects as excluded instruments.

question. PRODY intends to capture how sophisticated a given product is. The idea is that products typically exported by countries with high GDP per capita levels have higher inherent "productivity". PRODY is then used to calculate EXPY, which is a weighted average of PRODY across all products exported by a given country. The weights are the value shares of the products in the total exports of the country. Hausmann et el. (2007) base EXPY on a theory of self discovery (see Hausmann and Rodrik, 2003) which is a country-wide phenomena in their paper. EXPY is only time-varying within each country. We calculate a sector-specific version of EXPY and estimate its link to TFP:

$$\mathrm{EXPY}_{\mathrm{it}} = \sum_{\mathrm{p}} \mathrm{s}_{\mathrm{pit}} \mathrm{PRODY}_{\mathrm{p}} \tag{7}$$

EXPY contains a *product's* value share of the exports from a sector, s_{pit}, wheras EXCY is based on the value shares of *importers.*[12] $PRODY_p$, being a product characteristic, plays then an analogous role to the importer characteristics GDP per capita in EXCY.. We will use PRODY as published by Hidalgo et al. (2007). It is not time-varying and changing product weights is the only source of time-variation. Analogous to the procedure followed for EXCY, we estimate the following three equations:

$$A_{it} = \alpha_3 + \beta_3 EXPY_{it} + Z_{it}\gamma_3 + \eta_{3i} + \lambda_{3t} + \varepsilon_{3it} \tag{8}$$

$$s_{pit} PRODY_p = \alpha_4 + \delta_4^{HI} x_{pit}^{HI} + \delta_4^{L} x_{pit}^{L} + \mu_{4p} + Z_{it}\gamma_4 + \lambda_{4t} + \varepsilon_{4pit} \tag{9}$$

$$A_{it} = \alpha_5 + \beta_5 EXPY_{it}^{pred} + Z_{it}\gamma_5 + \eta_{5i} + \lambda_{5t} + \varepsilon_{5it} \tag{10}$$

To estimate equation (9) we set up the dataset on the product-year level (each sector consists of several products), as the interesting variation is across products within each sector.[13] We include product fixed effects in equation (9). This is analogous to the importer fixed effects included in the first stage estimation for EXCY, with the exception that they make sector fixed effects superfluous. We do not include PRODY on the right hand side of equation (9) as it is captured by product fixed effects.

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[12] A product's share of export from sector i in year t: $\mathrm{s}_{\mathrm{pit}} = \mathrm{x}_{\mathrm{pit}} / \sum_{\mathrm{p}\in\mathrm{i}} \mathrm{x}_{\mathrm{pit}}$

[13] In contrast, for EXCY the interesting variation was across importers (therefore the C rather than the P in the name), and the first stage data used to estimate equation (4) were at the importer-sector-year level.

EXCY intends to represent the potential for spillovers from importers, which arguably can be sector specific. EXPY builds on the mentioned theory of self discovery, perhaps a country-wide rather than a sector-specific mechanism. Secondly, Hausmann et al (2007) estimate the link between EXPY and growth in GDP per capita. Compared to our set up this means different functional form – growth rather than level as dependent variable – and different productivity measure – value added per citizen rather than TFP. The results from our EXPY estimations should be interpreted with these caveats in mind.

3.5. Data

The panel data on South African manufacturing sectors is provided by TIPS (Trade and Industry Policy Strategies). Our sample contains 25 sectors over the period 1971-1998 (TIPS, 2004). [14] To construct our total factor productivity measure, we employ value added (Y), capital (K), labor (L) and sector specific time-averaged income shares. Total factor productivity is defined in the standard way, where its growth is backed out from a Cobb-Douglas production function under the assumption of constant returns to scale using income shares at the factor weights, γ_K and γ_L (i and t indicate sector and year, respectively):

$$d\ln A_{it} = d\ln Y_{it} - \gamma_{iK} d\ln K_{it} - \gamma_{iL} d\ln L_{it} \qquad (11)$$

The TFP-level, A, is defined by setting the TFP-level to 100 in 1970 and employ the log growth rate of equation (1).

Our information on exports is from the database compiled by Feenstra et al. (2005).[15] Value of exports is measured in current USD. In the variable of interest, EXCY, export value weights are used and measuring in current versus fixed prices should not matter. The trade data are available at the 4-digit SITC Rev. 2 classification and they are merged to the South African SIC-classification as explained in Table 1. To get a rough check of the concordance we correlated real exports as available in the TIPS-panel (we do not have current price exports in our TIPS-dataset) with exports in current prices in the Feenstra-data. Three sectors had a correlation of less than 0.5 (12101: Food, 12131: Coke & refined petroleum prod. and 12142: Non-metallic minerals), and these were therefore excluded from the analysis. For 17 of the remaining 25 sectors the correlation was above 0.9, four additional were above 0.86, three were 0.70 or higher and one was 0.66.

[14] Data post 1996 are of questionable quality as the last manufacturing survey was undertaken in 1996. We assess this not to be a problem for us as we employ these data only up to 1998.
[15] For additional information on the data set, see http://cid.econ.ucdavis.edu/data/undata/FAQ_on_NBER-UN_data.pdf and http://cid.econ.ucdavis.edu/data/undata/undata.html.

As representations of the international productivity frontier we employ total factor productivity in US manufacturing sectors. In the literature on cross country differences in productivity, US is often taken as representative of the world technology frontier. Hsieh and Klenow (2007) is a recent example. As Harding and Rattsø (2007) we let 4-factor TFP provided by NBER (2000) represent the TFP-frontier, A^*_{it}. NBER presents this measure for 459 4-digit SIC 87-sectors over the period 1958-1996.[16] The concordance between sectors was done by manually attaching each 4-digit SIC87 sector to the corresponding sector in the TIPS data on South Africa. The matching of sectors is presented in Table 2. We use an un-weighted average across all 4-digit SIC 87 sectors corresponding to the South African sector i as A^*_{it}. We normalize A^*_{it} to 100 in t=1970. See Harding and Rattsø (2007, 2008) for more on the roles of international productivity frontiers in South Africa. Finally, data on PRODY is found at Hidalgo et al. (2007). The classification of countries into income groups and geographical regions (not shown) are done in accordance to the definition of the World Bank as of July 1 2006.

4. Results

This paper seeks to test the effect on a middle income country's TFP of being exposed to high productivity export-destinations, as intended measured by EXCY. To avoid that the estimated coefficient is not partly capturing other factors affecting TFP and therefore be misleading about the effect of EXCY, the first thing we want to do is to explicitly include such other factors in the estimation – so these are hold constant under the exercise and the coefficient-estimate is isolated from the effects of these factors. Although we include a series of controls, as earlier mentioned, we cannot be entirely sure that we have controlled for all relevant factors and the estimates are not biased due to omitted variables. A way to get around this problem, which is popular in studies aiming to identify casual effects, is to employ the instrumental variable method (Angrist and Krueger, 2001). The idea is to use variation in the variable of interest that can be assigned to a known source of variation. To be a good instrument, this source of variation should be highly correlated ("relevance") to the regressor of interest, EXCY, but only affect the outcome variable, TFP, via its effect on EXCY ("exclusion restriction satisfied").

We first present OLS-estimates of the correlation between EXCY and TFP, then we present our 2SLS-estimates, and finally we present both OLS and 2SLS-results where EXCY is swapped for the competing EXPY-measure.

[16] An earlier version of the data and calculations are documented in Bartelsman and Gray (1996). We chose to use the 4-factor TFP-measure because this measure is closest to the measure we construct for South Africa (2 factors). In Harding and Rattsø (2007) the results are practically identical for the 4-factor and 5-factor measure. According to Bartelsman and Gray (1996), the five factor measure is calculated using observed expenditure shares as factor shares. The capital share is calculated as a residual under the assumption that the shares add to 1. We assume the same method was used when constructing the 4-factor TFP measure.

4.1. OLS

OLS-estimates (i.e. EXCY is based on actual export shares) of equation (3) are presented in Table 7. In column 1 we include capacity utilization and sector and year fixed effects. In column 2 we control also for the international technology frontier. This exercise is then repeated five times with different lag-length of EXCY. All 12 columns indicate significant positive correlations – at the one percent level – between EXCY and total factor productivity. The size of the estimated coefficients varies between around 1.0 and 1.4, which implies that a one percent increase in EXCY is associated with around 0.15-0.22 increase in TFP.[17]

The estimated coefficients are in general smaller when the international TFP-frontier is included, possibly reflecting spillovers captured by EXCY to some extent are associated with the international technology frontier. The TFP-frontier itself is always significant at the one percent level and the coefficient is roughly 0.6. Capacity utilization is significant when the frontier-TFP is not included, consistent with the international TFP-frontier capturing also sector-specific global demand shocks in addition to global supply shocks. Our preferred specification includes the international TFP-frontier. Its robust and significant coefficients clearly suggest that it should be in the model, a finding consistent with Rattsø and Harding's (2007 and 2008) documentation of links between different measures of the international technology frontier and different productivity measures in South Africa. Cameron (2005), Cameron et al. (2005) and Griffith et al. (2004) show the importance of the international technology frontier in sector data for other countries. Inclusion of the frontier reduces potential omitted variable bias due to sector-specific global shocks. Such shocks could drive both the observed TFP in South Africa and exports from the sector.[18] Inclusion of the frontier arguably also reduces potential omitted variable bias due to omitted alternative channels of spillovers. The literature suggests for instance imports of intermediates and foreign direct investments as possible vehicles of technology spillovers across countries. Including the technology frontier explicitly as a control variable may reduce the potential for omitted variable bias due to omitted alternative vehicles, since the frontier should be important as source of such spillovers. The omitted variable bias in our estimations without the frontier is present but appears to be relatively small. We will in the preceding concentrate on a model including the frontier.[19]

[17] This is found be using the average of A and EXCY (actual) found in Table 4: Elasticity of A with respect to EXCY (actual) = dA/dEXCY (actual)*(EXCY (actual)/ A)=1.4*(17/110)=0.22

[18] This would be a challenge also in our proposed first stage regression, as global shocks could affect the proposed instruments (exports from other country-groups). The validity of the instruments – being correlated with endogenous regressor and uncorrelated with error term given controls included – is more plausible given the inclusion of the frontier.

[19] We have checked the robustness of the results presented in Table 7 to the inclusion of export value, US labor productivity instead of TFP as the technology frontier, and to defining EXCY based on time-invariant GDP per capita. We have also estimated all models with a log-linear functional form rather than with the direct levels as here. The results are found to be robust across all these different specifications.

In Table 7 EXCY is defined based on actual export shares and the results are therefore subject to a potential endogeneity bias. In the next section we implement the two-stages least squares procedure aiming to control for such potential endogeneity bias.

4.2. 2SLS

Our estimates of the first stage (equation 4) are shown in Table 8. We apply 2SLS procedure over zero to five lags on EXCY. This gives us six first stage estimations, where the dependent variable $s_{cit}GDPPC_{ct}$ and the time-varying excluded instruments are lagged from zero to five periods. The estimated coefficients of export value from high-income (H) and low-income (L) countries are significant at the 1 percent level (with one exception at the five-percent level and one at the 10-percent level). F-statistics on excluded instruments should as a rule of thumb be larger than ten, and the bigger it is the better (Angrist and Pischke, forthcoming).[20] The last rows of Table 8 show that export from low income countries is passing this criteria with a huge margin (always larger than 166), while export from high-income passes when included with four and five lags. The estimated coefficients of the two export-instruments are positive in all six estimations. Based on the average values reported in Table 3 and the estimates reported in column 1 the coefficients imply an elasticity of 0.021 for high-income countries and 0.093 for low income countries.[21] The coefficients for both country-groups are increasing with lags. This can partly be explained by exports values going down as more lags are used, as trade volumes and its values have been increasing over time and the size of the variables employed affect the size of the coefficients in our level-linear specification. We interpret the estimates to be consistent with a positive demand shock in export destination c positively affecting exports from South Africa, high-income and low income countries. A demand shock increasing the exports from the group of high-income countries with one percent induces a 0.021 percent increase in the exports from South Africa. If South Africa and the high-income countries were selling the same variety and markets shares across countries were unchanged, a demand shock of one percent should increase the exports from both sources with one percent. When this is not the case we should keep in mind that these estimates are based on variation across 25 different sectors, that there may be important differences between the corresponding sectors in South Africa and the country-groups and that heterogeneity is likely to occur also between the countries within the country-groups. Differences along dimensions like product quality, weights of products within sectors and trade costs due to geographical location can create different export responses across different sources and drag down the correlation.

[20] Angrist and Pischke (forthcoming) refer to Stock et al. (2002) for this rule. We report F-statistics for tests of the instruments individually rather than a joint test.
[21] Estimating the models of Table 8 in logs gives elasticities around 0.47 for exports from high-income countries and 0.22 for low income countries.

In our setting we are concerned with the positive sign and instrument relevance indicated by the significance level. The positive sign is important for our interpretation of the instrument. With a negative sign, we would worry that the instrument were picking up substitution between different sellers in country c. Since increased market shares are likely to be associated with high productivity, it would raise a concern of reverse causality. Say it was a positive productivity shock in sector i in South Africa. $s_{cit}GDPPC_{ct}$ could then increase at the cost of exports from other countries to country c, contributing to a negative correlation. An increase in the total market size is different. A bigger market should let all sellers sell more and this is our interpretation of the positive coefficients estimated in Table 8. In robustness checks we have run the 2SLS-procedure with exports from lower-middle and upper-middle income countries included as additional instruments. The coefficients on exports from middle income-countries are estimated to be negative, which we interpret to be consistent with substitution between different sellers. Recent trade literature suggests specializations within sectors and products across countries. It tends to vary systematically according to levels of development (Schott, 2004; Hummels and Klenow, 2005). It is plausible that competition between South Africa and groups of countries is the starkest between South Africa and other middle-income countries.[22]

GDP per capita is in Table 8 significant with three, four and five lags and the elasticities – given the averages reported in Table 3 – are between 0.6 and 0.9.[23] In addition to x_{cit}^{HI}, x_{cit}^{L} and $GDPPC_{ct}$ described above, country fixed effects are excluded instruments in our 2SLS. Predictions from the first stage are sensitive to the inclusion of these fixed effects in the estimation of the first stage, which signals the relevance of these fixed effects for our potentially endogenous variable $s_{cit}GDPPC_{ct}$.

As earlier explained, the country fixed effects collapse to a time-invariant constant per sector when we sum the predictions from the first stage according to equation (5). It is plausible that they are uncorrelated with the error term in the second stage given the included sector fixed effects. Regarding whether the exclusion restriction is met for the other excluded instruments, x_{cit}^{HI}, x_{cit}^{L} and $GDPPC_{ct}$, we rely on the story behind them.[24] Given that the included international technology frontier captures common shocks, an estimated positive association between exports from other countries and South

[22] We have explored the robustness of the first stage estimates by doing the following changes (one at the time): using product-level aggregation rather than sector-level aggregation, employing log-linear functional form, including country-year fixed effects and by grouping countries differently (in totals or according to geographic regions). The result, that South African export is strongly positively correlated with export from other groups of countries to the same destinations, seem overall to be robust. The instruments do therefore in our view meet the relevance criteria.
[23] Estimating the models of Table 8 in logs gives similar elasticities of GDP per capita (0.42-0.97).
[24] Different aggregation levels of our first and second stage explain why this is currently not tested. We are searching for formal tests.

African exports to country c indicates that the coefficients pick up demand shocks in country c.[25] GDP per capita of the export destinations should plausibly be uncorrelated with South African TFP beyond the effect through EXCY, again given that the included international technology frontier captures global supply shocks.

Now we turn to the second stage estimation. In Table 9 we use the predicted EXCY as expressed in equation (5). In contrast to the OLS-estimates of Table 7 the coefficients of EXCY are much smaller and none of them are significant.[26] The estimates of the coefficients of the technology frontier and capacity utilization variable is basically the same in the two tables. Our interpretation of these results is that the correlation between EXCY and TFP detected in Table 7 is driven by productive South African exporters managing to penetrate developed markets rather than spillovers going from developed markets to the exporters. Such a conclusion is in line with evidence referred by Keller (2004) and consistent with Helpman et al. (2004) and Melitz (2003). Exporters are on average found to be more productive. The understanding is that only the most productive firms can overcome the cost of exporting and manage to compete in foreign markets. In our setting, we are concerned with variation in exports across different markets. They same logic should apply. Only the most productive firms and sectors manage to compete in sophisticated markets. The GDP level of the markets and the productivity level of the exporters should therefore be correlated, as we find in the OLS-estimates. When we in our 2SLS estimation attempt to shut down the channel of self-selection into sophisticated markets, we find no association between the exporting sectors' TFP and EXCY.

[25] This interpretation relies on the assumption that supply shocks are global in character, while demand shocks can be national. The situation where the country-group in question and South Africa experience a common supply shock that is not captured by the international technology frontier could in principle occur. Such a situation could question the validity of the exclusion restriction for the export instrument because such as shock could be correlated with South African TFP..

[26] Due to a more disaggregated first stage than second stage, we run our 2SLS estimation manually rather than using a standard pre-programmed routine. That means that we have to be cautions regarding the standard errors reported in Table 9. These are calculated given the predicted values, while they should be calculated given the actual values of our endogenous variable, as described in Greene (2008, section 12.3.3). Such a procedure would most likely make our second-stage standard errors larger, not threaten the insignificance of our coefficients.

The results presented in Table 9 appear to be robust across a series of robustness checks. In estimations not shown to save space we find that the results are robust to changing the instrument set in terms of classifying countries in geographical regions rather than in income groups. The same is true for playing around with different combinations of income groups or geographical regions. The results are also robust to different functional form – log-linear instead of levels – imposed on both stages.[27]

Two additional robustness checks are shown in the appendix. Appendix table 1 and Appendix table 2 show first and second stage estimations differing from Table 8 and Table 9 in two ways. We impose a log-linear functional form and estimate the productivity effect in a one-step procedure, like Harding and Rattsø (2007). Log value added is dependent variable and log capital and log labor are added as control variables in addition to log of the ones used earlier. The excluded instruments x_{cit}^{HI}, x_{cit}^{L} and $GDPPC_{ct}$ are now significant at the one-percent level in all six models (Appendix table 1). The second stage shows as before no support of EXCY-effects on productivity (Appendix table 2).

Appendix table 3 and Appendix table 4 present the most significant EXCY-coefficients we have estimated with our 2SLS estimation. Two changes are done compared to Table 8 and Table 9. Exports from all income groups as well as importer-year fixed effects (instead of importer fixed effects) are included as excluded instruments. Including all income groups as instruments means that all other countries in the world exporting to South Africa's export destinations are included. This set up make us less comfortable as South African exports in some sense may appear as a residual. The results, however, seems reasonable and may indicate this to not be a problem. The second change, treating importer-year fixed effects – taking out all time-variant country-wide bilateral characteristics – as excluded instruments, may be justified by specific circumstances in South Africa's international relations. Trade sanctions as responses to the Apartheid regime were imposed from the mid 1980s to the early 1990s. These generated exogenous variation – varying across importers and time as the intensity and timing of the reactions varied across countries – in South African exports that are difficult for our first stage estimation to overcome in the absence of importer-year fixed effects. On the other hand, importer-year fixed effects may capture features of the specific markets that exporters respond to. This would invalidate the exclusion restriction as the importer-year fixed effects then would be correlated with South African TFP beyond EXCY. Importer-year fixed effects make importer GDPPC superfluous in the regressions. Keeping the above mentioned caveats in mind, Appendix table 3 shows that exports from high-income and low-income countries are always

[27] When we run 2SLS in logs we de-log the predictions from the first stage, then take the sum according to equation (5), for then finally to take the log of this sum and estimate the second stage.

significant at the one-percent level. Exports from upper-middle and lower-middle income countries have little predictive power. Appendix table 4 suggests a significant coefficient of EXCY at the five-percent level (zero lags) and one at the ten-percent level (5 lags). Those coefficients have about one third of the size of the corresponding OLS-coefficients. These results may reveal traces of spillovers through exports, but do also suggest that the OLS coefficients of Table 7 are strongly biased upwards.

4.3. EXCY or EXPY?

Finally we presents estimation results for EXPY capturing self-discovery (Hausmann and Rodrik, 2003; Hausmann et al. 2007), a hypothesized mechanism behind positive correlations between exports and growth that we regard as competing to the hypothesis of productivity spillovers via exports. Since we in EXPY use a time-invariant PRODY, we present in Appendix table 5 OLS-results for an EXCY-version based on time-invariant GDP per capita to make the comparison more accurate. The estimates are then based only on changing export-shares over time.[28] The correlation between the time-invariant EXCY and TFP is positive (with one exception) and mostly significant, although the significance level goes down as the lag-length increases. Table 10 presents OLS-estimates of the links between EXPY and TFP, while Table 11 and Table 12 present 2SLS-estimates. The estimated coefficients of EXPY are negative and insignificant in OLS and significantly negative in four of six second stage estimations. There seems in other words to be hard to find positive EXPY-links to productivity in our setting. These results should be read with caution. First, self-discovery may be an economy wide phenomena and it may therefore not be appropriate to treat as a sector-specific variable. Second, the first stage design used here may not be the most suited for the purpose of predicting $s_{pit}PRODY_p$. We find it interesting, however, that exports from the group of high-income countries seem to predict $s_{pit}PRODY_p$ well, while exports from the group of low-income countries do not (Table 11).

5. Conclusions

The combination of robust OLS-correlations between productivity and EXCY and insignificant estimates in 2SLS found in this paper is interpreted as endogenous destinations imposing a bias in the OLS-estimates. This is in line with a series of papers finding endogeneity of exports to seriously bias OLS-estimates of the link between exports and productivity. Caution is, however, warranted.

The main concern may be that our instruments are not predicting well. More precisely, they may not predict the variation in exports that have the potential of inducing productivity spillovers. Demand shocks, which is our interpretation of the variation exploited in our first stage regression, may be of a

[28] The time-invariant GDP per capita is defined as the average GDP per capita over the years 1998, 1999 and 2000.

temporary character and not picking up more stable export relations with, perhaps, larger potential for productivity spillovers. A natural next step for the research conducted in this paper is to explore more instruments and instrument combinations in the search for the relation between export-spillovers and productivity.

6. *Bibliography*

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7. *Tables: Information about the data used*

Table 1: sector concordances

sector	namesa	NAICS97	NAICS97desc	NAICS97sa	NAICS97sadesc
12102	Beverages [305]	312	Beverage and Tobacco Product Manufacturing	312b	Mod to fit SA
12103	Tobacco [306]	312	Beverage and Tobacco Product Manufacturing	312t	Mod to fit SA
12111	Textiles [311-312]	313	Textile Mills	313sa	Mod to fit SA
		314	Textile Product Mills	313sa	Mod to fit SA
		321	Wood Product Manufacturing	313sa	Mod to fit SA
12112	Wearing apparel [313-315]	315	Apparel Manufacturing	315	Apparel Manufacturing
12113	Leather & leather products [316]	316	Leather and Allied Product Manufacturing	316l	Mod to fit SA
12114	Footwear [317]	316	Leather and Allied Product Manufacturing	316f	Mod to fit SA
12121	Wood & wood products [321-322]	321	Wood Product Manufacturing	321	NAICS97 321 + sitc4 (2450, 245A)
		325	Chemical Manufacturing	321	NAICS97 321 + sitc4 (2450, 245A)
12122	Paper & paper products [323]	322	Paper Manufacturing	322	Paper Manufacturing
12123	Printing, publishing & recorded media [324-326]	323	Printing and Related Support Activities	323	Printing and Related Support Activities
12132	Basic chemicals [334]	325	Chemical Manufacturing	325b	Mod to fit SA
		326	Plastics and Rubber Products Manufacturing	325b	Mod to fit SA
12133	Other chemicals & man-made fibers [335-336]	325	Chemical Manufacturing	325o	Mod to fit SA
		313	Textile Mills	325o	Mod to fit SA
		327	Nonmetallic Mineral Product Manufacturing	325o	Mod to fit SA
12134	Rubber products [337]	326	Plastics and Rubber Products Manufacturing	326r	Mod to fit SA
12135	Plastic products [338]	326	Plastics and Rubber Products Manufacturing	326p	Mod to fit SA
12141	Glass & glass products [341]	327	Nonmetallic Mineral Product Manufacturing	327g	Mod to fit SA
12151	Basic iron & steel [351]	331	Primary Metal Manufacturing	331i	Mod to fit SA
12152	Basic non-ferrous metals [352]	331	Primary Metal Manufacturing	331n	Mod to fit SA
		339	Miscellaneous Manufacturing	331n	Mod to fit SA
12153	Metal products excluding machinery [353-355]	332	Fabricated Metal Product Manufacturing	332	Fabricated Metal Product Manufacturing
12154	Machinery & equipment [356-359]	333	Machinery Manufacturing	333	Machinery Manufacturing
12160	Electrical machinery [361-366]	335	Electrical Equipment, Appliance, and Component Manufacturing	335	Electrical Equipment, Appliance, and Component Manufacturing
12171	Television, radio & communication equipment [371-373]	334	Computer and Electronic Product Manufacturing	334t	Mod to fit SA
12172	Professional & scientific equipment [374-376]	334	Computer and Electronic Product Manufacturing	334p	Mod to fit SA
12181	Motor vehicles, parts & accessories [381-383]	336	Transportation Equipment Manufacturing	336m	Mod to fit SA
12182	Other transport equipment [384-387]	336	Transportation Equipment Manufacturing	336o	Mod to fit SA
12191	Furniture [391]	337	Furniture and Related Product Manufacturing	337	Furniture and Related Product Manufacturing
12193	Other industries [392]	339	Miscellaneous Manufacturing	339	Miscellaneous Manufacturing

Note: sector refers to the South African sector classification as found in the TIPS panel. We have assumed this to follow the *Standard Industrial Classification of all Economic Activities (SIC)*, Fifth Edition, Statistics South Africa (Stats SA), January 1993. NAICS97 refers to the North American Industry Classification System in its 1997-version. The concordance between SITC4 (classification of products in the trade data) and NAICS97 is done using the concordance found at: from http://www.nber.org/lipsey/sitc22naics97. For explanation, see http://www.nber.org/lipsey/sitc22naics97/6-30_concordance_intro.txt. The concordance between the trade data and the 28 South African industry sectors were done in two steps: first NAICS97 and sector were match from the names at the three-digit level. For some sectors (indicated with letters in the end of NAICS97sa), the match was not obvious and the matching was then done by attaching 4-digit SITC product codes directly to the South African sectors. The description of the South African sectors as of January 1993 published by Stats South Africa was used as guidance (see http://www.statssa.gov.za/additional_services/sic/sic.htm). The NAICS97sadesc-column explains changes. Detailed concordances for sectors marked "Mod to fit SA" are available upon request from author. As explained in the text, the sectors 12101, 12131 and 12142 were dropped due to low correlation with the real export figures, for which we had measures. These are therefore not presented in the table.

Table 2: Concordance TIPS data and SIC 87

Code SA	Name South Africa	Code SIC 87	Name SIC 87
12101	Food [301-304]	20	Food and kindred products
12102	Beverages [305]	20	Food and kindred products
12103	Tobacco [306]	21	Tobacco products
12111	Textiles [311-312]	22	Textile mill products
12112	Wearing apparel [313-315]	23	Apparel and other textile products
12113	Leather & leather products [316]	31	Leather and leather products
12114	Footwear [317]	31	Leather and leather products
12121	Wood & wood products [321-322]	24	Lumber and wood products
12122	Paper & paper products [323]	26	Paper and allied products
12123	Printing, publishing & recorded media [324-326]	27	Printing and publishing
12131	Coke & refined petroleum products [331-333]	29	Petroleum and coal products
12132	Basic chemicals [334]	28	Chemicals and allied products
12133	Other chemicals & man-made fibers [335-336]	28	Chemicals and allied products
12134	Rubber products [337]	30	Rubber and miscellaneous plastics products
12135	Plastic products [338]	30	Rubber and miscellaneous plastics products
12141	Glass & glass products [341]	32	Stone, clay, and glass products
12142	Non-metallic minerals [342]	32	Stone, clay, and glass products
12151	Basic iron & steel [351]	33	Primary metal industries
12152	Basic non-ferrous metals [352]	33	Primary metal industries
12153	Metal products excluding machinery [353-355]	34	Fabricated metal products
12154	Machinery & equipment [356-359]	35	Machinery, except electrical
12160	Electrical machinery [361-366]	36	Electric and electronic equipment
12171	Television, radio & communication equipment [371-373]	36	Electric and electronic equipment
12172	Professional & scientific equipment [374-376]	38	Instruments and related products
12181	Motor vehicles, parts & accessories [381-383]	37	Transportation equipment
12182	Other transport equipment [384-387]	37	Transportation equipment
12191	Furniture [391]	25	Furniture and fixtures
12193	Other industries [392]	39	Miscellaneous manufacturing industries

Note: The NBER data set used to construct the international frontier, A*, includes 459 4-digits SIC sectors. Each was matched to the corresponding 3-digit sector in South Africa. This table gives the rough picture of the concordance. The detailed concordance is available upon request from the authors.

Table 3: Descriptive statistics first stage EXCY

Variable	Obs	Mean	Std. Dev.	Min	Max
EXCY (pred_lag0)	8950	15.158	5.977	-1.201	35.649
s_x_GDPPC	8950	0.917	2.148	1.89E-06	22.525
s	8950	0.048	0.101	8.97E-07	0.977
GDPPC	8950	16.075	7.835	0.485	42.853
Export value prod. from H	8950	1.466	3.494	0.000029	68.667
Export value prod. from UM	8388	0.118	0.539	1.00E-06	18.748
Export value prod. from LM	8651	0.159	0.789	1.00E-06	21.490
Export value prod. from L	8950	0.033	0.174	1.00E-06	5.475
L2. A*	8950	107.987	10.998	86.213	215.782
U	8950	82.473	6.348	58.173	94.829
Year	8950			1975	1998

Note: EXCY is a weighted average of GDPPC met in export destinations, with s as weights. s is the share of a given sector's export value to a given export-destination. GDPPC is GDP per capita measured in thousands 2000 PPP US dollars Export value is measured as millions of current USD of exports to a specific export-destination from the following country groups: high-income (H), upper-middle income (UM), lower-middle income (LM), and low income (L). L2.A* is two-period lagged total factor productivity in corresponding sector in US measured as index set to 100 in 1970. U is capacity utilization, measured in percent. s and Export value from income groups vary by sector, year and export-destination, GDPPC by year and export-destination, the others by sector and year.

Table 4: Descriptive statistics second stage EXCY

Variable	Obs	Mean	Std. Dev.	Min	Max
A	563	110.241	27.734	47.920	232.857
EXCY (actual - time-inv. GDPPC)	563	21.953	5.864	1.202	33.232
EXCY (actual)	563	16.945	4.452	1.209	29.023
EXCY (pred_lag0)	547	14.996	6.008	-1.201	35.649
L2. A*	563	106.678	11.193	74.227	215.782
U	563	82.424	6.459	58.173	94.829
Year	563			1975	1998

Note: EXCY is a weighted average of GDPPC met in export destinations, with s as weights (see note Table 3).."actual": actual export is used to calculate the weights s. "pred_lag0": based on predictions from first stage with zero lags (column 1 Table 8). A is TFP in South Africa measured as index set to 100 in 1970. L2.A* is two-period lagged total factor productivity in corresponding sector in US measured as index set to 100 in 1970. U is capacity utilization, measured in percent. All variables vary by sector and year.

Table 5: Descriptive statistics first stage EXPY

Variable	Obs	Mean	Std. Dev.	Min	Max
EXPY (pred_lag0)	7442	16.623	10.078	0.732	51.798
s_pt*PRODY	7442	0.842	1.704	1.20E-06	16.393
s_pt	7442	0.071	0.145	2.88E-07	1.000
PRODY	7442	12.651	4.701	0.801	24.187
Export value prod. from H	7442	1.849	5.498	1.00E-06	107.152
Export value prod. from UM	7176	0.146	0.561	1.00E-06	12.639
Export value prod. from LM	7280	0.200	0.877	1.00E-06	21.971
Export value prod. from L	7442	0.041	0.249	1.00E-06	7.462
L2. A*	7442	107.518	10.725	76.739	215.782
U	7442	82.591	6.109	58.173	94.829
Year	7442			1971	1998

Note: EXPY is a weighted average of PRODY, with s_pt as weights. s_pt is product p's share of export value from a given sector. PRODY is as published by Hidalgo et al. (2007), and we assume it can be interpreted as measured in thousands of US dollars Export value is measured as millions of current USD of exports of product p from the following country groups: high-income (H), upper-middle income (UM), lower-middle income (LM), and low income (L). L2.A* is two-period lagged total factor productivity in corresponding sector in US, measured as an index set to 100 in 1970. U is capacity utilization, measured in percent. s_pt and Export value from income groups vary by product (sector) and year, PRODY by product, the others by sector and year.

Table 6: Descriptive statistics second stage EXPY

Variable	Obs	Mean	Std. Dev.	Min	Max
A	634	108.526	26.440	47.920	232.857
EXPY (actual - time-inv. PRODY)	634	11.275	3.755	0.600	19.211
EXPY (pred_lag0)	619	10.127	7.974	0.732	51.798
L2. A*	634	106.002	10.712	74.227	215.782
L2. (Y/L)*	446	100.094	271.413	13.067	2395.389
U	634	82.973	6.468	58.173	94.829
Year	634			1971	1998

Note: EXPY is a weighted average of PRODY, with s_pt as weights (see note Table 4). "actual": actual export is used to calculate the weights s. "pred_lag0": based on predictions from first stage with zero lags (column 1 Table 11). A is TFP in South Africa measured as index set to 100 in 1970. L2.A* is two-period lagged total factor productivity in corresponding sector in US measured as index set to 100 in 1970. U is capacity utilization, measured in percent. All variables vary by sector and year.

8. Tables: Estimation results

Table 7: EXCY baseline

	1	2	3	4	5	6	7	8	9	10	11	12
	A	A	A	A	A	A	A	A	A	A	A	A
EXCY (actual)	1.148***	1.008***										
	[0.242]	[0.225]										
L. EXCY (actual)			1.259***	1.155***								
			[0.263]	[0.234]								
L2. EXCY (actual)					1.284***	1.149***						
					[0.281]	[0.244]						
L3. EXCY (actual)							1.356***	1.222***				
							[0.297]	[0.256]				
L4. EXCY (actual)									1.408***	1.221***		
									[0.309]	[0.270]		
L5. EXCY (actual)											1.350***	0.959***
											[0.318]	[0.287]
L2. A*		0.640***		0.678***		0.694***		0.646***		0.560***		0.588***
		[0.129]		[0.133]		[0.139]		[0.147]		[0.155]		[0.161]
U	0.137	-0.031	0.410*	-0.055	0.668***	-0.019	0.907***	-0.007	0.976***	0.035	1.107***	0.162
	[0.204]	[0.185]	[0.222]	[0.193]	[0.237]	[0.203]	[0.255]	[0.215]	[0.263]	[0.222]	[0.272]	[0.231]
Observations	613	563	615	540	617	517	618	494	595	471	572	448
Number of sector	25	25	25	25	25	25	25	25	25	25	25	25
R-squared	0.14	0.19	0.16	0.20	0.18	0.19	0.19	0.17	0.20	0.15	0.20	0.14
R-squared overall	0.09	0.12	0.11	0.12	0.12	0.12	0.13	0.11	0.13	0.10	0.14	0.10

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 4 for variable definitions. LX means lagged X periods.

Table 8: First stage EXCY

Ic Is Iyear

	1	2	3	4	5	6
	$s_{cit}GDPPC_{ct}$	$L.s_{cit}GDPPC_{ct}$	$L2.s_{cit}GDPPC_{ct}$	$L3.s_{cit}GDPPC_{ct}$	$L4.s_{cit}GDPPC_{ct}$	$L5.s_{cit}GDPPC_{ct}$
Export value from H	0.013*					
	[0.007]					
Export value from L	2.572***					
	[0.109]					
GDP per capita (ppp)	0.005					
	[0.011]					
L. Export value from H		0.015**				
		[0.007]				
L. Export value from L		2.587***				
		[0.125]				
L. GDP per capita (ppp)		0.011				
		[0.014]				
L2. Export value from H			0.022***			
			[0.008]			
L2. Export value from L			2.652***			
			[0.139]			
L2. GDP per capita (ppp)			0.013			
			[0.014]			
L3. Export value from H				0.029***		
				[0.009]		
L3. Export value from L				2.793***		
				[0.168]		
L3. GDP per capita (ppp)				0.033*		
				[0.020]		
L4. Export value from H					0.049***	
					[0.011]	
L4. Export value from L					2.944***	
					[0.200]	
L4. GDP per capita (ppp)					0.051**	
					[0.023]	
L5. Export value from H						0.066***
						[0.012]
L5. Export value from L						3.078***
						[0.239]
L5. GDP per capita (ppp)						0.053**
						[0.026]
L2. A*	-0.003	-0.002	-0.003	-0.003	0.001	0.001
	[0.004]	[0.004]	[0.004]	[0.005]	[0.006]	[0.007]
U	0.016***	0.022***	0.021***	0.025***	0.026***	0.016*
	[0.005]	[0.006]	[0.006]	[0.007]	[0.008]	[0.009]
Observations	8950	7970	7765	6453	5693	4993
R-squared	0.44	0.44	0.44	0.45	0.45	0.44
F:						
Export value from H	3.71	3.95	7.17	9.55	19.9	27.91
Export value from L	556.24	426.25	366.56	276.76	217.60	166.02
GDP per capita (ppp)	0.23	0.66	0.87	2.71	5.08	4.25

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 3 for variable definitions. LX means lagged X periods.

Table 9: Second stage EXCY

	1	2	3	4	5	6
	A	A	A	A	A	A
EXCY (pred_lag0)	0.051					
	[0.148]					
EXCY (pred_lag1)		0.025				
		[0.147]				
EXCY (pred_lag2)			0.030			
			[0.152]			
EXCY (pred_lag3)				-0.005		
				[0.153]		
EXCY (pred_lag4)					0.001	
					[0.158]	
EXCY (pred_lag5)						0.119
						[0.165]
L2. A*	0.669***	0.688***	0.705***	0.672***	0.622***	0.665***
	[0.139]	[0.144]	[0.146]	[0.155]	[0.163]	[0.166]
U	0.059	0.100	0.168	0.183	0.198	0.160
	[0.196]	[0.207]	[0.212]	[0.226]	[0.234]	[0.236]
Observations	547	520	502	476	452	429
Number of sector	25	25	25	25	25	25
R-squared	0.15	0.15	0.15	0.14	0.12	0.14
R-squared overall	0.06	0.06	0.06	0.05	0.05	0.06

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 4 for variable definitions. LX means lagged X periods.

Table 10: EXPY baseline

	1	2	3	4	5	6	7	8	9	10	11	12
	A	A	A	A	A	A	A	A	A	A	A	A
EXPY (actual - t-inv. PRODY)	-0.083	-0.416										
	[0.426]	[0.377]										
L. EXPY (actual - t-inv. PRODY)			-0.124	-0.388								
			[0.441]	[0.370]								
L2. EXPY (actual - t-inv. PRODY)					-0.190	-0.363						
					[0.454]	[0.363]						
L3. EXPY (actual - t-inv. PRODY)							-0.401	-0.418				
							[0.454]	[0.349]				
L4. EXPY (actual - t-inv. PRODY)									-0.553	-0.350		
									[0.450]	[0.348]		
L5. EXPY (actual - t-inv. PRODY)											-0.629	-0.282
											[0.444]	[0.345]
L2. A*		0.703***		0.706***		0.696***		0.670***		0.639***		0.626***
		[0.120]		[0.122]		[0.123]		[0.123]		[0.124]		[0.124]
U	0.361*	0.143	0.659***	0.134	0.872***	0.124	1.049***	0.106	1.088***	0.145	1.120***	0.175
	[0.203]	[0.185]	[0.211]	[0.186]	[0.219]	[0.188]	[0.224]	[0.189]	[0.225]	[0.190]	[0.226]	[0.191]
Observations	684	634	707	632	730	630	752	628	750	626	748	624
Number of sector	25	25	25	25	25	25	25	25	25	25	25	25
R-squared	0.11	0.16	0.12	0.15	0.15	0.15	0.18	0.15	0.18	0.14	0.18	0.14
R-squared overall	0.07	0.09	0.08	0.09	0.10	0.09	0.12	0.09	0.12	0.09	0.12	0.09

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 6 for variable definitions. LX means lagged X periods.

Table 11: First stage EXPY

Ip Iyear

	1	2	3	4	5	6
	$s_{pit}PRODY_p$	$L.s_{pit}PRODY_p$	$L2.s_{pit}PRODY_p$	$L3.s_{pit}PRODY_p$	$L4.s_{pit}PRODY_p$	$L5.s_{pit}PRODY_p$
Export value prod. from H	0.042***					
	[0.003]					
Export value prod. from L	0.006					
	[0.063]					
L. Export value prod. from H		0.042***				
		[0.004]				
L. Export value prod. from L		0.014				
		[0.067]				
L2. Export value prod. from H			0.049***			
			[0.004]			
L2. Export value prod. from L			-0.004			
			[0.074]			
L3. Export value prod. from H				0.059***		
				[0.004]		
L3. Export value prod. from L				-0.033		
				[0.082]		
L4. Export value prod. from H					0.072***	
					[0.005]	
L4. Export value prod. from L					-0.082	
					[0.094]	
L5. Export value prod. from H						0.078***
						[0.006]
L5. Export value prod. from L						-0.103
						[0.106]
L2. A*	-0.002	-0.002	-0.003	-0.002	-0.002	-0.003
	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]
U	-0.008**	-0.005	-0.004	-0.003	0.001	0.005
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Observations	7442	7251	7217	6898	6675	6489
R-squared	0.76	0.75	0.74	0.75	0.76	0.75
F:						
Export value prod. from H	162.27	137.88	150.56	171.77	192.94	184.56
Export value prod. from L	0.01	0.04	0.00	0.17	0.77	0.94

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 5 for variable definitions. LX means lagged X periods.

Table 12: Second stage EXPY

	1	2	3	4	5	6
	A	A	A	A	A	A
EXPY (hatIpHL_l0)	-0.575**					
	[0.261]					
EXPY (hatIpHL_l1)		-0.578**				
		[0.260]				
EXPY (hatIpHL_l2)			-0.546**			
			[0.260]			
EXPY (hatIpHL_l3)				-0.472*		
				[0.264]		
EXPY (hatIpHL_l4)					-0.259	
					[0.275]	
EXPY (hatIpHL_l5)						-0.140
						[0.275]
L2. A*	0.700***	0.697***	0.686***	0.658***	0.673***	0.656***
	[0.124]	[0.126]	[0.125]	[0.126]	[0.127]	[0.127]
U	0.143	0.152	0.121	0.114	0.176	0.158
	[0.189]	[0.189]	[0.191]	[0.193]	[0.194]	[0.194]
Observations	619	617	620	614	613	609
Number of sector	25	25	25	25	25	25
R-squared	0.15	0.15	0.15	0.16	0.15	0.15
R-squared overall	0.07	0.07	0.08	0.07	0.08	0.08

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 6 for variable definitions. LX means lagged X periods.

9. Appendix:

Appendix table 1: First stage EXCY, one-step

Ic Is Iyear

	1 ls_x_GDPPC	2 ls_x_GDPPC_lag	3 ls_x_GDPPC_lag2	4 ls_x_GDPPC_lag3	5 ls_x_GDPPC_lag4	6 ls_x_GDPPC_lag5
ln Export value bilateral (H)	0.482***					
	[0.016]					
ln Export value bilateral (L)	0.215***					
	[0.009]					
ln GDP per capita (ppp)	0.422***					
	[0.110]					
L. ln Export value bilateral (H)		0.454***				
		[0.016]				
L. ln Export value bilateral (L)		0.220***				
		[0.009]				
L. ln GDP per capita (ppp)		0.651***				
		[0.140]				
L2. ln Export value bilateral (H)			0.468***			
			[0.016]			
L2. ln Export value bilateral (L)			0.223***			
			[0.010]			
L2. ln GDP per capita (ppp)			0.557***			
			[0.146]			
L3. ln Export value bilateral (H)				0.470***		
				[0.018]		
L3. ln Export value bilateral (L)				0.220***		
				[0.010]		
L3. ln GDP per capita (ppp)				0.890***		
				[0.180]		
L4. ln Export value bilateral (H)					0.472***	
					[0.019]	
L4. ln Export value bilateral (L)					0.219***	
					[0.011]	
L4. ln GDP per capita (ppp)					0.930***	
					[0.204]	
L5. ln Export value bilateral (H)						0.472***
						[0.021]
L5. ln Export value bilateral (L)						0.232***
						[0.012]
L5. ln GDP per capita (ppp)						0.982***
						[0.232]
ln K	0.126*	0.067	0.010	-0.087	-0.176*	-0.178*
	[0.073]	[0.077]	[0.081]	[0.088]	[0.094]	[0.103]
ln L	-0.305***	-0.231**	-0.273***	-0.200*	-0.204*	-0.089
	[0.088]	[0.092]	[0.097]	[0.108]	[0.119]	[0.131]
L2. ln A*	-0.345	-0.407	-0.316	-0.085	0.465	0.171
	[0.332]	[0.345]	[0.369]	[0.408]	[0.450]	[0.506]
ln U	-1.181***	-0.963***	-0.645*	-0.223	0.066	-0.837*
	[0.331]	[0.351]	[0.374]	[0.415]	[0.448]	[0.478]
Observations	8950	7970	7765	6453	5693	4993
R-squared	0.74	0.75	0.75	0.74	0.74	0.73

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 5 for variable definitions. LX means lagged X periods.

Appendix table 2: Second stage EXCY, one-step

	1	2	3	4	5	6
	ln Y	ln Y	ln Y	ln Y	ln Y	ln Y
ln EXCY (pred-ln-onestep_l0)	-0.019					
	[0.018]					
ln EXCY (pred-ln-onestep_l1)		-0.007				
		[0.022]				
ln EXCY (pred-ln-onestep_l2)			0.003			
			[0.019]			
ln EXCY (pred-ln-onestep_l3)				-0.034		
				[0.021]		
ln EXCY (pred-ln-onestep_l4)					-0.024	
					[0.024]	
ln EXCY (pred-ln-onestep_l5)						0.003
						[0.021]
ln K	0.548***	0.566***	0.573***	0.613***	0.640***	0.677***
	[0.035]	[0.037]	[0.038]	[0.039]	[0.041]	[0.041]
ln L	0.635***	0.643***	0.643***	0.685***	0.704***	0.712***
	[0.041]	[0.042]	[0.043]	[0.044]	[0.047]	[0.047]
L2. ln A*	0.957***	1.003***	0.980***	1.035***	1.030***	1.083***
	[0.151]	[0.156]	[0.160]	[0.165]	[0.174]	[0.171]
ln U	-0.094	-0.005	0.054	0.153	0.236	0.239
	[0.143]	[0.148]	[0.152]	[0.157]	[0.163]	[0.157]
Observations	547	520	502	476	452	429
Number of sector	25	25	25	25	25	25
R-squared	0.67	0.66	0.65	0.64	0.60	0.61
R-squared overall	0.76	0.77	0.76	0.77	0.78	0.78

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 4 for variable definitions. LX means lagged X periods.

Appendix table 3: First stage EXCY, given all four income groups and destination-year fixed effects as instruments

	1	2	3	4	5	6
	s_x_GDPPC	l.s_x_GDPPC	l2.s_x_GDPPC	l3.s_x_GDPPC	l4.s_x_GDPPC	l5.s_x_GDPPC
Export value from H	0.027***					
	[0.009]					
Export value from UM	0.158***					
	[0.058]					
Export value from LM	-0.096**					
	[0.040]					
Export value from L	2.922***					
	[0.151]					
L. Export value from H		0.033***				
		[0.010]				
L. Export value from UM		0.117				
		[0.073]				
L. Export value from LM		-0.066				
		[0.046]				
L. Export value from L		2.885***				
		[0.170]				
L2. Export value from H			0.035***			
			[0.011]			
L2. Export value from UM			0.165*			
			[0.091]			
L2. Export value from LM			-0.050			
			[0.051]			
L2. Export value from L			2.880***			
			[0.186]			
L3. Export value from H				0.039***		
				[0.012]		
L3. Export value from UM				0.184		
				[0.121]		
L3. Export value from LM				-0.057		
				[0.063]		
L3. Export value from L				3.017***		
				[0.222]		
L4. Export value from H					0.054***	
					[0.014]	
L4. Export value from UM					0.157	
					[0.151]	
L4. Export value from LM					-0.090	
					[0.074]	
L4. Export value from L					3.262***	
					[0.268]	
L5. Export value from H						0.067***
						[0.016]
L5. Export value from UM						0.150
						[0.191]
L5. Export value from LM						-0.172*
						[0.091]
L5. Export value from L						3.551***
						[0.314]
L2. A*	-0.004	-0.004	-0.005	-0.006	-0.001	-0.002
	[0.004]	[0.004]	[0.005]	[0.005]	[0.006]	[0.007]
U	0.018***	0.023***	0.022***	0.027***	0.028***	0.016
	[0.006]	[0.007]	[0.007]	[0.008]	[0.009]	[0.010]
Observations	8269	7374	7113	5976	5300	4699
R-squared	0.49	0.49	0.49	0.49	0.49	0.49

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 5 for variable definitions. LX means lagged X periods. Importer-fixed effects takes out all bilateral time variation making importer GDPPC as control variable superfluous.

Appendix table 4: Second stage EXCY, given all four income groups and destination-year fixed effects as instruments

	1 A	2 A	3 A	4 A	5 A	6 A
EXCY (pred-ct_l0)	0.329** [0.156]					
EXCY (pred-ct_l1)		0.253 [0.159]				
EXCY (pred-ct_l2)			0.210 [0.165]			
EXCY (pred-ct_l3)				0.207 [0.169]		
EXCY (pred-ct_l4)					0.195 [0.171]	
EXCY (pred-ct_l5)						0.329* [0.176]
L2. A*	0.665*** [0.138]	0.679*** [0.143]	0.679*** [0.146]	0.679*** [0.156]	0.616*** [0.163]	0.660*** [0.165]
U	0.016 [0.195]	0.060 [0.207]	0.158 [0.212]	0.156 [0.227]	0.157 [0.234]	0.129 [0.235]
Observations	546	520	501	475	452	429
Number of sector	25	25	25	25	25	25
R-squared	0.15	0.15	0.14	0.14	0.12	0.14
R-squared overall	0.07	0.07	0.07	0.06	0.06	0.07

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 4 for variable definitions. LX means lagged X periods.

Appendix table 5: Robustness of baseline, level; time-invariant EXCY

	1	2	3	4	5	6	7	8	9	10	11	12
	A	A	A	A	A	A	A	A	A	A	A	A
EXCY (actual - t-inv. GDPPC)	0.534***	0.408***										
	[0.171]	[0.154]										
L. EXCY (actual - t-inv. GDPPC)			0.476***	0.380**								
			[0.177]	[0.151]								
L2. EXCY (actual - t-inv. GDPPC)					0.439**	0.351**						
					[0.183]	[0.148]						
L3. EXCY (actual - t-inv. GDPPC)							0.434**	0.351**				
							[0.188]	[0.146]				
L4. EXCY (actual - t-inv. GDPPC)									0.297*	0.206		
									[0.180]	[0.141]		
L5. EXCY (actual - t-inv. GDPPC)											0.104	-0.024
											[0.172]	[0.135]
L2. A*		0.716***		0.735***		0.745***		0.739***		0.720***		0.703***
		[0.118]		[0.119]		[0.120]		[0.120]		[0.121]		[0.121]
U	0.210	0.055	0.476**	0.040	0.675***	0.037	0.841***	0.026	0.889***	0.066	0.946***	0.114
	[0.197]	[0.180]	[0.205]	[0.181]	[0.212]	[0.181]	[0.217]	[0.182]	[0.218]	[0.183]	[0.218]	[0.184]
Observations	705	655	730	655	755	655	779	655	779	655	779	655
Number of sector	25	25	25	25	25	25	25	25	25	25	25	25
R-squared	0.13	0.18	0.14	0.18	0.16	0.18	0.18	0.18	0.18	0.17	0.17	0.16
R-squared overall	0.08	0.11	0.09	0.11	0.11	0.10	0.12	0.10	0.12	0.09	0.11	0.09

Note: Standard errors in brackets , * significant at 10%; ** significant at 5%; *** significant at 1%. See Table 4 for variable definitions. LX means lagged X periods.

Chapter 4

Developing economies and international investors: Do investment promotion agencies bring them together?

With Beata Smarzynska Javorcik , University of Oxford

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ABSTRACT

Developing Economies and International Investors: Do Investment Promotion Agencies Bring Them Together?*

Many countries spend significant resources on investment promotion agencies (IPAs) in the hope of attracting inflows of foreign direct investment (FDI). Despite the importance of this question for public policy choices, little is known about the effectiveness of investment promotion efforts. This study uses newly collected data on national IPAs in 109 countries to examine the effects of investment promotion on FDI inflows. The empirical analysis follows two approaches. First, we test whether sectors explicitly targeted by IPAs receive more FDI in the post-targeting period relative to the pre-targeting period and non-targeted sectors. Second, we examine whether the existence of an IPA is correlated with higher FDI inflows. Results from both approaches point to the same conclusion. Investment promotion efforts appear to increase FDI inflows to developing countries. Moreover, agency characteristics, such as its legal status and reporting structure, affect the effectiveness of investment promotion. There is also evidence of FDI diversion due to investment incentives offered by other countries in the same geographic region.

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Torfinn Harding
Research Department
Statistics Norway
P.O.B. 8131 Dep.
N-0333
Oslo
Norway
Email: torfinn.harding@ssb.no

Beata Smarzynska Javorcik
Development Economics
Research Group
The World Bank
1818 H Street N.W.
MSN MC3-303
Washington, DC 20433
USA
Email: bjavorcik@worldbank.org

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1. Introduction

Countries around the globe compete fiercely for foreign direct investment (FDI). Policy makers believe that FDI can contribute to a faster economic growth by bringing capital, technology and know-how to developing countries. Recent empirical evidence suggests that FDI may also lead to positive productivity spillovers to local firms.[1] Given these potential benefits of FDI inflows, an important question for policy makers in developing countries is how to attract foreign investors.

Many governments believe that this can be achieved through investment promotion activities. The purpose of investment promotion is to reduce the costs of FDI by providing information on the host country, helping foreign investors cut through bureaucratic procedures, and offering fiscal or other incentives to international investors. Despite its importance for public policy choices, little is known about the effectiveness of investment promotion efforts. While the existing literature generally finds a positive relationship between investment promotion and FDI, most studies are hampered by a low number of observations, rely on cross-sectional data or focus solely on industrialized economies.[2]

During the past two decades, developing countries began to actively engage in investment promotion and offer incentives to foreign investors. For instance, the 2005 Census of Investment Promotion Agencies (IPAs) revealed that 85 percent of the responding IPAs in developing countries were established in 1980 or later (see Figure 1). Moreover, 68 out of 81 developing countries reported offering financial, tax or other incentives to foreign investors. However, even if some earlier studies suggest that investment promotion appears to work in developed countries, it is unclear whether the same conclusion holds in a developing country context. On the one hand, investment promotion may be more important in the developing world where information is more difficult to access. On the other hand, it is possible that investment promotion may be ineffective due to deficiencies of the business environment or superfluous if low labor costs alone are powerful enough to attract foreign investors.

This paper contributes to the existing literature on FDI promotion and FDI determinants in three ways. First, using a newly collected dataset, it shows that investment promotion activities lead to higher FDI inflows to developing countries. Before this data set became available, it was not possible to analyze this question in a convincing manner in the context of developing countries. Second, the results suggest that the effectiveness of the investment promotion agency is affected by its legal status and its reporting structure. Besides having policy implications, obtaining intuitive results on these more nuanced questions gives us more confidence that the analysis captures the IPA effect rather than other factors. Third, our analysis provides evidence consistent with FDI incentives offered by other IPAs *within a geographic region* diverting FDI inflows. There is no indication of such competition among countries within the same income group but located in different geographic regions.

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[1] Recent empirical studies suggest that such spillover may primarily benefit industries supplying multinationals (for empirical evidence see Javorcik, 2004a, Blalock and Gertler, 2007, Javorcik and Spatareanu, 2007; for a literature review see Görg and Strobl, 2001, and Görg and Greenaway, 2004).

[2] See section 2 for the literature review. A related literature evaluates export promotion activities (e.g., Görg, Henry and Strobl, 2007, and Lederman, Olarreaga and Payton, 2006).

Our analysis employs the data collected through a recent Census of Investment Promotion Agencies around the world. The Census contains information on investment promotion efforts in 109 countries, representing all income groups and geographic regions. About three quarter of responses pertain to developing countries. A unique feature of the Census is that it includes time-varying information on the existence of an IPA, its status and reporting structure, sector targeting and incentives offered to foreign investors.

Our identification strategy relies on the fact that the majority of IPAs target particular sectors in their efforts to attract FDI. Sector targeting is considered to be best practice by investment promotion professionals (Loewendahl, 2001, Proksch, 2004). It also allows us to identify the effect of investment promotion using the difference-in-differences approach. We compare FDI inflows into targeted sectors, before and after targeting, to FDI inflows into non-targeted sectors, during the same time period.[3] Our analysis is based on US FDI data, disaggregated by host country and sector and available for the period 1990-2004, provided by the US Bureau of Economic Analysis. We control for changes in host country business environment by including country-year fixed effects, for heterogeneity of sectors in different locations by including country-sector fixed effects and for shocks to supply of FDI in particular sectors by adding sector-time fixed effects.

Our results suggest that investment promotion efforts lead to higher FDI inflows to developing countries. We find that targeted sectors receive more than twice as much FDI as non-targeted sectors. This magnitude is plausible, given that many sectors receive small amounts of FDI in absolute terms. For instance, in 2004 the median sector-level inflow of US FDI to developing countries in our sample that received some US investment was 11 million dollars. Thus, the increase of 155 percent estimated in our analysis would translate into additional 17 million dollars of FDI.

As sector targeting is a choice of the IPA, the targeting decision could be a response to earlier experience of the sector, which could present a reverse causality problem. However, when we exclude countries that reported in the Census that the targeting decision was based on the past success or failure in attracting FDI to the sector, our results hold. In addition, we find no evidence suggesting that targeting took place in sectors with relatively high or low inflows in the years preceding targeting.

A series of robustness checks supports our conclusions. First, we show that the results hold if we exclude services sectors and utilities. This gives us confidence that our findings are not driven by simultaneous opening to FDI and targeting of services industries where entry of foreign investors was restricted in the past. Second, we demonstrate that controlling for the past stock of FDI does not affect the estimated coefficients. Third, to address the concern that FDI flows may be a poor reflection of actual activities of foreign investors (Lipsey, 2007), we demonstrate that our results hold if we use sales or employment of US affiliates abroad as our dependent variable.

[3] Charlton and Davis (2006) use a similar identification strategy in their analysis of FDI inflows into OECD countries.

The significant positive effect of investment promotion found in the sector-level analysis is confirmed when we examine country-level data. The information on country-level FDI inflows comes from the IMF *International Financial Statistics (IFS)* and covers the 1972-2005 period. In this case, our variable of interest is the existence of an investment promotion agency, deduced from the establishment year reported by each agency. The magnitude of the effect is almost identical to that found in the sector-level exercise.

As we are concerned about the potential endogeneity of IPA existence with respect to FDI inflows, we also use the instrumental variable approach. As our first instrument, we employ the existence of an export promotion agency (EPA) in the host country in the same year. We exploit the fact that while EPA activities are typically directed at domestic firms, IPAs and EPAs are often established at the same time. Our second instrument is the inflow of foreign aid into the host country which is justified on the grounds that multilateral and bilateral donors tend to co-finance establishment of IPAs and provide support to agencies. The instrumental variable approach confirms our earlier findings.

In the country-level analysis, we also examine a more nuanced question: are certrain types of agencies more successful than others in attracting FDI? The existing case study evidence suggests that quasi-government agencies tend to be more effective than subunits of ministries (Wells and Wint, 2000). Similarly, it is believed that agencies accountable to external entities are more effective than those accountable to a board. The fact that our findings are in line with these predictions gives us confidence that our results reflect the effect of investment promotion efforts rather than some other factors.

To confirm that we are not attributing general policy reforms to investment promotion, we examine the relationship between IPA existence and domestic capital formation. A general reform should affect both domestic investments and inflows of FDI, while investment promotion should only affect inflows of FDI. We find that IPA existence has no effect on domestic investment. This result is robust across a series of specifications, both with and without controls for inflows of FDI.

We then turn our attention to an aspect of investment promotion that receives considerable attention from both policy makers and academics, namely FDI incentives. We use time-varying information on the existence of five different types of incentives. These are: financial incentives, tax holidays, reduced tax rates, subsidized infrastructure or services, and regulatory concessions. Unfortunately, due to a high correlation between the existence of an IPA and the use of incentives, it is difficult to distinguish between the two effects. When the existence of investment promotion agency and incentives are included simultaneously, the IPA variable is significant while the incentive variable is not. When the investment promotion variable is excluded, we find statistically significant positive coefficients on tax incentives and subsidized infrastructure or services. The magnitude of the effect is about the same as what we typically find for investment promotion.

Last we focus on the concern of government officials that policies in competing countries might divert FDI inflows. We test this hypothesis by including the number of competing countries that have an investment promotion agency and the number of competing countries that make use of

investment incentives in the same time period. We find that competitors' general investment promotion efforts, as proxied by the existence of an IPA, do not lead to diversion of FDI. However, the competitors' investment incentives negatively affect FDI inflows. This suggests that incentives work differently from general investment promotion efforts. The evidence of competition effects is present only when competitors are defined as other countries in the same geographic region, but not when they are defined as other countries at the same income level. The evidence of competition for FDI taking place at the regional level is consistent with practitioners' insight that potential foreign investors first choose a target region, and then choose a country within that region as their investment destination (Bjorvatn and Eckel, 2006).[4]

Our results have several policy implications. First, they suggest that investment promotion may be a viable policy option for developing countries which wish to attract FDI inflows. Second, our results confirm the practitioners' view that subunits of ministries tend to be less effective in attracting FDI than agencies with a more autonomous status and that accountability to an external entity positively affect agencies' performance. Third, our findings on the diverting effect of tax incentives offered by other countries in the sane geographic region point to potential benefits of regional coordination in this area.

This study is structured as follows. Section 2 discusses the role of investment promotion and places the study in the context of the existing literature. Section 3 describes the empirical strategy and the data employed. Section 4 presents the results, while section 5 concludes.

2. Literature review

2.1 What is investment promotion?

Wells and Wint (2000) define investment promotion as activities through which governments aim to attract FDI inflows. These activities encompass: advertising, investment seminars and missions, participation in trade shows and exhibitions, distribution of literature, one-to-one direct marketing efforts, facilitating visits of prospective investors, matching prospective investors with local partners, help with obtaining permits and approvals, preparing project proposals, conducting feasibility studies and servicing investors whose projects have already become operational. Their definition of promotion excludes granting incentives to foreign investors, screening potential investment projects and negotiations with foreign investors, even though some IPAs may also be engaged in such activities.

Investment promotion activities can be grouped into four areas: (i) national image building, (ii) investment generation, (iii) investor servicing, and (iv) policy advocacy. Image building activities aim to build a perception of the country as an attractive location for foreign direct investment. Investment generation involves identifying potential investors who may be interested in establishing a presence in the country, developing a strategy to contact them and starting a dialogue with the purpose of having them commit to an investment project. Investor servicing involves assisting committed investors in analyzing business opportunities, establishing a business and maintaining it. Policy advocacy encompasses initiatives aiming to improve the

[4] Charlton (2003) reviews case studies on competition in incentives and finds it to be the strongest between close neighbors with similar economic conditions and factor endowments.

quality of the investment climate and identifying the views of private sector in this area (Wells and Wint, 2000).

2.2 How can investment promotion affect the decision process of a potential investor?[5]

A company that has decided to engage in FDI usually starts the process of selecting the investment location by drawing a long list of potential host countries. The list is put together by the company executives or by a consulting firm hired for the purpose of site selection. The long list typically includes 8 to 20 countries which can be thought of as belonging to three groups: (i) most popular FDI destinations in the world, (ii) countries close to the existing operations of the investor, and (iii) emerging FDI destinations (that is, countries that the investor may not be initially very serious about but which represent "out of the box" thinking). The inclusion of the third category presents an opportunity for IPAs. The potential investor or the consulting firm working on its behalf is likely to include in the third group countries whose advertisements they have recently seen in international media, countries whose IPAs have recently approached them or their colleagues, or countries whose IPA representatives they have met at conferences and industry fairs.[6]

Based on the trade-off between costs and the quality of business environment, the long list is narrowed down to a short list of up to 5 potential host countries. This is usually done without visiting the potential host countries, so the accessibility of the information about the business conditions in a host country plays a crucial role. IPAs that provide up-to-date, detailed and accurate data on their websites and IPAs that are willing to spend time preparing detailed answers to investors' inquiries and customize these answers to the needs of an individual investor can increase the chances of their countries being included in the short list.

The next step in the decision-making process involves visiting the countries included in the short list. This can be done by the potential investor, consultants or both. Multiple sites in each country may be visited. A visit often involves interactions with an IPA which has the opportunity to emphasize the advantages of locating in its country, answer questions, show executives potential investment sites or introduce them to potential local business partners.

In the final stage of the process, the foreign investor chooses an investment location based on the availability of potential sites, costs, the overall quality of business climate and availability of incentives. An IPA can assist in providing information on incentives and offering help with the registration process.

As evident from the above outline, IPAs can play a significant role in the selection process of FDI sites. The national IPA is often the first entity which a potential investor contacts to obtain information. Absence of an IPA not only increases the investor's cost of gathering information

[5] This subsection draws on MIGA (2006) and the authors' interviews with former professional consultants assisting companies in establishing facilities abroad.

[6] For instance, the Polish IPA believes that TV advertising spots increased the number of visitors to its website by 43 percent in 2006 (source: *Dziennik online*. "Wielka promocja rozpoczeta. Polska jak proszek do prania" December 29, 2006. http://www.dziennik.pl/Default.aspx?TabId=97&ShowArticleId=26406).

but also sends a negative signal suggesting that the country is not interested in attracting FDI. It may constitute a reason to eliminate a location during the selection process.

2.3 Rationale for public support of investment promotion

The theoretical justification for public support for investment promotion is based on a market failure. Potential foreign investors must incur a cost to gather information about potential returns available in alternative investment locations. This cost may be higher in a developing country context where published statistics and other information sources are scarce. As argued by Greenwald and Stiglitz (1986), markets for information are fundamentally different from other markets, and in the presence of imperfect information they may not produce Pareto efficient outcomes. The information cost may also be increased by local firms and other foreign investors operating in the location who may have an incentive to restrict information flows in order to prevent the entry of potential competitors. By disseminating information about potential investment opportunities, an IPA can enhance the availability of information to potential foreign investors and facilitate more efficient capital allocation.

The second reason governments may want to subsidize investment promotion is due to positive externalities associated with FDI inflows. There is a large literature arguing that foreign direct investment may result in knowledge spillovers to the domestic industry. As foreign investors do not take into account this externality when making their decisions, they will provide less than the socially optimal level of FDI. Public intervention is then needed to increase the amount of investment to the socially optimal level.[7]

2.4 Existing literature on effectiveness of investment promotion

Despite widespread implementation of investment promotion around the world, little is known about how effective these policies are. Pioneering work by Wells and Wint (2000), based on case studies and a very limited econometric analysis, found a positive correlation between investment promotion and the level of FDI per capita. Subsequent work by Morisset and Andrews-Johnson (2004) also concluded that IPAs appear to play a useful role in attracting FDI. However, both studies were based on cross-sectional data and a very small number of observations (between 36 and 58).

Contributions studying FDI inflows into the US have relied on more detailed data and employed a more rigorous methodology. Head, Ries and Swenson (1999) estimated a location choice model on a sample of 760 Japanese manufacturing establishments in the US between 1980 and 1992. In addition to agglomeration factors and other controls, the authors examined the effects of profit taxes, factor subsidies, the existence of a foreign trade zone in the state, the use of unitary taxation by the state, and the presence of an investment promotion office in Japan. They did not find a significant effect of investment promotion offices in Japan. Bobonis and Shatz (2007) analyzed determinants of the FDI stock in US states from eight source countries using Arellano-Bond dynamic panel data estimator. They measured investment promotion with the number of years a state had a full-time state trade or investment office in each of the eight countries. They found that a one-percent increase in the number of years with an investment office increased the

[7] For a detailed discussion of reasons why countries may choose to subsidize FDI see Hanson (2001).

FDI stock by between 0.14 and 0.27 percent. In their sample, the latter figure corresponded to a one million USD (at the median) or a 2.6 million USD (at the mean) increase in the value of the FDI stock.[8]

The most rigorous analysis to date performed in a multi-country setting was done by Charlton and Davis (2006). The authors focused on the question of whether IPAs have been more successful in attracting FDI inflows into industries they explicitly target. Industry-level data on FDI inflows into 19 industries in 22 OECD countries during the 1990-2001 period combined with information on targeted industries collected through a survey of IPAs provided the basis for their study. Using propensity score matching and the difference-in-differences specification, the authors found that targeting of an industry increased the growth rate of FDI inflows into that industry by 41 percent.

This study extends the existing literature in several directions. First, it applies a rigorous approach, similar to that pioneered by Charlton and Davis (2006), to a large sample of developed and developing countries. As mentioned before, little is known about the effectiveness of investment promotion in developing countries. One could argue that investment promotion could be more effective in the developing world due to scarcity of detailed information on the prevailing business conditions, rules and regulations and due to high costs of gathering such information. Alternatively, one can argue that in developing countries lacking a "good product to market" (i.e. good business climate), investment promotion efforts may be a waste of resources, while in developing countries with an acceptable business environment low labor costs may be attracting FDI inflows even in the absence of investment promotion. Second, this study examines whether the status and the reporting structure of investment promotion agencies matter for their effectiveness. Third, our analysis goes beyond the existing literature by examining the effect of regional competition in FDI incentives.

3. Empirical strategy and data

3.1 Empirical strategy

Our empirical analysis will rely on two datasets: (i) country-sector panel data and (ii) aggregate country-level panel data. The basic empirical specification in the sector-level analysis is

$$\ln FDIflow_{cit} = \alpha_1 + \beta_1 Sector\_targeted_{cit} + \gamma_{ci} + \gamma_{ct} + \gamma_{it} + \varepsilon_{cit}$$

The dependent variable is the log of inflow of foreign direct investment into sector i in country c at time t. $Sector\_targeted_{cit}$ equals one if country c targets sector i at time t and zero otherwise. γ_{ci}, γ_{ct} and γ_{it} are country-industry, country-time and industry-year fixed effects, respectively.

The question of interest is whether targeted sectors receive higher FDI inflows in the post targeting period (relative to pre-targeting period and non-targeted sectors). Note that time-invariant characteristics that differentiate sectors chosen for targeting from other sectors will be captured by country-sector fixed effects. Shocks common to all sectors in a particular country in a particular year will be captured by country-year fixed effects. Shocks affecting supply of FDI in a

[8] The literature on location determinants of FDI in the US goes back to at least the 1980s. See Bobonis and Shatz (2007) and Coughlin and Segev (2000) for a review.

particular sector will be controlled for by sector-year fixed effects. The model will be estimated on a sample of countries that have or have not practiced sector targeting. Narrowing the sample to only countries engaged in targeting does not change the conclusions of the study.

In the aggregate analysis, we will estimate the following model:

$$\ln FDIflow_{ct} = \alpha_2 + \beta_2 IPA_{ct} + X_{ct}\theta + \psi_c + \psi_t + \varsigma_{ct}$$

where the dependent variable is the log of aggregate inflow of foreign direct investment into country c at time t. IPA_{ct} equals one if country c had an investment promotion agency at time t and zero otherwise. ψ_c and ψ_t are country and year fixed effects, respectively. X_{ct} includes time-varying country controls. All variables and their sources are described in section 3.3.

3.2 Econometric issues

Identifying the relationship between investment promotion efforts and FDI inflows poses several challenges. Perhaps the most important challenge is establishing the direction of causality. It could be argued that the choice of sectors to be targeted is endogenous; IPAs could be targeting sectors which already experienced high inflows. In our sector-level analysis, which compares FDI inflows to targeted and non-targeted sectors pre- and post-targeting, we use four different strategies to deal with the potential reverse causality. First, we include country-industry fixed effects, which take out unobserved time-invariant characteristics specific to country-industry combinations. If, for example, the mining sector in South Africa was chosen for targeting because of the endowment of gold and this endowment is also the reason for large FDI inflows into the sector, this is controlled for by the country-sector fixed effect. Second, we show that our results are robust to a specification with first, second and third lags. A change in FDI inflows is unlikely to explain a change in policy which precedes it, although the strategy is not robust to forward looking behavior of policy makers. Third, we investigate if the sectors targeted were different from other sectors in the years before the targeting started. We find no evidence of relatively successful or unsuccessful sectors being chosen for targeting. Fourth, as IPAs were asked in the Census about the reasons behind targeting a particular set of sectors, we show that the results hold even if we exclude targeted sectors in countries that made targeting decisions based on the past success or failure in attracting FDI to that sector.

The measures described above do not address the theoretical possibility that IPAs know which sectors will attract a lot of FDI in the future and choose to target them to show results. In the Census, IPAs were asked about who decided which sectors to target.[9] The incentive to target sectors that already have high expected FDI inflows may have been present at the agency board level, but it is harder to make the same case for the other entities. Of the 97 agencies that responded, only 6 said the decision was entirely left to the agency board, 24 reported the board having some input into the decision, and 67 said the agency board was not at all involved in the decision. Since the majority of the countries in the sample responded that the agency board was not involved in the choice of sectors, we do not view this possibility as a cause for concern.

[9] The entities involved in the decision were: president's office, prime minister's office, ministry of foreign affairs, ministry of finance, ministry of industry, ministry of commerce, agency board or the decision was based on a national strategy plan. In some cases, several entities were involved.

In the analysis based on aggregate data, where we use the existence of an IPA as our investment promotion variable, we follow three approaches to deal with the potential reverse causality problem. The first approach is to attenuate the problem by including country fixed effects and lagging the IPA indicator by one or more periods. The second approach is instrumental variables estimation, where information on the existence of an export promotion agency and the amount of foreign aid are used as instruments. The third approach is to ask more nuanced questions such as: do IPA's independence and reporting structure matter for its effectiveness in attracting FDI? As it is not clear why the amount of FDI inflows should affect the type of an agency being created or a change in the agency status or reporting structure, these results give us more confidence that the causality goes from investment promotion to inflows and not the other way around, especially because the findings are consistent with the conclusions of the case study literature.

The second challenge in our analysis is to distinguish the effect of an IPA from other changes in policies (or anything else relevant for FDI inflows) occurring at the same time. In the sector-level analysis, we address this challenge by including country-year fixed effects which capture country-specific factors that may influence FDI inflows at a particular point in time. For instance, if country c started special investment promotion efforts in the automotive sector in year t and at the same time simplified registration procedures for foreign investors, to the extent that the latter reform affected all sectors equally, it would be captured by the country-year fixed effect. We also include sector-time fixed effects to capture factors affecting worldwide supply of FDI in a particular sector at a particular point in time. These fixed effects capture global unobserved sector-specific shocks. For example, if international investors suddenly decided to increase investments in the ICT sector, and a country at the same time started targeting the ICT sector, the investment promotion variable could capture the global shock rather than the country's promotion efforts. Inclusion of sector-year fixed effects takes care of this possibility.

In the country-level analysis, we include controls for various aspects of the business climate in the host country and other typical FDI determinants used in the literature. We also show that the existence of an IPA does not affect domestic investment. As most policy changes would tend to influence both domestic and foreign investment, this gives us more confidence in our results.

The third challenge is to distinguish between general investment promotion (information provision, image building, help with red tape etc.) and tax incentives. There is a high correlation between IPA existence and tax incentives, which unfortunately prevents us from separating the two effects with confidence.

3.3 Data

Our data on investment promotion activities comes from the 2005 Census conducted by the World Bank's Research Department in cooperation with the Foreign Investment Advisory Services, the Multilateral Investment Guarantee Agency and the World Association of Investment Promotion Agencies. An electronic survey was sent out to all national investment promotion agencies around the world. After several weeks reminder e-mails were sent out, and after some more weeks phone calls were made to increase the likelihood of response. As the survey forms came in, the data were carefully checked for inconsistencies and missing information. Then new rounds of phone calls were made to clarify inconsistencies and complete the data. The survey was sent out in December 2005, and by April 2006 most of the information was complete. The survey

form gave uniformity needed for comparison across countries, while the information collected through the phone calls provided guidance on interpretation of the responses. This comprehensive process yielded responses from 109 national investment promotion agencies. Additionally, we found detailed information on the activities of the Austrian IPA, which did not respond to the Census, on its website. The sample covers countries across all geographic regions as well as all income levels. Eighty-one of the responses received were from developing countries. The sample also includes additional 31 countries that we regard as very likely to not have an investment promotion agency. These were identified by their absence in different directories of IPAs, lack of websites, by confirmation of national embassies/other national public institutions or by consultations with World Bank country economists.[10]

A potential concern is that high quality agencies are overrepresented in the sample due to self-selection. We cannot rule out this possibility completely, but a glance at our sample reveals a wide representation of countries across all income groups and regions. Also our experience from collecting the data suggests the opposite. Some developed countries were among the hardest to obtain answers from, while countries in, for example, Sub Saharan Africa were often extremely helpful in providing as extensive and precise information as possible. One explanation could be the opportunity cost; officers of IPAs in developed countries often appeared to be more busy and harder to contact. Therefore, it is not clear which way a potential sample bias would work. If anything, it could make investment promotion appear less efficient than it actually is.

In the design of the survey, special attention was given to collecting time-varying information. While this increased the effort needed to collect the data, it also allowed for the use of panel estimation techniques and made it possible to control for time-invariant country-specific unobservable factors. Attention was also given to sector-specific time-varying measures of investment promotion The agencies were asked if they targeted specific sectors and when targeting started and ended.

The Census also included questions on more subtle characteristics of the agencies. For instance, IPAs were asked about their legal status (sub-unit of ministry, autonomous public body, semi-autonomous agency reporting to a ministry, joint public-private entity, private entity), and if the status had changed, when the change happened and what the status was before the change. Additionally the Census included a question asking to whom the agency was accountable and how long they had been reporting to the overseeing entity.

Investment incentives were another aspect of investment promotion covered in the Census. Despite the attention received by investment incentives, to the best of our knowledge, a database with broad cross-country and cross-time coverage of investment incentives offered does not exist. Collection of such data in itself represents a contribution to the FDI literature.

Parallel to the survey on investment promotion, Lederman, Olarreaga and Payton (2006) collected information on export promotion agencies. Data on the date of establishment of an export promotion agency are used in our study as an instrument for the existence of an investment

[10] The actual number of countries included in the empirical analysis depends on the availability of other variables included.

promotion agency in a country, since establishment of these two types of agencies have often been a part of a more active internationalization strategy of governments. At the same time, the exclusion restriction, that the existence of an export promotion agency should not be included directly in the equation explaining FDI inflows, should be fulfilled, since export promotion agencies primarily help domestic firms.

FDI data for the sector-level analysis are supplied by the US Bureau of Economic Analysis (BEA). These data give the stocks of US FDI abroad.[11] We use the first difference of the stocks to calculate flows. BEA publishes information on 13 sectors until 1998 and 15 sectors from 1999.[12] We made two changes to the BEA data. We aggregated "Other manufacturing" and "Other industries" into one sector in the pre-1999 data, and "Machinery" and "Computer and electronic products" into one sector in the post-1998 data. The second change was to match sectors over time. Due to a break in the aggregation in 1998 in the BEA data, sector definitions are not exactly the same during the entire period (1989-2004). As our identification strategy is to follow sectors over time and test if post-targeting inflows are significantly higher than pre-targeting inflows (and inflows to non-targeted sectors), we would like to have long time periods before and after targeting. As the break in aggregation appeared around the middle of the period, we would typically have either very few years pre-targeting or very few years post-targeting had we not implemented the matching procedure.

After these two changes, we match BEA sectors to the sector classification used in the Census to collect targeting information. See Table 1 for the concordance and Figure 2 for summary statistics on sectors that are most frequently targeted. We have a maximum of 15 sectors per country. The stock data are available from 1989-2004 (first differenced for 1990-2004). Table 2 shows the 124 countries included in the sector sample.[13] For additional statistics on the sectors see Table 3 and Table 4.

The US is one of the top FDI source countries, so by focusing on US FDI we capture a large share of the world's FDI stock. Figure 3, which compares the stock of US FDI to the stock of FDI from other OECD countries in 2000, demonstrates that US was the dominant source country in Latin America, East Asia and industrialized economies. Additional advantages of using the BEA data are their comparability across countries and access to figures on sales and employment of US affiliates abroad. We use the latter figures in our robustness checks.

In the aggregate analysis, flow data from the IMF *International Financial Statistics* are used. The IMF data capture inflows of FDI to each country from any country in the world. The aggregate

[11] U.S. direct investment abroad is defined as the ownership or control, directly or indirectly, by one US resident of 10 percent or more of the voting securities of an incorporated foreign business enterprise or the equivalent interest in an unincorporated foreign business enterprise. The data capture the cumulative value of parents' investments in their affiliates (source: http://www.bea.gov/bea/ai/0395iid/maintext.htm). Data points suppressed by the BEA for confidentiality reasons are treated as missing. Data points reported as values belonging to the range between -500,000 and 500,000 US dollars are treated as equal to 500,000 dollars. We interpolated missing information on stocks to increase the number of observations.

[12] From 1999, the BEA-data are classified under the 1997 North American Industry Classification System (NAICS). Previously, data were classified under the Standard Industrial Classification System (SIC).

[13] The number of 124 countries corresponds to the baseline specification in Table 9.

analysis covers the period 1972-2005. Table 2 and its footnotes lists the 128 countries that are included in the aggregate analysis.[14]

In both the analysis based on BEA sector data and in the analysis based on IFS aggregate data we use the log of FDI inflows as our dependent variable. To deal with zeros we add one US dollar to all observations before taking logs. To deal with negative values we follow Blonigen (2004) and Eichengreen and Tong (2005) and set all negative values to 0.1 US dollar before taking logs.[15]

We follow the literature on FDI determinants (e.g. Wheeler and Mody, 1992; Javorcik, 2004b) and control for market size, labor costs, macroeconomic stability and business climate. Purchasing power of local consumers is measured as the log of GDP per capita. This variable could also be interpreted as a proxy for labor costs; thus the expected sign on the coefficient could be either positive or negative. Market-seeking FDI would be attracted to countries with high purchasing power, while FDI with the intention of cutting production costs is more likely to flow to countries with lower wage cost. GDP growth and the log of population size are proxies for the potential market size, and a positive coefficient is expected on these variables. The GDP and population variables are from the World Bank's *World Development Indicators* (WDI).[16] The inflation rate, provided by the IMF *International Financial Statistics*, is a proxy for macroeconomic stability. High inflation indicates an unstable macroeconomic environment and thus we expect a negative coefficient. As measures of political institutions and business climate we use an index of civil liberties from Freedom House (available from 1972-2004).[17] It ranges from one denoting the most free countries to seven denoting the least free countries. A negative coefficient is, therefore, expected. The political risk rating provided by the International Country Risk Guide (ICRG), available for 1984-2006, is also used.[18] A positive coefficient is anticipated since the variable ranges from 0 to 100, where 0 means very high political risk and 100 very low political risk.

In some specifications, we use gross capital formation or gross fixed capital formation as the dependent variable. Both variables come from IMF's *International Financial Statistics*. In the instrumental variable approach, we use information on aid inflows per capita (in current US dollars) and official development assistance and official aid (in current US dollars), both from the WDI. The summary statistics are presented in Table 5 – 8.

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[14] The number of years differs across countries, and the number of observations differs across econometric specifications due to the availability of control variables. The figure of 128 refers to relevant countries (countries from which we got a response, for which IPA existence could not be confirmed, or for which we know that they do not have an IPA) with FDI data in IFS.

[15] As we were concerned about a significant number of cases with zero investment, we also used the Tobit specification including regional rather than country fixed effects. The Tobit results confirmed our findings. This was true both when the lower censoring limit for the dependent variable was set to log(1) and log(0.1), which corresponds to zero and negative FDI inflows, respectively. As a robustness check in the sector-level data, we also estimated the models from Table 9 without distinguishing between zeros and negative FDI flow values (i.e. we set both zero and negative values to 0.1 before taking logs). The effect of targeting was significant at the 1% level for all the specifications in the developing country sample (the coefficient varied between 1.018 and 1.454).

[16] http://publications.worldbank.org/WDI/

[17] http://www.freedomhouse.org/. The results are also robust to using political rights from Freedom house.

[18] http://www.icrgonline.com/

4. Results

4.1 Sector-level analysis

We start our investigation of the effectiveness of investment promotion efforts with a sector-level analysis. Our identification strategy relies on the fact that most IPAs focus their efforts on a certain number of priority (target) sectors.[19] Sector targeting is viewed by investment promotion practitioners as best practice as it is believed that more intense efforts concentrated on a few priority sectors are likely to lead to greater FDI inflows than less intense across-the-board attempts to attract FDI. Targeting means engaging in the standard investment promotion activities, such as image building, investment generation, investor servicing and policy advocacy (see subsections 2.1 and 2.2), but applying them to a selection of industries rather than to foreign investors in general. Thus, an IPA not engaged in targeting will promote its country as a good place to do business, while an IPA targeting particular sectors will emphasize why its country is an ideal location for investors operating in these industries. Similarly, the former IPA will attend many different types of fairs and conferences while the latter will present only at events specific to the industries it aims to attract. The idea behind targeting is that a more focused message tailored and delivered to a narrow audience will be more effective than general investment promotion activities.

Taking advantage of information on sectors targeted by IPAs (if any), we use the difference-in-differences approach and examine whether sectors targeted by IPA receive more FDI inflows in the post-targeting period relative to the pre-targeting period and non-targeted sectors. Our goal is not to check whether countries with IPAs engaged in sector targeting receive more FDI than countries that do not follow this approach. Rather, targeting is used as a convenient identification strategy that allows us to ask whether IPAs are successful at bringing the type of FDI they are meant to attract.

The estimated specification includes a set of controls. To take into account heterogeneity across sector-country combinations, we include sector-country fixed effects. Rather than including explicit country-level controls, we include in the specification country-year fixed effects. These control for *all* country-specific changes taking place over time. To the extent that changes in the host country policies, regulations and other factors affect FDI inflows to all sectors in the same way, country-year fixed effects will capture them. It is also possible that some global shocks affect the supply of FDI in a particular sector. To take this into account, we add sector-year fixed effects. To the extent global shocks affect flows of FDI into a particular sector in the same way across countries, they will be captured by sector-year fixed effects.

The results, presented in Table 9, suggest that investment promotion efforts are associated with higher FDI inflows to developing countries. The coefficient on the dummy for a sector being targeted is positive and statistically significant in the developing country subsample. In the full sample, contemporaneous targeting does not appear to matter. In the post-targeting period, targeted sectors in developing countries appear to receive 155% higher FDI inflows (column 5). This effect is statistically significant at the 1% level.

[19] 86 IPAs, out of the 104 responding to the question on sector targeting, answered that they were using sector targeting or had done so in the past. Of these, 56 gave complete timing of the targeting efforts towards at least one sector and we were able to include these targeted sectors in the sample. We did not include in the sample targeted sectors for which we did not have complete timing.

While the magnitude of the effect may seem large, it is not implausible. Many sectors experience zero and close to zero inflows, and if we consider only positive flows of US FDI, the median 2004 value is 21 and 11 million dollars in the full and the developing country sample, respectively. Thus, the estimated 155% percent increase would mean an additional annual inflow of 17 million dollars for the median sector-country observation in the developing country subsample.[20] A quick look at the amounts multinational corporations actually invest in developing countries reveals that FDI inflows of that magnitude are not uncommon. For example, in 2005 Wal-Mart planned to open 70 new units in Mexico with an expected investment of 736 million dollars[21] and in 1995 Pepsi announced a 55 million dollar investment in a snack-food company in South Africa,[22] Boeing McDonnell Douglas invested 31 million dollars in the Czech Republic in 1998.[23]

It is reasonable to expect that some time is needed before the full effect of targeting materializes. Therefore, Table 9 also includes specifications with the targeted variable lagged by one, two or three periods. Another, already mentioned, positive aspect of using lagged values is that they attenuate potential concerns about endogeneity. We find positive and significant effects of lagged targeting in all specifications estimated, both in the full sample and for developing countries. Lagging appears to make the results stronger.

To investigate the possibility that our results are driven by reverse causality–that is investment inflows determine subsequent targeting rather the other way around–in Table 10 we include a dummy variable taking the value of one for targeted sectors in the years *before* targeting started and zero otherwise. In different specifications, we consider one year before the start of targeting (column 1 and 5), two years (2 and 6), three years (3 and 7) and four years (4 and 8).[24] A positive and significant coefficient on the dummy would indicate that sectors receiving higher FDI inflows were the ones subsequently chosen for targeting. In other words, it would indicate that the investment promotion agencies were picking successful sectors as their priority sectors and thus our earlier findings would reflect this selection process rather than the effectiveness of investment promotion activities. However, the results presented in Table 10 suggest that this was not the case in the developing country subsample. In none of the four specifications, does the dummy appear to be statistically significant. The coefficients on the targeting variable remain positive and significant. The F-test included in the two lower rows of the table suggests that there is a statistically significant difference between the dummy and the targeting variable. In contrast, in the full sample, the two effects are not different from each other and the targeting variable is not statistically significant.

In Table 11, we present the results from a probit regression modeling the determinants of sector targeting. The dependent variable is equal to one if country c begins targeting industry i at time t,

[20] The median value of 11 million dollars pertains to those country-sector combinations, included in the regression presented in column 5 in Table 9, which received a positive amount of US FDI in 2004. The figure of 155% is based on the estimate reported in the same column.
[21] http://walmartstores.com/GlobalWMStoresWeb/navigate.do?catg=379
[22] http://query.nytimes.com/gst/fullpage.html?res=990CE0DF1430F931A15755C0A963958260
[23] http://www.factbook.net/countryreports/cz/cz_fdi_us.htm
[24] Thus, for instance, if country c decided to target sector i in year 2000, the dummy will take on the value of one in 1999 (columns 1 and 5), in 1998 and 1999 (columns 2 and 6), etc., and zero in all other years.

and zero if the industry is not targeted at time t.[25] The purpose of the exercise is to find out whether past FDI inflows or FDI stocks in industry i in country c (lagged one, two or three periods) can predict future targeting of the industry. The model also includes controls for country characteristics as well as country and year fixed effects.[26] In only one of twelve specifications, we find a significant coefficient on the FDI variable. The coefficient bears a negative sign which suggests that, if anything, developing countries chose for targeting sectors with lower FDI flows.

As another robustness check, we remove from the sample observations for targeted sectors in countries where the investment promotion agencies reported in the Census that the choice of priority sectors was based on the earlier success in attracting inflows to those sectors or the lack thereof. As seen in Table 12, removing these countries leads to a stronger rather than weaker effect of the investment promotion efforts.

4.2 Sector-level analysis – additional robustness checks

A potential concern is that our findings could be driven by simultaneous opening to FDI and targeting of services industries where entry of foreign investors was restricted in the past. To eliminate this possibility, we exclude from the sample services sectors and utilities and show that this change does not affect our findings (see Table 13).

As agglomeration effects may be important in attracting FDI, we include the lagged FDI stock in the sector in Table 14. This additional control variable is not statistically significant and its inclusion does not affect our results.

To address the concern that FDI flows may be a poor reflection of actual activities of foreign investors, as suggested by Lipsey (2007), we demonstrate that our results hold if we use sales or employment of US affiliates abroad as our dependent variable. To save space, we present only results for the developing country subsample. When sales are used, the magnitude of the effect is very similar to that found in the baseline specification. When employment figures are considered, the size of the effect halves (see Table 15).

The choice of the control group is an important consideration. In our analysis, we have compared targeted sectors before and after targeting with sectors that were not targeted. A potential concern is that inclusion of a large number of low performing (in terms of FDI inflows) sectors could amplify the effect of targeting and thus exaggerate its effect. To evaluate this concern we estimate the effect of targeting on the subsample of 56 countries that targeted at least one sector during the period covered by our analysis (for the list see Table 3). These results are not shown, but the estimated coefficient on the targeting variable is positive and significant at the 1% or 5% level for the subsample of developing countries.[27]

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[25] Thus observations for targeted sectors in years other than the first year of targeting are not included in the sample.

[26] See table note for the list of control variables.

[27] More specifically, we estimated the baseline specifications from Table 9 on the sample of 56 countries which gave us detailed timing information. The coefficient on the targeting variable in the developing country subsample varied between 0.767 and 1.244.

In sum, our results suggest that investment promotion efforts are associated with higher FDI inflows to targeted sectors in developing countries. The results are robust to a large number of specifications, and the available evidence suggests that they are unlikely to suffer from reverse causality problems. The findings for the combined sample of developing and developed countries are less clear. Therefore, we are hesitant to comment on the effectiveness of investment promotion efforts in a developed country context.[28]

4.3 Country-level analysis

The next part of our analysis focuses on aggregate FDI flows and examines whether the existence of an investment promotion agency affects the amount of investment received by all sectors in a given country. There are several reasons for extending the analysis to the aggregate level. First, the information on sector targeting could be plagued by measurement errors. Employing an alternative measure of investment promotion activities reduces the possibility that the results are affected by measurement error, as obtaining information on the year of IPA establishment is more straightforward than cataloguing targeting information. The second reason for looking at aggregate data is that aggregate FDI figures are available for a longer time span (we go back to the year 1972 as opposed to 1990 in the case of sector-level information). Similarly, we can consider a larger number of countries than in the sector-level analysis where we are forced to discard countries with incomplete targeting information. Third, the detailed information on the status and reporting structure of the agencies obtained in the Census allows us to focus on more nuanced questions and thus can give us more confidence that we are picking up the IPA effect.

The aggregate analysis confirms the finding of the sector-level analysis. In Table 16, we start with a specification with host-country fixed effects, time fixed effects and control variables. The variable of interest is a dummy taking on the value of one if a host country has an IPA at time t and zero otherwise. As before, we find that developing countries engaged in investment promotion receive about two and a half times higher FDI inflows than developing countries not having an IPA. The estimated coefficients are statistically significant at the 1% level and are very much in line with the estimates based on the sector-level data. When developed countries are included in the sample, we find a positive effect when the IPA variable is lagged one and two periods but not in the other two specifications, which again mirrors our overall conclusions from the previous section. An alternative specification where investment promotion efforts are measured by the number of years an IPA has been in existence (and its square) leads to the same conclusions.

The estimated effects of the control variables broadly conform to our expectations. We find that countries experiencing faster GDP growth tend to attract more FDI. The expected sign on the per capita GDP is ambiguous, since this variable can be seen as a measure of the purchasing power of local consumers (thus implying a positive relationship for market seeking FDI) or a proxy for labor costs (thus implying a negative relationship for efficiency seeking FDI). The estimated negative effects might indicate that the latter effect dominates. Population size could be viewed as a proxy for the potential market size of the host country. The fact that we find a negative effect is somewhat surprising and can perhaps be explained by the inclusion of country fixed effects which capture the average country size over the period. Even though the population size tends to change

[28] When we focus on the subsample of developed countries we fail to detect any positive effect of investment promotion.

little over time, significant changes are likely to take place during the 30-year period covered by our study. As population growth tends to decrease with economic development, the negative sign could be a reflection of high population growth being correlated with poor performance in other areas of economic performance. As anticipated, we find that countries experiencing macroeconomic instability (as proxied by high inflation) receive less FDI. Restrictions on civil liberties do not appear to matter in the developing country subsample and enter with a negative sign in the full sample.

In Table 17, we test the robustness of our results to the inclusion of proxies for political risk, restrictions on political rights and general measures of openness. We lag the openness measures two periods to reduce the problem of simultaneity. We find that this extension has little effect on our earlier findings. As expected, we find that higher political risk reduces the magnitude of FDI inflows.[29] Restrictions on political rights do not appear to matter, while openness to trade is associated with lower inflows of FDI. As these additional controls severely reduce our sample size, we do not include them in subsequent estimations.

A typical challenge presented by this type of regressions is separating the effect of the variable of interest, investment promotion efforts in our case, from the effects of other economic, political or regulatory changes happening at the same time. Therefore, to gain more confidence in our results, we examine whether there is a positive relationship between gross fixed domestic capital formation and the existence of an IPA. As the mandate of a typical IPA is restricted to promoting investment flows from abroad, there is no reason for a positive relationship between the IPA dummy and domestic investment. If a positive relationship were found, it would suggest that the IPA dummy may be capturing some policy reforms beneficial for investments in general rather than efforts to attract FDI.

The results, presented in Table 18, indicate the absence of such a relationship and thus give us confidence that the IPA variable indeed reflects investment promotion activities. In all eight regressions, the coefficient on the IPA dummy (contemporaneous or lagged by one or more periods) is negative and not statistically significant. In the four columns to the right we add contemporaneous or lagged (by one or more periods) FDI inflows as additional control variable. The coefficient on FDI inflows is positive and statistically significant in all regressions. The results (not shown) are almost identical when we consider gross domestic capital formation rather than gross fixed domestic capital formation as the dependent variable.

Next we turn to the instrumental variable approach in an attempt to address the potential endogeneity between past FDI flows and creation of an investment promotion agency. We use a linear probability model to predict existence of an IPA. Our first instrument is the existence of an export promotion agency in the host country. The rationale is that countries often decide to establish an investment promotion agency and an export promotion agency around the same time. To be a valid instrument, the establishment of the EPA should explain the establishment of the investment promotion agency, without having any direct effect on FDI inflows. As EPAs typically focus on increasing the exports of domestic firms, it is not likely that presence of an EPA could directly affect FDI inflows.

[29] Recall that higher values of the index correspond to lower risk, hence the expected positive sign.

To justify our second instrument we use the fact that bilateral and multilateral donors (e.g., the World Bank Group, and in particular its Foreign Investment Advisory Services and the Multilateral Investment Guarantee Agency) have been actively engaged in assisting developing countries in setting up investment promotion agencies. The involvement of donors in supporting IPAs has been significant. As shown in Figure 4, in 2004 donors contributed on average 8 percent of the IPA budget in developing countries. Donor involvement went beyond financing and included technical advice, staff training, etc. Thus our second instrument is defined as the log of aid received by the host country at time t either in dollar terms or in dollars per capita.

As is evident from Table 19, our instruments have a satisfactory predictive power as reflected in the high F statistic. We find a positive correlation between the existence of an IPA and an EPA and a positive association between the amount of per capita aid received and IPA existence. The Sargan test does not reject the validity of the instruments. The results from the second stage confirm our earlier findings: the coefficient on the IPA variable is still positive and highly significant in all specifications. Some caution is, however, appropriate here given the much larger size of the estimated coefficients when compared to the OLS results. Optimistically interpreted, this could be an indication of reverse causality: IPAs are more likely to be established in countries with low FDI inflows. OLS estimation fails to take this into account and thus underestimates the magnitude of the effects. Pessimistically interpreted, the increase in the coefficients in the IV estimations could indicate that the exclusion restrictions are not fulfilled and that the instruments affect FDI inflows directly. Given the challenge of finding truly exogenous instruments in a panel of countries, we do not want to overemphasize the instrumental variable results.[30]

4.4 Agency characteristics

In response to the difficulties in teasing out the true effect of investment promotion, we next turn to asking questions about the effectiveness of different agency structures. We believe that finding patterns consistent with the case study evidence collected by investment promotion professionals and conventional wisdom will give us more faith in the results we have found so far.

The first question we analyze is whether the agency's legal status affects its performance. According to the case study work by Wells and Wint (2000), the nature of investment promotion activities suggests that quasi-governmental agencies may be best positioned to fulfill this function. On the one hand, there are several reasons why investment promotion should be performed by governments. First, the results of investment promotion activities may be difficult to translate into direct profits. While there is a market for consulting firms assisting companies in finding potential investment destinations, image building activities cannot be translated into profits that are readily captured by private companies. Second, agencies linked to the government may find it easier to assist investors in getting regulatory approvals, channel their complaints to the government and lobby authorities on behalf of foreign companies. On the other hand, the key ingredients of investment promotion—marketing a country as an attractive FDI location and

[30] To further investigate the possible endogeneity of IPA establishment to FDI inflows we also estimated several probit models. The dependent variable was equal to one if an IPA was established in country c at time t, and zero if there was no IPA in country c at time t. On the right hand side, we included the log of FDI inflows as well as the other controls from Table 16. Neither contemporary FDI inflows nor their first, second or third lags appeared to be statistically significant in any of the specifications. As the IFS database contains very few observations on FDI stocks, we did not repeat the exercise with FDI stocks as an explanatory variable.

investor servicing—are closer in nature to activities that are better performed by the private sector. Successful marketing requires the flexibility to respond to changing business conditions and investor needs, calls for close interactions with the private sector and relies on the ability to generate and implement consistent promotional strategies throughout a long period of time. Usually, government entities are neither flexible nor immune to political interference from changing governments. Investor servicing also requires a good understanding of the needs of the private sector. Other private sector advantages in investment promotion include cost containment, flexibility in hiring and firing and ability to pay salaries above the civil service levels which allows the agency to hire highly skilled and motivated staff.

Our results confirm the intuition of Wells and Wint. In regressions not reported here, we find that agencies with a more autonomous status (i.e. agencies which are not subunits of a ministry) are more effective in attracting FDI inflows than subunits of a ministry.[31] In Table 20 (the first two columns), we show that this pattern is confirmed when we consider cases of the status change. We find that agencies starting out as subunits of a ministry become more effective when they gain more autonomy (that is they change their status to being either an autonomous public body, semi-autonomous agency reporting to a ministry, joint public-private or private entity), compared to those that remain subunits of a ministry.

In a related exercise (also Table 20), we find that IPAs accountable to external entities (in addition to or instead of being accountable to the agency's board) tend to be more effective. Further, we find that agencies accountable to entities dealing with economic issues rather than political issues (ministry of finance versus ministry of foreign affairs for example) are more effective in attracting FDI.[32] An explanation for this result might be that the work of an IPA is of economic nature and its involvement in the design of economic policy might make the IPA more effective in its mission.

4.5 Investment incentives

An aspect of investment promotion that typically receives high levels of attention from both policy makers and academics is investment incentives. In the Census, we collected time-varying information on five different types of investment incentives: financial incentives, tax holidays, reduced tax rates, subsidized infrastructure or services, and regulatory concessions. Our finding is that it is in general difficult to distinguish the effect of incentives from a more general effect of investment promotion, as there is a high correlation between these variables (see Table 8). When both the existence of investment promotion agency and incentives are included simultaneously, we generally find that the investment promotion dummy is significant while the incentive variable is not, as can be seen in Table 21. When the investment promotion variable is excluded, as in Table 22, we find a statistically significant positive correlation between FDI inflows and tax incentives and between FDI inflows and subsidized infrastructure or services. The magnitude is about the same as what we have typically found for the IPA existence effect in the earlier specifications.

[31] We define "more autonomous" as having a status other than a subunit of a ministry. In the Census, 30 IPAs had the status of a sub-unit of ministry, 26 an autonomous public body, 43 a semi-autonomous agency reporting to a ministry, 3 a joint public-private entity and 2 a private entity (figures for 2004).

[32] We defined economic institutions as ministry of finance, ministry of industry, ministry of commerce or related institutions. The group of political institutions consists of president, prime minister and ministry foreign affairs.

4.6 Competition between countries

Government officials are often concerned about growing competition for FDI among countries. To shed some light on this issue we extend our specification to include presence of IPAs and FDI incentives in a peer group of host countries. In other words, in each year we count the number of countries in the peer group with an existing IPA and with FDI incentives on offer.[33] In Table 23, the peer group refers to countries within the same geographic region, while in Table 24 to countries within the same income group.[34] We control for the average GDP growth in the peer group (weighted by each country's GDP).

Two interesting findings emerge. First, FDI incentives appear to divert FDI inflows, but only within the geographic region, not within the income group. FDI competition taking place within a geographic region is consistent with the anecdotal evidence cited earlier. Second, the presence of agencies in the peer group does not divert FDI inflows.

Why don't we find that the presence of IPAs in the peer group leads to diversion of FDI? Presence of IPAs in neighboring countries might have three effects. First, positive externalities could exist from the marketing and information provision of IPAs in neighboring countries. For instance, CzechInvest's work may induce potential investors to consider not just the Czech Republic but also other countries in the region (e.g., neighboring Slovakia). Second, CzechInvest's marketing and hand-holding might convince an investor already considering the region to go to the Czech Republic rather than to a neighboring country. Third, the provision of investment incentives by the Czech Republic could influence an investor to choose the Czech Republic rather than another country in the region. In other words, the first factor is expected to have a positive effect on FDI inflows to other countries in the region, while the latter two would work in the opposite direction. The expected sign on the coefficient of IPA existence in other countries in the region is, therefore, ambiguous. When we do not control for FDI incentives offered by the peer group, we do not find a statistically significant coefficient on the number of IPAs in the peer group (results not reported to save space). When we explicitly include incentives, the effect of incentives is negative as expected. The IPA presence in other countries is still insignificant, which is consistent with the first and second effect being present but working in opposite directions.

5. Conclusions

Recent decades have witnessed an increased competition among countries for FDI inflows. To keep up with their peers many countries have engaged in investment promotion efforts and have offered incentives to foreign investors. Our analysis, based on newly collected information on national investment promotion efforts offers several insights into these developments. First, our results suggest that investment promotion may be a viable policy option for developing countries which wish to attract foreign investors. Second, our results confirm the practitioners' view that

[33] To be more precise the variable enters as the log(number of other countries in the group with z + 0.001), where z is an IPA or incentive provision in year t.

[34] We use the World Bank classification of geographic regions: Latin American and the Caribbean (LAC), East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Sub-Saharan Africa (SSA), South Asia (SA) and Middle East and North Africa (MENA). We also use the World Bank classification of income groups: low income, lower middle income, upper middle income, high income.

agencies' characteristics matter. As expected, subunits of ministries tend to be less effective in attracting FDI than agencies with a more autonomous status. Third, our findings on the diverting effect of tax incentives offered by other countries in the region point to potential benefits of regional coordination in this area.

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Tables: Information about the data used

Table 1: Aggregation across sectors and time, and matching Census sectors with BEA data

Sector	*Targeted sectors matched*	*BEA-data*	*Aggregated*	*Time period in BEA-data*
Petroleum	Mining and Quarrying	Petroleum		1989-1998
		Mining		1999-2004
Utilities	Electricity, gas and water provision	Utilities		1999-2004
Food	Food products	Food and kindred products		1989-1998
		Food		1999-2004
Chemicals	Petroleum, chemical, rubber, plastic products	Chemicals and allied products		1989-1998
		Chemicals		1999-2004
Metals	Metal and metal products	Primary and fabricated metals		1989-2004
Machinery	Machinery; Computers and electronic equipment	Industrial machinery and equipment		1989-1998
		Machinery	Yes	1999-2004
		Computer and electronic products	Yes	1999-2004
Electrical equipment	Computers and electronic equipment	Electronic and other electric equipment		1989-1998
		Electrical equipment, appliances, and components		1999-2004
Transportation equipment	Vehicles and other transport equipment	Transportation equipment		1989-2004
Wholesale trade	Trade and repairs	Wholesale trade		1989-2004
Banking	Financial intermediation; Back office services	Banking		1989-1998
		Depository institutions		1999-2004
Other Finance	Financial intermediation; Real estate and business activities; Back office services	Finance (except banking), insurance and real estate		1989-1998
		Finance (except depository institutions) and insurance		1999-2004
Services	Hotels and restaurants (until 1998); Real estate and business activities; Software; Biotechnology; Back office services	Services		1989-1998
ICT	Transport and telecommunications (from 1999); Real estate and business activities; Software; Back office services	Information		1999-2004
Professional services	Software; Biotechnology	Professional, scientific, and technical services		1999-2004
Other industries	Agriculture, Fishing and Forestry; Textiles and apparel; Wood and wood products; Construction; Hotels and restaurants (from 1999); Transport and telecommunications (until 1998)	Other industries	Yes	1989-2004
		Other manufacturing	Yes	1989-1998

Note: Aggregated means that we have combined the sectors into one.

Table 2: Countries included in the sector-level analysis

Survey respondents											Existence of IPA could not be confirmed		No IPA exists	
No		Targeted	Total	No		Targeted	Total	No		Targeted	Total	No	Total	No	Total
1	Albania	*20*	*129*	34	Guatemala	*58*	*165*	67	Pakistan	*0*	*60*	98 Andorra	*70*	119 Congo, Rep.	*188*
2	Algeria	*0*	*175*	35	Guinea	*97*	*161*	68	Palau	*0*	*177*	99 Brunei	*180*	120 Kuwait	*176*
3	Argentina	*0*	*180*	36	Guyana	*0*	*65*	69	Panama	*4*	*49*	100 Cameroon	*183*	121 Liechtenstein	*171*
4	Armenia	*25*	*70*	37	Hungary	*24*	*98*	70	Paraguay	*0*	*163*	101 Central African Rep	*70*	122 Norway	*175*
5	Aruba	*30*	*161*	38	Iceland	*40*	*170*	71	Peru	*26*	*147*	102 Chad	*189*	123 Somalia	*189*
6	Australia	*172*	*187*	39	Iran, Islamic Rep.	*0*	*187*	72	Poland	*0*	*37*	103 Cuba	*174*	124 St. Kitts and Nevis	*189*
7	Bangladesh	*0*	*60*	40	Ireland	*0*	*76*	73	Portugal	*121*	*166*	104 Djibouti	*179*		
8	Belize	*0*	*160*	41	Israel	*0*	*104*	74	Romania	*0*	*163*	105 Equatorial Guinea	*153*		
9	Bhutan	*0*	*29*	42	Italy	*0*	*79*	75	Samoa	*30*	*189*	106 Ethiopia	*188*		
10	Bosnia and Herzegovina	*55*	*128*	43	Jamaica	*14*	*78*	76	Saudi Arabia	*0*	*95*	107 Eritrea	*93*		
11	Botswana	*20*	*170*	44	Japan	*0*	*188*	77	Senegal	*65*	*165*	108 Gabon	*178*		
12	Brazil	*0*	*155*	45	Jordan	*129*	*162*	78	Serbia and Montenegro	*43*	*106*	109 Haiti	*173*		
13	Bulgaria	*59*	*104*	46	Kazakhstan	*64*	*123*	79	Singapore	*0*	*179*	110 Iraq	*14*		
14	Cambodia	*58*	*81*	47	Kenya	*0*	*141*	80	Slovak Republic	*0*	*107*	111 Kyrgyz Republic	*70*		
15	Canada	*84*	*178*	48	Korea, Rep.	*0*	*188*	81	Slovenia	*110*	*150*	112 Libya	*177*		
16	Chile	*98*	*151*	49	Lao PDR	*0*	*59*	82	Solomon Islands	*0*	*13*	113 Mali	*174*		
17	China	*0*	*177*	50	Latvia	*28*	*88*	83	South Africa	*115*	*140*	114 Sudan	*189*		
18	Colombia	*0*	*79*	51	Lebanon	*103*	*176*	84	St. Vincent and the G	*50*	*189*	115 Suriname	*162*		
19	Congo, Dem. Rep.	*50*	*180*	52	Lesotho	*0*	*85*	85	Sweden	*119*	*153*	116 Togo	*189*		
20	Costa Rica	*96*	*176*	53	Lithuania	*85*	*110*	86	Switzerland	*0*	*173*	117 Turkmenistan	*129*		
21	Cyprus	*40*	*173*	54	Macedonia, FYR	*0*	*60*	87	Taiwan, China	*0*	*79*	118 Uzbekistan	*123*		
22	Czech Republic	*53*	*108*	55	Madagascar	*180*	*180*	88	Thailand	*0*	*50*				
23	Côte d'Ivoire	*133*	*174*	56	Malta	*0*	*66*	89	Tunisia	*68*	*161*				
24	Denmark	*0*	*131*	57	Mauritania	*100*	*184*	90	Turkey	*0*	*166*				
25	Ecuador	*43*	*163*	58	Mauritius	*99*	*178*	91	Uganda	*150*	*180*				
26	Egypt, Arab Rep.	*0*	*137*	59	Mexico	*18*	*141*	92	United Kingdom	*0*	*189*				
27	El Salvador	*120*	*163*	60	Moldova	*0*	*35*	93	Uruguay	*0*	*169*				
28	Fiji	*41*	*156*	61	Mozambique	*35*	*114*	94	Vanuatu	*108*	*178*				
29	Finland	*46*	*164*	62	Netherlands	*25*	*107*	95	Venezuela, RB	*64*	*151*				
30	France	*40*	*92*	63	Netherlands Antilles	*35*	*163*	96	Zambia	*0*	*171*				
31	Georgia	*0*	*65*	64	New Zealand	*97*	*156*	97	Zimbabwe	*0*	*123*				
32	Ghana	*82*	*165*	65	Nicaragua	*74*	*163*								
33	Greece	*124*	*183*	66	Oman	*78*	*159*								
	Group total										*13051*		*3057*		*1088*
	Total														*17196*

Note: Figures in this table correspond to column 1, Table 9. Countries listed either responded to the IPA Census or are very likely not to have an IPA. Census respondents either gave the full timing (the start and the end year of targeting) for at least one targeted sector or reported not having practiced sector targeting. Sectors with incomplete timing information are excluded from the sample. The column "Targeted" lists the number of sector-years with observed targeting. "Total" is the total number of observations on the country included in the estimation. 124 countries are included in the sector-level analysis. Ten countries are included in the sector-level analysis but excluded from the country-level analysis due to missing data in IFS. Five of them responded to the Census: Bhutan, Dem. Rep. Congo, Palau, Serbia and Montenegro, and Taiwan, China. IPA existence could not be confirmed for four: Andorra, Brunei, Cuba, and Uzbekistan. Liechtenstein confirmed no having an IPA. There are 14 countries included in the country-level analysis but excluded from the sector-level analysis: nine Census respondents (Burkina Faso, Cape Verde, French Polynesia, The Gambia, Mongolia, Spain, Sri Lanka, Syrian Arab Republic and Ukraine), Austria for whom the data was found on the IPA website, two for whom IPA existence could not be confirmed (Benin, Guinea-Bissau), and two where the absence of an IPA was confirmed (Comoros and Tajikistan). The total number of countries available for the country-level analysis is 128. The actual sample of the analysis based on aggregate data varies across regressions due to availability of controls.

Table 3: Number of sectors targeted by countries engaged in targeting

No		*Sectors targeted*	No		*Sectors targeted*
1	Albania	*2*	29	Kazakhstan	*6*
2	Armenia	*5*	30	Latvia	*4*
3	Aruba	*2*	31	Lebanon	*8*
4	Australia	*13*	32	Lithuania	*9*
5	Bosnia and Herzegovina	*6*	33	Madagascar	*14*
6	Botswana	*3*	34	Mauritania	*8*
7	Bulgaria	*8*	35	Mauritius	*8*
8	Cambodia	*10*	36	Mexico	*2*
9	Canada	*7*	37	Mozambique	*4*
10	Chile	*8*	38	Netherlands	*3*
11	Congo, Dem. Rep.	*4*	39	Netherlands Antilles	*3*
12	Costa Rica	*8*	40	New Zealand	*10*
13	Côte d'Ivoire	*10*	41	Nicaragua	*6*
14	Cyprus	*4*	42	Oman	*7*
15	Czech Republic	*7*	43	Panama	*2*
16	Ecuador	*3*	44	Peru	*3*
17	El Salvador	*10*	45	Portugal	*11*
18	Fiji	*4*	46	Samoa	*2*
19	Finland	*5*	47	Senegal	*5*
20	France	*4*	48	Serbia and Montenegro	*5*
21	Ghana	*7*	49	Slovenia	*10*
22	Greece	*10*	50	South Africa	*11*
23	Guatemala	*5*	51	St. Vincent and the Grenadines	*4*
24	Guinea	*8*	52	Sweden	*11*
25	Hungary	*4*	53	Tunisia	*6*
26	Iceland	*4*	54	Uganda	*12*
27	Jamaica	*1*	55	Vanuatu	*8*
28	Jordan	*10*	56	Venezuela, RB	*6*

Note: Tables gives maximum number of sectors targeted by a country within one year. Sample corresponds to column 1, Table 9.

Table 4: Sectors included in the sector-level analysis

Sector	Number of observations
Petroleum	1,370
Utilities	526
Food	1,353
Chemicals	1,430
Metals	1,435
Machinery	1,389
Electrical equipment	1,449
Transportation equipment	1,429
Wholesale trade	1,612
Banking	1,186
Other Finance	1,356
Services	473
ICT	445
Professional services	491
Other industries	1,252
Total	17,196

Note: The number of observations corresponds to the regression of column 1, Table 9.

Table 5: Descriptive statistics corresponding to benchmark table, sector-level analysis

	All countries			Developing countries		
	No. of observations	Mean	Std. dev.	No. of observations	Mean	Std. dev.
FDI inflow (million current US dollars)	17196	49.20	791.00	13012	10.50	170.00
L.FDI stock (million current US dollars)	17193	471.00	3120.00	13012	102.00	545.00
Sector targeting dummy	17196	0.10	0.30	13012	0.10	0.30
1 year before sect. targ.	17196	0.02	0.14	13012	0.02	0.14
1 and 2 years before sect. targ.	17196	0.04	0.20	13012	0.04	0.20
1, 2 and 3 years before sect. targ.	17196	0.06	0.24	13012	0.06	0.24
1, 2, 3 and 4 years before sect. targ.	17196	0.07	0.27	13012	0.08	0.27

Note: The period is 1990-2004. L means lagged one period.

Table 6: Descriptive statistics corresponding to table using sales and employment and the dependent variable, sector-level analysis

	No. of. obs.	Mean	Std. dev.
Developing, sales			
Sales (million current US dollars)	3087	1040.00	2470.00
Sector targeting dummy	3087	0.05	0.22
Developing, employment			
Employment	3360	7092.46	18198.19
Sector targeting dummy	3360	0.06	0.23

Note: The period covered is 1983-2003.

Table 7: Descriptive statistics aggregate analysis

	All countries			Developing countries		
	No. of observations	Mean	Std. dev.	No. of observations	Mean	Std. dev.
FDI flow (millions current US dollars)	2644	2050.00	7090.00	1876	918.00	4290.00
IPA	2644	0.43	0.49	1876	0.42	0.49
GDP growth (based on GDP in constant 2000 US dollars)	2644	0.03	0.05	1876	0.03	0.05
Inflation	2644	0.40	3.50	1876	0.53	4.14
GDP per capita (current US dollars)	2644	5680.00	8230.00	1876	1794.93	1958.76
Population (millions)	2644	26.80	102.00	1876	29.90	119.00
Restrictions on civil liberties	2644	3.31	1.79	1876	3.90	1.56
Restrictions on political rights	2644	3.15	2.07	1876	3.77	1.95
Political risk (ICRG)	1658	65.32	15.76	1143	58.77	12.87
L2.Exports+Imports (millions constant 2000 US dollars)	2231	60500.00	125000.00	1627	21300.00	51500.00
L2.(Exports+Imports)/GDP (GDP in constant 2000 US dollars)	2231	0.66	0.42	1627	0.71	0.46
Gross fixed capital formation (millions constant 2000 US dollars)	2146	38800.00	127000.00	1562	13400.00	42500.00
EPA (existence of an export agency)	1618	0.52	0.50	1125	0.48	0.50
Aid (million current US dollars)	2030	298.00	457.00	1844	308.00	457.00
Aid per capita (current US dollars)	2030	49.86	68.27	1844	48.84	64.91
Time varying dummy agency status: subunit of ministry	2274	0.16	0.37	1561	0.12	0.32
Time varying dummy agency status: quasi autonomous public body	2274	0.28	0.45	1561	0.32	0.47
Time varying dummy agency status: other	2274	0.05	0.22	1561	0.07	0.26
Status change: from subunit of ministry	2644	0.01	0.08	1876	0.01	0.09
Accountable to external entity	2374	0.32	0.47	1702	0.31	0.46
Accountable to economic entity	2374	0.29	0.45	1702	0.28	0.45
Accountable to political entity	2374	0.03	0.18	1702	0.03	0.18
Accountable to agency board	2374	0.04	0.20	1702	0.06	0.23
Voice and Accountability	2621	0.21	0.92	1853	-0.13	0.77
Political Stability	2621	0.04	0.90	1853	-0.28	0.80
Government Effectiveness	2621	0.26	1.03	1853	-0.28	0.60
Regulatory Quality	2621	0.26	0.85	1853	-0.14	0.63
Rule of Law	2621	0.19	1.02	1853	-0.35	0.62
Control of Corruption	2621	0.25	1.09	1853	-0.34	0.57
Average of all KKZ	2621	0.20	0.91	1853	-0.25	0.59
Financial incentives	2351	0.05	0.22	1705	0.04	0.20
Tax holidays	2327	0.15	0.35	1581	0.18	0.39
Reduced tax rates	2099	0.12	0.32	1411	0.13	0.33
Tax hol. or red. tax rates	2383	0.17	0.38	1637	0.21	0.40
Subsidized infras. or serv.	2353	0.02	0.15	1615	0.03	0.18
Regulatory concessions	2488	0.01	0.08	1720	0.01	0.10
Fin. or tax inc.	2550	0.18	0.39	1782	0.21	0.41
Fin. or tax inc. or subs.	2563	0.18	0.38	1795	0.21	0.41
IPAs, region level	2644	7.56	4.92	1876	6.89	4.71
Tax hol. or red. tax rates, region level	2383	3.08	2.83	1637	3.46	3.17
Fin. or tax inc., region level	2550	3.28	3.10	1782	3.67	3.46
Fin. or tax inc. or subs., region level	2563	3.30	3.13	1795	3.70	3.50
IPAs, income gr. level	2644	10.72	6.55	1876	10.91	6.87
Tax hol. or red. tax rates, income gr. level	2383	4.57	4.52	1637	5.64	5.00
Fin. or tax inc., income gr. level	2550	4.94	4.63	1782	5.98	5.03
Fin. or tax inc. or subs., income gr. level	2563	4.96	4.64	1795	6.01	5.04
GDP growth, region (based on GDP in constant 2000 US dollars)	2644	0.03	0.02	1876	0.03	0.03
GDP growth, income gr. (based on GDP in constant 2000 US dollars)	2644	0.04	0.02	1876	0.04	0.02

Note: The sample corresponds to columns 1 and 5, Table 16. Quasi autonomous public body means Autonomous public body or Semi-autonomous agency reporting to a ministry. Rest means Joint public-private entity or Private or Other. The period covered is 1972-2004. LX means lagged X periods.

Table 8: Correlation between IPA existence and incentives

	IPA	Financial	Tax holidays	Tax reductions	Tax hol. or red.	Subsidies	Regulations	Other	Fin, tax or sub.	Fin or tax.
IPA	1.00									
Financial	0.28	1.00								
Tax holidays	**0.44**	0.34	1.00							
Tax reductions	**0.48**	0.30	0.61	1.00						
Tax hol. or red.	**0.50**	0.34	0.92	0.76	1.00					
Subsidies	0.14	0.07	0.38	0.18	0.36	1.00				
Regulations	0.18	0.27	0.19	0.19	0.17	0.01	1.00			
Other	0.15	0.07	0.39	0.28	0.38	0.43	0.17	1.00		
Fin, tax or sub.	0.53	0.45	0.89	0.74	0.97	0.35	0.24	0.363	1.00	
Fin or tax.	0.53	0.45	0.89	0.74	0.97	0.35	0.24	0.363	1.00	1.00

Note: “Subsidies” refers to subsidized infrastructure or services, “Regulations” to regulatory concessions, “Fin, tax or sub.” to offering financial incentives, tax holidays, tax reductions or subsidies to infrastructure/services, “Fin or tax” to offering financial incentives, tax reductions or tax holidays.

Tables: Sector-level analysis

Table 9: Baseline specification with country-year, sector-year and country-sector fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
Sector targeting	0.308				0.935***			
	[0.341]				[0.330]			
L. Sector targeting		0.770**				1.159***		
		[0.362]				[0.346]		
L2. Sector targeting			1.033**				1.377***	
			[0.406]				[0.387]	
L3. Sector targeting				0.968**				1.360***
				[0.457]				[0.430]
Observations	17196	17193	16610	16009	13012	13012	12522	12017
No. of country-sector groups	1570	1570	1570	1568	1203	1203	1203	1201
Within R-squared	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.19

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i in country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. LX means lagged X periods.

Table 10: Controlling for FDI inflows before targeting. Specification with country-year, sector-year and country-sector fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
Sector targeting	0.227	0.307	0.143	0.230	**0.920*** **	**1.052*** **	**0.770** **	**0.864** **
	[0.354]	[0.367]	[0.381]	[0.395]	[0.343]	[0.355]	[0.369]	[0.384]
1 year before sect. targ.	-0.404				-0.073			
	[0.460]				[0.437]			
1 and 2 years before sect. targ.		-0.004				0.311		
		[0.365]				[0.347]		
1, 2 and 3 years before sect. targ.			-0.330				-0.322	
			[0.337]				[0.322]	
1, 2, 3 and 4 years before sect. targ.				-0.130				-0.113
				[0.329]				[0.314]
Observations	17196	17196	17196	17196	13012	13012	13012	13012
No. of country-sector groups	1570	1570	1570	1570	1203	1203	1203	1203
Within R-squared	0.17	0.17	0.17	0.17	0.19	0.19	0.19	0.19
Test coeff F	1.58	0.57	1.54	0.97	4.30	3.52	8.91	7.76
Test coeff p	0.21	0.45	0.21	0.32	**0.04**	**0.06**	**0.00**	**0.01**

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i in country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. "X year before sect. targ." is a dummy variable equal to one in the X years before targeting started in a particular sector, and zero otherwise. "F" and "p-value" is the F-statistics and the p-value of a test if the coefficient of the dummy before targeting started is different from the coefficient of the targeting dummy.

Table 11: Explaining the choice of sectors to be targeted. Probit specification

	All	All	All	Developing	Developing	Developing
L.FDI flow	-0.006			-0.007		
	[0.005]			[0.006]		
L2.FDI flow		0.000			-0.001	
		[0.005]			[0.007]	
L3.FDI flow			-0.008			-0.014**
			[0.005]			[0.007]
Observations	4274	4079	3842	3272	3111	2904
L.FDI stock	0.001			0.001		
	[0.005]			[0.006]		
L2.FDI stock		0.005			0.006	
		[0.005]			[0.006]	
L3.FDI stock			0.005			0.007
			[0.006]			[0.006]
Observations	4914	4295	4097	3790	3293	3129

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is equal to one if country c begins targeting industry i at time t, and zero if the industry is not targeted at time t. LX means lagged X periods. Other controls include GDP per capita, population size, GDP growth, inflation, restrictions on civil liberties, country and year fixed effects. Population, GDP per capita, FDI flow and FDI stock enter in the log form.

Table 12: Removing cases of targeting determined by previous success or failure in attracting FDI to the sector. Specification with country-year, sector-year and country-sector fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
Sector targeting	**0.866***				**1.511*****			
	[0.488]				[0.472]			
L. Sector targeting		**1.373*****				**1.821*****		
		[0.514]				[0.489]		
L2. Sector targeting			**1.166****				**1.654*****	
			[0.564]				[0.534]	
L3. Sector targeting				0.839				0.824
				[0.640]				[0.595]
Observations	15285	15282	14750	14204	11699	11699	11246	10782
No. of country-sector groups	1389	1389	1389	1387	1075	1075	1075	1073
Within R-squared	0.19	0.20	0.20	0.20	0.21	0.21	0.21	0.21

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i in country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. LX means lagged X periods.

Table 13: Removing services sectors and utilities. Specification with country-year, sector-year and country-sector fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
Sector targeting	0.590				1.406***			
	[0.438]				[0.420]			
L. Sector targeting		0.801*				1.457***		
		[0.467]				[0.446]		
L2. Sector targeting			0.838				1.359***	
			[0.515]				[0.487]	
L3. Sector targeting				0.615				1.329**
				[0.573]				[0.535]
Observations	11107	11104	10894	10678	8400	8400	8217	8028
No. of country-sector groups	868	868	868	868	665	665	665	665
Within R-squared	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. LX means lagged X periods.

Table 14: Controlling for lagged FDI stock in the sector. Specification with country-year, sector-year and country-sector fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
Sector targeting	0.313				**0.936*****			
	[0.341]				[0.330]			
L. Sector targeting		**0.770****				**1.160*****		
		[0.362]				[0.346]		
L2. Sector targeting			**1.032****				**1.377*****	
			[0.406]				[0.387]	
L3. Sector targeting				**0.965****				**1.360*****
				[0.457]				[0.430]
L. FDI stock	0.000	0.000	-0.003	-0.011	0.006	0.006	0.002	-0.004
	[0.014]	[0.014]	[0.014]	[0.015]	[0.014]	[0.014]	[0.014]	[0.015]
Observations	17193	17193	16610	16009	13012	13012	12522	12017
No. of country-sector groups	1570	1570	1570	1568	1203	1203	1203	1201
Within R-squared	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.19

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i in country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. LX means lagged X periods. FDI stock is included in the log form.

Table 15: Using US affiliate sales and employment as dependent variables. Specification with country-year, sector-year and country-sector fixed effects

	US affiliate sales				US affiliate employment			
	Developing	Developing	Developing	Developing	Developing	Developing	Developing	Developing
Sector targeting	**1.033*** **				**0.520*** **			
	[0.363]				[0.143]			
L. Sector targeting		**1.096*** **				**0.483*** **		
		[0.402]				[0.158]		
L2. Sector targeting			**1.054** **				**0.505*** **	
			[0.452]				[0.186]	
L3. Sector targeting				**1.164** **				**0.507** **
				[0.534]				[0.223]
Observations	3087	3034	2976	2917	3360	3295	3227	3159
No. of country-sector groups	227	226	225	225	233	233	233	233
Within R-squared	0.37	0.37	0.37	0.37	0.40	0.39	0.39	0.39

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of US foreign direct investment into industry i in country c at time t. Sector targeting is equal to one if industry i was targeted by country c at time t, and zero otherwise. LX means lagged X periods.

Tables: Country-level analysis

Table 16: Specification with country and time fixed effects

	All	All	All	All	Developing	Developing	Developing	Developing
IPA	0.640				**1.337*** **			
	[0.393]				[0.481]			
L. IPA		**1.036*** **				**1.646*** **		
		[0.398]				[0.485]		
L2. IPA			**0.822** **				**1.353*** **	
			[0.403]				[0.489]	
Age				0.489				**1.333*** **
				[0.405]				[0.507]
Age squared				0.006				-0.253
				[0.152]				[0.195]
GDP per capita	-1.651***	-1.633***	-1.644***	-1.696***	-2.243***	-2.250***	-2.234***	-2.231***
	[0.431]	[0.431]	[0.431]	[0.438]	[0.512]	[0.512]	[0.512]	[0.516]
GDP growth	8.646***	8.557***	8.683***	8.611***	9.752***	9.740***	9.967***	9.781***
	[2.432]	[2.430]	[2.430]	[2.431]	[2.744]	[2.741]	[2.743]	[2.744]
Population	-3.267**	-3.196**	-3.221**	-3.261**	-8.684***	-8.596***	-8.555***	-8.679***
	[1.417]	[1.416]	[1.417]	[1.418]	[2.225]	[2.222]	[2.225]	[2.226]
Inflation	-0.089***	-0.090***	-0.090***	-0.091***	-0.081**	-0.082**	-0.083**	-0.082**
	[0.033]	[0.033]	[0.033]	[0.033]	[0.034]	[0.034]	[0.034]	[0.034]
Restrictions on civil liberties	-0.222	-0.233*	-0.233*	-0.252*	-0.183	-0.201	-0.200	-0.209
	[0.140]	[0.140]	[0.140]	[0.141]	[0.157]	[0.157]	[0.157]	[0.159]
Observations	2644	2644	2644	2644	1876	1876	1876	1876
No. of countries	114	114	114	114	89	89	89	89
Within R-squared	0.14	0.14	0.14	0.14	0.18	0.18	0.18	0.18

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Age, Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. All regressions include host country and year fixed effects. LX means lagged X periods.

Table 17: Specification with country and time fixed effects and additional control variables

	All	All	All	All	Developing	Developing	Developing	Developing
IPA	0.437	0.458	0.544	0.494	**1.386** **	**1.394** **	**1.307** **	**1.280** **
	[0.489]	[0.489]	[0.505]	[0.505]	[0.589]	[0.589]	[0.603]	[0.605]
Restrictions on political rights		-0.296				-0.132		
		[0.215]				[0.230]		
L2. Exports+Imports			**-1.464** **				**-1.279***	
			[0.676]				[0.713]	
L2. (Exports+Imports)/GDP				**-1.737*** **				-1.001
				[0.641]				[0.684]
GDP per capita	-2.711***	-2.647***	-1.979***	-2.149***	-3.554***	-3.522***	-3.031***	-3.354***
	[0.594]	[0.596]	[0.727]	[0.672]	[0.663]	[0.665]	[0.799]	[0.743]
GDP growth	12.574***	12.527***	11.241***	12.942***	13.359***	13.325***	12.154***	13.734***
	[3.682]	[3.681]	[4.002]	[3.916]	[3.997]	[3.999]	[4.247]	[4.143]
Population	-10.336***	-9.931***	-7.413***	-6.971**	-13.280***	-13.008***	-13.477***	-12.990***
	[2.503]	[2.519]	[2.698]	[2.709]	[3.383]	[3.417]	[3.574]	[3.685]
Inflation	-0.089**	-0.090***	-0.088***	-0.086**	-0.075**	-0.076**	-0.078**	-0.076**
	[0.035]	[0.035]	[0.034]	[0.034]	[0.035]	[0.035]	[0.035]	[0.035]
Restrictions on civil liberties	-0.320*	-0.084	-0.373*	-0.311	-0.219	-0.106	-0.317	-0.296
	[0.190]	[0.256]	[0.193]	[0.195]	[0.200]	[0.280]	[0.203]	[0.205]
Political risk (ICRG)	0.069***	0.064***	0.070***	0.065***	0.090***	0.087***	0.090***	0.088***
	[0.022]	[0.022]	[0.023]	[0.023]	[0.026]	[0.026]	[0.026]	[0.026]
Observations	1658	1658	1512	1512	1143	1143	1092	1092
No. of countries	94	94	89	89	69	69	67	67
Within R-squared	0.18	0.18	0.19	0.20	0.24	0.24	0.24	0.24

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Exports+Imports, Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. The index of political risk ranges from 0 to 100, where 0 means very high political risk and 100 very low political risk. All regressions include host country and year fixed effects. LX means lagged X periods.

Table 18: The effect of IPA on domestic capital formation

	Developing	Developing	Developing	Developing	Developing	Developing	Developing	Developing
IPA	-0.040				-0.041	-0.038	-0.035	-0.036
	[0.027]				[0.027]	[0.027]	[0.027]	[0.026]
L. IPA		-0.029						
		[0.028]						
L2. IPA			-0.046					
			[0.028]					
L3. IPA				-0.047				
				[0.029]				
FDI inflows					0.003**			
					[0.001]			
L. FDI inflows						0.004***		
						[0.001]		
L2. FDI inflows							0.003**	
							[0.001]	
L3. FDI inflows								0.003**
								[0.001]
L2. GDP per capita	0.425***	0.425***	0.425***	0.424***	0.372***	0.362***	0.349***	0.340***
	[0.026]	[0.026]	[0.026]	[0.026]	[0.029]	[0.029]	[0.029]	[0.029]
L2. GDP growth	1.491***	1.494***	1.504***	1.500***	1.509***	1.496***	1.478***	1.588***
	[0.142]	[0.142]	[0.142]	[0.142]	[0.152]	[0.150]	[0.150]	[0.158]
L2. Population	0.280**	0.280**	0.276**	0.273**	0.028	0.034	-0.003	-0.041
	[0.120]	[0.120]	[0.120]	[0.120]	[0.130]	[0.132]	[0.134]	[0.135]
L2. Inflation	-0.002**	-0.002**	-0.002**	-0.002**	0.000	0.001	0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
L2. Restrictions on civil liberties	0.019**	0.020**	0.020**	0.020**	0.012	0.008	0.006	0.004
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.008]
Observations	1753	1753	1753	1753	1523	1524	1507	1477
No. of countries	80	80	80	80	77	77	77	77
Within R-squared	0.51	0.51	0.51	0.51	0.53	0.52	0.53	0.53

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of gross fixed capital formation in country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. FDI inflows, Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. All regressions include host country and year fixed effects. LX means lagged X periods.

Table 19: Instrumental variable estimation

First stage	Developing	Developing	Developing
EPA	**0.362*** **	**0.360*** **	**0.362*** **
	[0.036]	[0.037]	[0.037]
Aid		**0.007***	
		[0.004]	
Aid per capita			**0.029** **
			[0.014]
Within R-squared	0.48	0.47	0.47
Shea partial R2	0.13	0.13	0.13
F	99.99	48.35	48.98
Second stage			
IPA	**7.706*** **	**7.011*** **	**7.141*** **
	[1.773]	[1.681]	[1.676]
Sargan statistics		0.00	0.12
Sargan P-value		0.99	0.73
Observations	761	743	743
No. of countries	44	44	44

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The first stage is a linear probability model predicting existence of an IPA. The dependent variable in the second stage is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Control variables both in first and second stage are the usual: log of GDP per capita, GDP growth, log of Population, Inflation, Restrictions on civil liberties and Political risk (ICRG). All regressions include host country and year fixed effects. The instruments used to predict IPA existence are the existence of an export agency (EPA) in country c at time t, as well as aid and aid per capita inflows to country c at time t.

Table 20: Agency reporting and status

	Developing	Developing	Developing	Developing	Developing	Developing	Developing
IPA	1.584		-2.067	-0.345	**1.413****	**1.716*****	
	[1.083]		[1.553]	[1.045]	[0.571]	[0.571]	
Status change: from subunit of ministry	**3.217***	**3.971***					
	[1.849]	[2.096]					
Accountable to external entity			**3.783****				
			[1.602]				
Accountable to economic entity				**2.130***			**1.815*****
				[1.110]			[0.594]
Accountable to political entity					-0.499		0.966
					[1.394]		[1.362]
Accountable to agency board						-3.783**	-2.069
						[1.602]	[1.553]
GDP per capita	-4.374***	-5.795***	-2.216***	-2.320***	-2.292***	-2.216***	-2.246***
	[1.307]	[1.958]	[0.548]	[0.549]	[0.551]	[0.548]	[0.551]
GDP growth	10.720	9.396	9.710***	9.709***	9.621***	9.710***	9.729***
	[6.667]	[9.211]	[2.905]	[2.907]	[2.910]	[2.905]	[2.906]
Population	-17.375***	-20.098	-6.617***	-6.557***	-6.809***	-6.617***	-6.547***
	[4.940]	[14.268]	[2.403]	[2.407]	[2.407]	[2.403]	[2.406]
Inflation	0.307	-0.076	-0.086**	-0.086**	-0.083**	-0.086**	-0.087**
	[0.537]	[0.547]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]
Restrictions on civil liberties	-0.311	1.004	-0.227	-0.244	-0.233	-0.227	-0.233
	[0.413]	[0.697]	[0.174]	[0.174]	[0.174]	[0.174]	[0.174]
Observations	327	193	1702	1702	1702	1702	1702
Number of group(code)	15	15	88	88	88	88	88
R-squared	0.25	0.29	0.18	0.17	0.17	0.18	0.18

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. All regressions include host country and year fixed effects. The estimates in the first two columns are based on a sample including counties where the IPA either changed its status from being a subunit of a ministry to a more autonomous setup or remained a subunit of a ministry throughout the entire period. The model in the first column is estimated on all years available for these countries, while the sample in the second column includes only years during an IPA was in operation. Accountable to external entity takes the value of one if either "Accountable to economic entity" takes the value of one or the "Accountable to political entity" takes the value of one.

Table 21: IPA existence and incentives

	Developing	Developing	Developing	Developing	Developing	Developing	Developing	Developing
IPA	**1.122****	0.320	0.763	0.373	**1.298****	**1.030****	**1.082****	**1.046****
	[0.495]	[0.536]	[0.621]	[0.534]	[0.528]	[0.509]	[0.510]	[0.506]
Financial incentives	-0.686							
	[0.985]							
Tax holidays		0.777						
		[0.615]						
Reduced tax rates			-0.403					
			[0.815]					
Tax hol. or red. tax rates				0.474				
				[0.597]				
Subsidized infras. or serv.					**2.460***			
					[1.392]			
Regulatory concessions						-0.202		
						[2.705]		
Fin. or tax inc.							0.232	
							[0.562]	
Fin. or tax inc. or subs.								0.260
								[0.558]
GDP per capita	-1.940***	-1.625***	-1.906***	-1.543***	-2.178***	-2.325***	-1.767***	-1.767***
	[0.543]	[0.592]	[0.632]	[0.581]	[0.574]	[0.542]	[0.547]	[0.545]
GDP growth	10.420***	10.580***	11.517***	10.519***	8.948***	8.878***	10.110***	9.296***
	[2.864]	[3.027]	[3.254]	[2.976]	[3.003]	[2.850]	[2.886]	[2.817]
Population	-7.348***	-2.100	-1.452	-2.410	-4.280*	-7.256***	-6.103***	-5.845**
	[2.333]	[2.479]	[2.678]	[2.445]	[2.441]	[2.335]	[2.307]	[2.289]
Inflation	-0.076**	-0.077**	-0.089**	-0.081**	-0.082**	-0.080**	-0.079**	-0.080**
	[0.033]	[0.034]	[0.035]	[0.034]	[0.035]	[0.034]	[0.034]	[0.034]
Restrictions on civil liberties	0.018	-0.132	-0.093	-0.116	-0.221	-0.081	-0.271*	-0.268*
	[0.166]	[0.169]	[0.179]	[0.166]	[0.171]	[0.166]	[0.162]	[0.161]
Observations	1705	1581	1411	1637	1615	1720	1782	1795
No. of countries	81	75	70	79	78	83	85	86
Within R-squared	0.16	0.17	0.17	0.16	0.16	0.17	0.16	0.16

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. All regressions include host country and year fixed effects.

Table 22: Incentives when IPA existence is excluded

	Developing	Developing	Developing	Developing	Developing	Developing	Developing	Developing
Financial incentives	-0.718							
	[0.992]							
Tax holidays		**1.431****						
		[0.594]						
Reduced tax rates			-0.403					
			[0.752]					
Tax hol. or red. tax rates				**1.071***				
				[0.571]				
Subsidized infras. or serv.					**2.887****			
					[1.395]			
Regulatory concessions						0.102		
						[2.721]		
Fin. or tax inc.							**0.997***	
							[0.539]	
Fin. or tax inc. or subs.								**1.008***
								[0.535]
GDP per capita	-2.191***	-1.883***	-2.167***	-1.794***	-2.414***	-2.522***	-1.951***	-1.952***
	[0.541]	[0.588]	[0.627]	[0.578]	[0.571]	[0.540]	[0.545]	[0.543]
GDP growth	10.267***	10.183***	11.074***	10.033***	8.744***	8.718***	9.713***	9.021***
	[2.855]	[3.005]	[3.230]	[2.958]	[2.990]	[2.837]	[2.874]	[2.805]
Population	-6.385***	-1.266	-0.559	-1.714	-3.327	-6.282***	-5.130**	-4.898**
	[2.341]	[2.475]	[2.673]	[2.446]	[2.447]	[2.339]	[2.310]	[2.292]
Inflation	-0.077**	-0.076**	-0.089**	-0.080**	-0.083**	-0.080**	-0.077**	-0.078**
	[0.034]	[0.034]	[0.035]	[0.034]	[0.035]	[0.034]	[0.034]	[0.034]
Restrictions on civil liberties	0.078	-0.089	-0.026	-0.065	-0.149	-0.027	-0.214	-0.212
	[0.167]	[0.169]	[0.179]	[0.166]	[0.171]	[0.167]	[0.163]	[0.162]
Observations	1731	1607	1437	1663	1641	1746	1808	1821
No. of countries	82	76	71	80	79	84	86	87
Within R-squared	0.17	0.18	0.18	0.17	0.17	0.18	0.17	0.17

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. IPA equals one if an investment promotion agency exists in country c at time t. Population and GDP per capita enter in the log form. The index of restrictions on civil liberties ranges from 1 denoting most free countries to 7 denoting least free countries. All regressions include host country and year fixed effects.

Table 23: Competition within the geographic region

		Developing	Developing	Developing
Host country variables	IPA	0.437	**1.093****	**1.056****
		[0.538]	[0.512]	[0.508]
	Tax hol. or red. tax rates	0.527		
		[0.598]		
	Fin. or tax inc.		0.215	
			[0.563]	
	Fin. or tax inc. or subs.			0.246
				[0.558]
Regional variables	IPAs, region	0.648	0.785	0.751
		[0.874]	[0.810]	[0.806]
	Tax hol. or red. tax rates, region	**-0.230****		
		[0.104]		
	Fin. or tax inc., region		**-0.291*****	
			[0.097]	
	Fin. or tax inc. or subs., region			**-0.291*****
				[0.097]
	GDP growth, region	-6.830	-10.468	**-11.160***
		[7.022]	[6.703]	[6.642]
	Observations	1637	1782	1795
	No. of countries	79	85	86
	Within R-squared	0.16	0.17	0.17

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. Host country variables: IPA equals one if an investment promotion agency exists in country c at time t, and zero otherwise. The incentive variables are equal to one if country c provided at least one of the relevant incentives at time t, and zero otherwise. Host country control variables (not shown in the table) include: log of GDP per capita, GDP growth, log of Population, Inflation, Restrictions on civil liberties. All regressions include host country and year fixed effects. Regional variables: "regions" are defined following the World Bank classification: Latin American and the Caribbean (LAC), East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Sub-Saharan Africa (SSA), South Asia (SA) and Middle East and North Africa (MENA). GDP growth is the GDP weighted average of the GDP growth of the other countries in the region (included in the sample). The weights are year specific. Other regional variables include the log of the number of other countries in country c's region that have an IPA or offer one of the incentives in year t.

Table 24: Competition within the income group

		Developing	Developing	Developing
Host country variables	IPA	0.364	**1.079****	**1.043****
		[0.536]	[0.512]	[0.508]
	Tax hol. or red. tax rates	0.489		
		[0.598]		
	Fin. or tax inc.		0.194	
			[0.563]	
	Fin. or tax inc. or subs.			0.223
				[0.559]
Income group variables	IPAs, inc. gr	0.311	-0.045	-0.051
		[1.018]	[0.976]	[0.972]
	Tax hol. or red. tax rates, income gr.	0.126		
		[0.138]		
	Fin. or tax inc., income group		0.080	
			[0.143]	
	Fin. or tax inc. or sub., income gr.			0.081
				[0.142]
	GDP growth, income gr.	-15.941	-12.534	-12.539
		[10.869]	[10.453]	[10.376]
	Observations	1637	1782	1795
	No. of countries	79	85	86
	Within R-squared	0.16	0.16	0.16

Note: Standard errors are reported in brackets. ***, **, * denotes significance at the 1, 5 and 10% level, respectively. The dependent variable is the log of inflow of foreign direct investment into country c at time t. Host country variables: IPA equals one if an investment promotion agency exists in country c at time t, and zero otherwise. The incentive variables are equal to one if country c provided at least one of the relevant incentives at time t, and zero otherwise. Host country control variables (not shown in the table) include: log of GDP per capita, GDP growth, log of Population, Inflation, Restrictions on civil liberties. All regressions include host country and year fixed effects. Regional variables: "income groups" are defined following the World Bank classification: low income, lower middle income, upper middle income. GDP growth is the GDP weighted average of the GDP growth of the other countries in the region (included in the sample). The weights are year specific. Other regional variables include the log of the number of other countries in country c's region that have an IPA or offer one of the incentives in year t.

Figures

Figure 1: Number of IPAs in existence

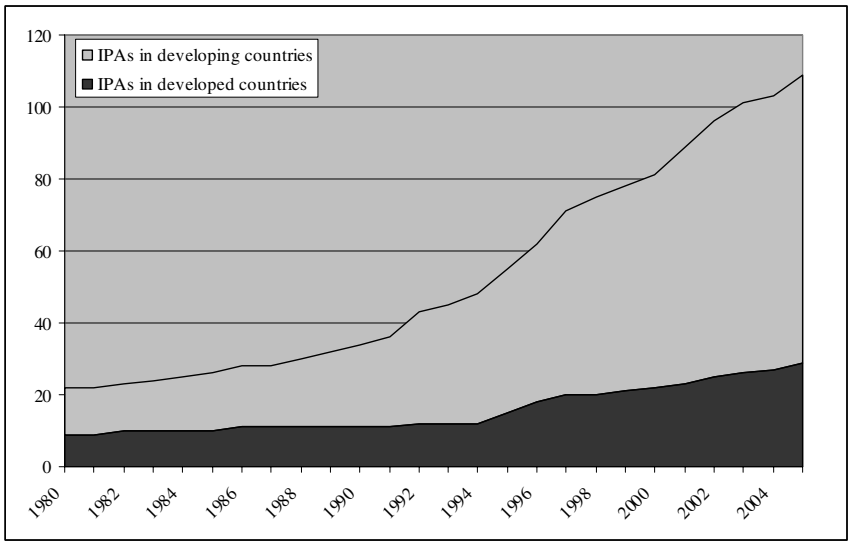


Figure 2: Frequency of targeting by sector

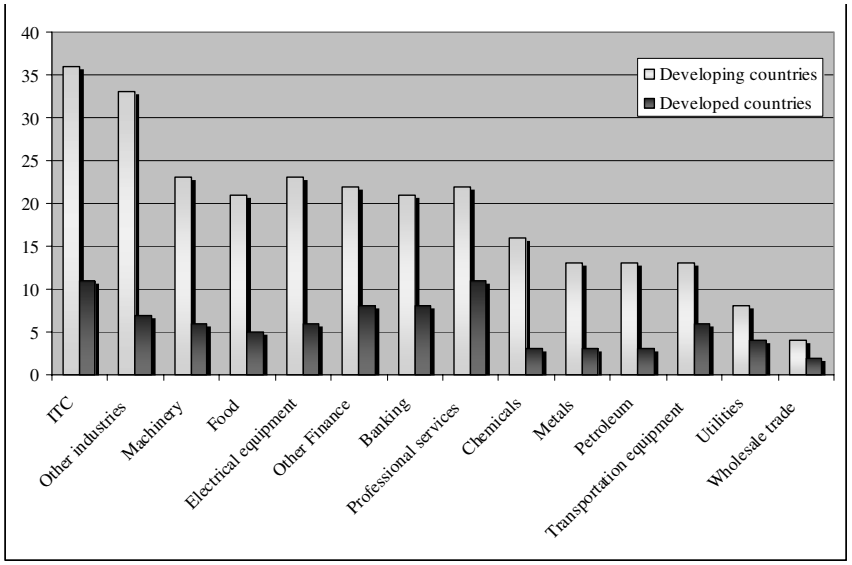
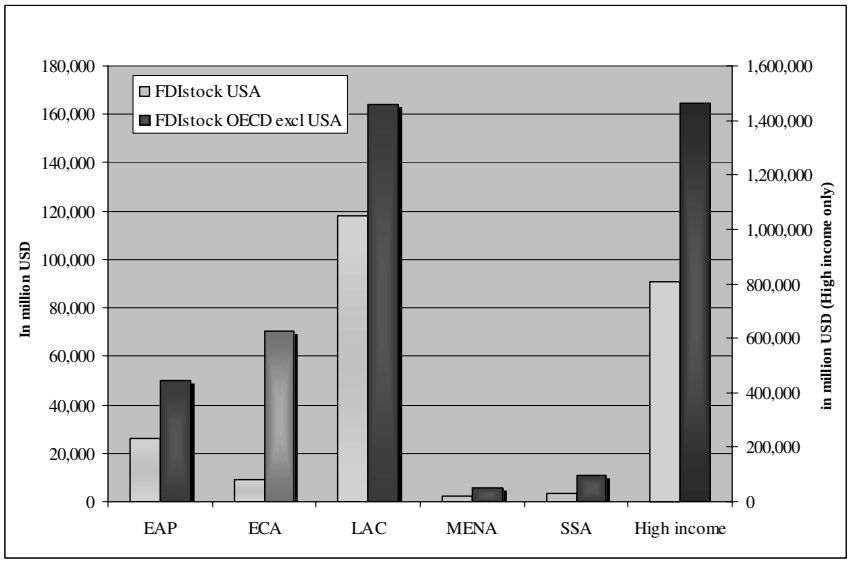
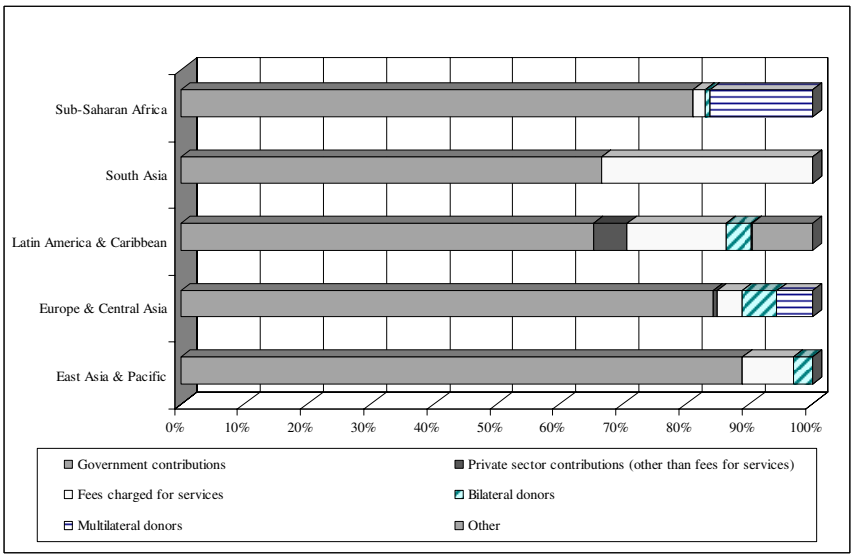


Figure 3: US FDI stock versus FDI stock from other OECD countries in year 2000



Note: Figure based on bilateral OECD data, FDI stocks in million USD, year 2000. Regional breakdown corresponds to the World Bank classification of developing countries: Latin American and the Caribbean (LAC), East Asia and the Pacific (EAP), Europe and Central Asia (ECA), Sub-Saharan Africa (SSA), South Asia (SA) and Middle East and North Africa (MENA). High income countries do not include the US.

Figure 4: Donor participation in IPA funding



Chapter 5

Export upgrading through infrastructure policy reforms: evidence from 10 new EU members

Export Upgrading through Infrastructure Policy Reforms: Evidence from 10 New EU members

Torfinn Harding*

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Abstract

Is there a link between infrastructure and export upgrading? By utilizing infrastructure reforms taken place in ten Eastern European countries since the abolishment of central planning we find evidence consistent with higher unit values of export products due to better infrastructure. The link between general export diversification and infrastructure needs more justification.

* Statistics Norway and Norwegian University of Science and Technology, Postboks 8131 Dep, 0033 Oslo, Norway. Email: torfinn.harding@ssb.no. I would like to thank Beata Smarzynska Javorcik for being instrumental for the idea of writing this paper. I am also indebted to my PhD-advisor Jørn Rattsø for his constructive comments. Thanks also to Jon Fiva and Marte Rønning for helpful comments and suggestions. A chapter based on the unit value part of this paper will appear in the forthcoming book "Emerging Lessons for Export Diversification", edited by Richard Newfarmer, William Shaw and Peter Walkenhorst, and published by the World Bank. I thank the editors for comments improving the paper along the way. The project is financed by the Norwegian Research Council.

1. Introduction

If you are a manufacturing firm in the Czech Republic aiming for exporting car parts to Germany, you are likely to have to promise delivery on time, you may need electronic ordering systems, and the parts you make need to meet a certain level of quality. Regardless of how good you and your staff are as car part makers, you are dependent on access to reliable and efficient infrastructure services to be able to get the job. This paper suggests that reforms of infrastructure services in 10 Eastern European countries during the 1990s were important for exports from these countries.

It is widely believed that infrastructure is an integrated part of economic development (Duflo and Pande, 2007), and there seems to be some development optimism surrounding policies aimed at upgrading infrastructure services such as electric power supply, transportation and telecommunications. The World Development Report 1994 of the World Bank emphasized the importance of the quality of such services for development.[1] Intuitively, it is not hard to make the case that better infrastructure can increase economic efficiency, and many studies do indeed find a positive association between infrastructure investments and growth. In this chapter, we argue that better infrastructure policies, leading to improved infrastructure (quality and quantity), can increase unit values of export products as well as make a country's export basket more diversified. We have two mechanisms in mind. Better infrastructure may increase manufacturing productivity. Higher manufacturing productivity may increase product quality and unit values. Better infrastructure may also reduce trade costs. Shorter delivery time to buyers, for instance, can be as valued as increased product quality and can result in higher unit values.

In several strands of the economics literature, one can see a growing interest in the relation between characteristics of countries' export baskets and countries' economic performance. Export diversification in the most straightforward sense—an export bundle not too concentrated on a few products—is argued to be beneficial as it provides a hedge toward price variations in specific product markets (Bertinelli et al., 2006; Levchenko and di Giovanni, 2006). The risk in foreign exchange earnings is reduced if foreign exchange is earned across different products. Furthermore, there may be a link between *which* products are exported and the potential for structural change, which is often necessary for developing countries to climb the development ladder (Hausmann et al., 2007; Hausmann and Klinger 2006; Whang, 2006). Change in the export basket in the direction of more sophisticated products may also be instrumental for economic growth (Hausmann et al., 2007). A final recent observation to mention is that unit values of exports seem to vary greatly across countries. Both Schott (2004) and Hummels and Klenow (2005) present evidence suggesting a positive association

[1] See, for instance, World Development Report 1994 and Bogetić and Fedderke (2006) for more on the role of infrastructure in development.

between countries' level of development and the unit values of their export products. The fact that export diversification and export product quality and sophistication seem to go together with the level of development and growth poses an interesting question: how can developing countries diversify and upgrade their export baskets to rich country levels? The results of this paper indicate that infrastructure reforms have potential to be part of the answer.

Despite high levels of attention toward export characteristics both in the economics literature and in policy debates, and despite the plausible positive role that infrastructure could play in upgrading exports, we are not aware of any other studies investigating the effects of infrastructure on export unit values.

To analyze the effects of infrastructure improvements on export diversification and unit values, we exploit data on infrastructure services reforms in 10 Eastern European countries. In the period studied, 1989–2000, these economies went from being governed by central planning to become open market economies. Service industries were not regarded as important during the era of central planning (Eschenbach and Hoekman, 2006), and since 1989, the countries studied have massively reformed these sectors. Moreover, the 10 countries are all now members of the European Union, and the variation in our data on service sector reforms is interpreted as variation driven by preparation for EU membership. We use indices on the extent of reforms of three infrastructure sectors: electric power, roads and telecommunications. Examples of the reforms in question are improved regulatory regimes and increased competition in the generation of electric power and road provision. We analyze export diversification at the three-digit sector level and export unit values at the four-digit product level. In total, we exploit variation across about 1700 observations of export diversification and more than 30 000 observations of unit values of exports.

Our findings are consistent with higher export unit values due to infrastructure sector reforms, as reforms of all three sectors—electric power, roads and telecommunications—are significantly positively correlated with unit values. Across products, better roads seem to be particularly important for unit values of differentiated products. The results for diversification need more careful justification. On the variation in diversification across sectors, we find roads reforms to be robustly tied to higher diversification in sectors with large export quantities, for given export value levels.[2] A measure of general service reforms (including reforms of both financial and infrastructure sectors), is found to be significantly associated with both export characteristics. Reforms of financial sectors, on the other hand, do not seem to have a robust positive association with either export diversification or unit values.

[2] Export product value = (Export product unit value) * (Export product quantity). A high export quantity for a given export value means low unit values.

2. Exporters and Infrastructure Reform

In our setting of exporters we can think of infrastructure effects along two lines. Better infrastructure may increase the productivity of the production process, and thereby the volume and quality of the products exported. Better infrastructure may also facilitate trade—for instance, by reducing transportation and time costs—which also is likely to increase the competitiveness of the export sector and therefore result in increased export quantities and unit values. We will now go through evidence on both mechanisms in some more detail.

2.1 Infrastructure and manufacturing productivity

Infrastructure service sectors provide manufacturers with important inputs like power, transport and telecommunications. Nadiri and Mamuneas (1994) mention that several types of public capital are important for enhancing productivity in the private sector, of which the quality and size of the network of infrastructure in an economy is one of the most important ones. They estimate the effects of publicly financed infrastructure and R&D capital on the cost structure of 12 two-digit US manufacturing sectors. Although their estimated effects are smaller than the previous literature had reported, they find infrastructure to positively affect productivity.

Röller and Waverman (2001) focus specifically on telecommunications infrastructure and economic growth. They argue that the economic returns to telecommunications investments are much larger than just the direct returns, as they affect communication between firms. Improving telecommunications systems lowers the transaction costs of ordering, gathering information and searching for services. For instance, better telecommunications services can increase firms' ability to engage in new productive activities, they argue.[3] Their estimates, using a simultaneous structural model estimated for 21 OECD countries over the period 1970–1990, suggest positive effects of telecommunications infrastructure on aggregate output. Their results are also consistent with the existence of positive network externalities in telecommunications technologies.

Fernald (1999) looks specifically at roads and manufacturing productivity in the US and interprets his results to suggest that public capital in the form of roads leads to higher productivity in (vehicle-intensive) manufacturing sectors. Yeaple and Golub (2007) find that infrastructure provision, especially roads, helps to explain sectoral total factor productivity (comparative advantage) across 10 sectors and 18 developed and developing countries. Esfahani and Ramirez's (2003) findings suggest substantial contribution of power and telecom services to GDP in developing countries. Arnold,

[3] For more on the effects of telecommunications, see the literature references in Röller and Waverman (2001). They conclude that "preceding studies provide some evidence that telecommunications investment has positive effects on output".

Mattoo and Narciso (2006) use a sample of Sub-Saharan African firms and provide some evidence "that firms in regions with more frequent power outages are less productive than others."

Arnold, Javorcik and Mattoo (2007) find positive effects of service sector reform on productivity in Czech manufacturing firms and interpret their findings as "consistent with service sector liberalization, particularly foreign direct investment (FDI) inflows into the sector, being associated with improved availability, range and quality of services, which in turn contribute to improved performance of manufacturing firms using services as inputs."[4] Work on the link between service sector reforms and economic growth is provided by Eschenbach and Hoekman (2006). Utilizing the source of data on service sector reforms that are used in this chapter, they find a positive association between services liberalization and economic growth in 24 transition countries over the 1990–2004 period.

In other words, a positive correlation between infrastructure services and indicators of economic development such as productivity and value-added growth seems to be well established, although it may be hard to establish convincing causal relationships.[5]

2.2 Infrastructure and trade costs

Infrastructure can influence trade costs. Anderson and van Wincoop (2004) suggest that of a total estimated tax equivalent trade cost for industrialized countries of 170 percent, 21 percent is transportation cost.[6] These transport costs include directly measured freight costs and a 9-percent tax equivalent because of the time value of having goods in transit.[7]

Limao and Venables (2001) estimate that poor infrastructure accounts for 40 percent of predicted transport costs for coastal countries and up to 60 percent for landlocked countries. While only own infrastructure is relevant for coastal countries, the figure for landlocked countries can be broken down to 36 percent because of own infrastructure and 24 percent because of transit infrastructure. In their analysis based on shipping company quotes of transporting a container from Baltimore to different destinations, they also estimate that transporting over land is about seven times more costly per unit distance than transporting over sea. Bougheas, Demetriades and Morgenroth (1999) find, in

[4] See their literature section for more findings pointing in the direction of positive effects of general service sector reforms, level of service sector development and economic development. See Sakakibara et al. (1997) on the role of infrastructure for successful just-in-time production practices.

[5] A positive correlation between infrastructure and economic development seems to be found in both developed and developing countries. See, for instance, Fernald (1999) for works on developed countries. Sachs et al. (2004) seem to assign a central role to infrastructure in the development process of the poorest countries. Esfahani and Ramirez (2003) provide another example from a developing country context. Fernald (1999) and Esfahani and Ramirez (2003) emphasize that the direction of causality is often hard to identify in these studies. Infrastructure investments are likely to increase efficiencies and therefore GDP. At the same time, the demand for and supply of infrastructure services are likely to be affected by GDP.

[6] 44 percent is because of border-related barriers and 55 percent is because of retail and wholesale distribution costs (2.7 = 1.21*1.44*1.55). (Anderson and van Wincoop, 2004, p. 692.)

[7] See Hummels (2007) for more on transportation costs and trade.

accordance with their theoretical model and based on bilateral trade for up to nine Western European countries, that infrastructure has a positive impact on the volume of trade. Shepherd and Wilson (2006) exploit data on minimum distance road routes for 27 European and Central Asian countries, and their results suggest a positive association between improved road network quality and intraregional trade.[8]

The nine-percent time costs reported by Anderson and van Wincoop (2004) are estimated for the US for 1998 by Hummels (2001), who argues that faster ships and switching from shipping to air have taken these costs down from 32 percent in 1950. Djankov, Freund and Pham (2006) find that a one-day extra delay prior to a product being shipped reduces trade by at least one percent, or the equivalent of an extra distance of 70 km on average. They find the effects to be larger for exports from developing countries and for time-sensitive products.

2.3 Summing up: infrastructure and diversification/unit values

We have argued that better infrastructure can positively affect the quality and efficiency of production processes. This channel is consistent with increased unit values of manufacturing exports as it is likely that the quality of the export products are positively related to the productivity of exporters.[9] The channel of reduced trade costs is consistent with better infrastructure leading to higher unit values as buyers are willing to pay extra for fast and accurate delivery. Both higher manufacturing productivity and lower trade costs should raise competitiveness of exporters increasing the volume of already exported products and may make new products profitable, consistent with increased diversification due to infrastructure reforms.

3. Empirical Strategy and Data

In this paper, we estimate reduced form equations for diversification and unit values of exports. The variables of which we seek to estimate the effects are infrastructure reforms in the electric power, roads and telecommunications services sectors. In this section, we present our arguments for why we think the estimated models do identify the link between infrastructure reforms and diversification and unit values of exports.

As will be further explained below, the indices of infrastructure policy reform used in this paper measure the extent of policy reforms that have taken place in a given country at a given time. These are to be interpreted as stocks of policy reforms. Implementation of one new reform lifts the index

[8] See references within Shepherd and Wilson (2006) for more on effects of infrastructure and trade facilitation on trade.
[9] Schott (2004) states that his data are inconsistent with an inverse relationship between unit values and producer productivity, which is the prediction of some new trade theory models.

permanently to a higher level. The assumption of the paper is that reforms lift the quality and/or quantity of infrastructure services available to exporters. We do not think this is a controversial assumption as it is well know that bottlenecks—also in infrastructure—were common in centrally planned economies.[10] Measures of infrastructure as such are not in our possession, and it is a task for future research to evaluate the exact channels through which infrastructure policies may affect the export characteristics in question. We interpret these infrastructure policies as instruments for infrastructure services and use them directly in the estimations. Having access to policy measures is an advantage in the sense that policy may be more exogenous than actual infrastructure (to be discussed below). It may, on the other hand, come with the cost of larger measurement errors. To use the policy indices as instruments for actual infrastructure outcomes in a two-step least squares estimation could be a way to bridge the two approaches.

The estimation in this paper will be the standard differences-in-differences approach used in panel data settings (see equation 1 in Bertrand, Duflo and Mullainathan, 2004), where some "individuals" are exposed to an intervention of some kind and unexposed, otherwise similar "individuals" are observed in several years before and after the intervention. One issue of concern is the possible endogeneity of the intervention in question. An ideal setup for us would be to observe reforms that were randomly assigned. Then reformed and nonreformed countries could be compared before and after the reform, and the reform would explain the differences. In practice, we do not observe randomly assigned reforms.

On the possible endogeneity of the policy changes, Besley and Case (2000) emphasize that the source of variation in the policy change should be fully understood by the researcher. We argue in our setting that the 10 countries under study were all changing from being centrally planned economies to preparing themselves for EU membership during the period of study. This is interpreted as external variation in policy. To identify the coefficient of the infrastructure reform variable, the variable must be orthogonal (i.e., uncorrelated with the error term) *conditionally* on the controls included in the regression. As will become clear, we include country–sector fixed effects—controlling for all time-invariant factors relevant for policy variation across the countries—and sector- or product-year fixed effects that take out all common time variation across the countries. In addition, we control for a series of other factors that arguably could be correlated with both the policy changes and the export characteristics. The policy variation we exploit is therefore only the time variation within each country not explained by common shocks or our controls. Besley and Case (2000) make the argument that the forces driving the policy intervention in question should be identified and controlled for, to achieve unbiased estimates of the effects of the policy change. We will leave for future research explicit

[10] For a discussion of socialist systems as resource-constrained economies, see Kornai (1979).

modeling of the political process determining these reforms. Our current understanding is that reforms co-varied across these countries suggesting variation driven from outside the countries.[11]

A second issue raised by Besley and Case (2000) is the control group. A common approach to test the effects of policy changes is to compare outcomes across groups of treated and non-treated countries. In our setting, we compare within-sector or within-product changes across countries. If we use the terminology "control group", it indicates the corresponding sector(s) or product(s) in countries reformed to a different extent. Although we include observable controls, it also strengthens our confidence in our results that the countries arguably have many similarities. For instance, they are similar in the sense that they are in the same geographic region, they all used to be centrally planned economies, they started the movement toward becoming open market economies at the same time and they all became EU members. As we include country–sector fixed effects taking out all time-invariant characteristics relevant for our independent variables, it is the time-varying aspects of such similarities—and the extent to which they would respond similarly to a given intervention—that is relevant for us.

Bertrand, Duflo and Mullainathan (2004) raise the issue of estimating too-low standard errors in panel differences-in-differences models because of serial correlation rooted in three factors: many periods, serial correlation in the dependent variable and little variation in the intervention studied within each group over time. Our reforms typically took place gradually (see Figure 1), and it may make our standard error less vulnerable to such a serial correlation problem. To address dynamic issues better than in the standard models, we estimate error correction versions of the standard models.

The main identification challenge of this paper is separating the effects of infrastructure reforms from other reforms that were implemented as part of the transformation from central planning to open market economies. Our first measure to tackle this omitted variable problem is to control explicitly for other reforms. Following Eschenbach and Hoekman (2006), we capture the reforms of six economic aspects other than infrastructure by constructing an investment climate index based on the extent of reforms in those six other areas. Second, we investigate more carefully the links between our export characteristics of interest and reforms of financial services. Third, perhaps the most convincing test we are able to do is to take advantage of heterogeneity in the link between infrastructure and unit values across products. By classifying products in differentiated and homogenous products (following Rauch, 1999), we identify a positive association between roads reforms and unit values for differentiated products. As we now have variation across products within each country, we can include country–year fixed effects. Comparing the estimates of roads reforms in the models with the explicit controls against

[11] Arnold, Javorcik and Mattoo (2007) use services reforms in Slovakia and Hungary as instruments for services reform in Czech Republic, indicating these to have common variation.

the (interaction-terms in the) models with country–year fixed effects and no country-wide controls (the country–year fixed effects control for all country-wide changes over time), we find that they are very similar. At least for roads reforms, this strengthens our confidence that our results are not driven by something else going on at the country level.[12] We now discuss more explicitly our estimation setup.

3.1 Empirical strategy

Like Harding and Javorcik (2007b), we follow Hwang (2006) and measure export diversification with a Herfindahl index of export shares in sector i in country c at time t.[13] The Herfindahl index, H, indicates the level of concentration of export products from sector i for country–sector ci at time t given by (sector i consists of several products p):

$$H_{cit} = (\sum_{p \in i} s_{cpt}^2) * 100, \tag{1}$$

where s_{cpt} is product p's share of country-sector ci's exports at time t and is given by:

$$s_{cpt} = \frac{x_{cpt}}{X_{cit}} \tag{2}$$

where x_{cpt} is the export value of p from country c in sector i at time t and X_{cit} is the total export value from sector i in country c at time t. The measure of concentration, $H_{cit,}$ ranges from 0 to 100, and in our empirical specification we use 100 – H_{cit} as our measure of export diversification. We estimate the following equation linking infrastructure and export diversification:

$$\begin{aligned} 100 - H_{cit} = {} & \alpha_1 + \beta_1 Infrastructure_{ct} + \gamma_1 \ln Export\_value_{cit-1} + \delta_1 \ln Tariffs_{cit}^{Hi\_OECD} \\ & + X_{ct}\theta_1 + \eta_{ci} + \eta_{it} + \omega_{cit} \end{aligned} \tag{3}$$

To test the effect of infrastructure reform on export unit values, we estimate the equation:

$$\begin{aligned} \ln Unit\_value_{cpt} = {} & \alpha_2 + \beta_2 Infrastructure_{ct} + \gamma_2 \ln Export\_value_{cpt-1} + \delta_2 \ln Tariffs_{cit}^{Hi\_OECD} \\ & + X_{ct}\theta_2 + \lambda_{ci} + \lambda_{pt} + \varepsilon_{cpt} \end{aligned} \tag{4}$$

[12] These estimations are open to the criticism that some other reform could be closely correlated with our infrastructure reform and at the same time with unit values *through* differentiated products.

[13] Imbs and Wacziarg (2003) use as main measures the Gini coefficient, Herfindahl index, coefficient of variation in sector shares, the max-min spread and log-variance of sector shares. In this paper, we only employ the Herfindahl index, but in future work, we will consider checking the robustness of the results using more measures.

$Unit\_value_{pct}$ is the unit value (value of exports/quantity of exports) of product p exported by country c at time t. Products are defined at the four-digit SITC level.

$Infrastructure_{ct}$, which is our variable of primary interest in all estimations, measures the extent of reforms that have been undertaken in either of the following three infrastructure sectors: electric power, roads or telecommunications. We also estimate a version of equation (1) letting $Infrastructure_{ct}$ equal an average of the five infrastructure sectors: the three above plus trains and water and waste water. All these measures of infrastructure policies are country specific and time varying (see Section 3.2 for details).

As infrastructure reform is not the only aspect of an economic environment that can affect export diversification and unit values, we need to think hard about other potential explanations and attempt to include them in our models. Failing to do so would mean that there could be other factors correlated with both the export characteristics of interest and our infrastructure reforms that could be picked up in our estimated coefficient on infrastructure reform. Explicitly controlling for factors that we believe are important for the export characteristics reduces this danger.

The export value is included to take into account the size of the export sector in question. Motivations are that scale can affect aspects like production productivity, transport costs and marketing costs, which arguably could affect the export characteristics of interest. For the unit values in particular, changes in scale could also imply sliding along the world demand curve. Acemoglu and Ventura (2002) point to such an effect in a model with specialization in production across countries. The export value variable varies by sector, country and year in the diversification analysis, and product, country and year in the analysis of unit values. We lag the export value one period as our dependent variables are functions of export value or its unit value component.

Based on their theoretical model, Feenstra and Kee (2008) instrument export variety across countries with tariffs, trade agreements and distance. We control for changes in such factors over time with the inclusion of tariffs as a control variable. A simple average of tariffs into high-income OECD countries is chosen to represent tariffs, as we do not employ bilateral trade data in this paper. We believe these are representative as the most important markets for the countries in question. These tariffs vary by exporter country, three-digit sectors and year. Feenstra and Kee (2008) motivate their tariff instrument by transport costs. Analogous to costs of other taxes, tariff costs may generally be split between sellers and buyers, affecting competitiveness and demand. In other words, export quantity and unit values are

likely to be affected by tariffs. Physical distance to any export market, being a time-invariant characteristic of each country, will in our estimations be controlled for by country–sector fixed effects (see below).

The vector X consists of time-varying country-level controls: lagged log GDP per capita, inflation and an investment climate index. Several papers find export characteristics like diversification and unit values to be correlated with the level of development, which we control for by including GDP per capita (for instance, Schott (2004), Hummels and Klenow (2005), Brenton and Newfarmer (2007), and Cadot, Carrère and Strauss-Kahn (2007)). Hausmann et al. (2007) and Feenstra and Kee (2008) argue for links between export characteristics—the sophistication of export products in the former and export variety in the latter—and GDP per capita growth and productivity. We lag GDP per capita one period to reduce the danger of GDP per capita being a function of our dependent variable. Inflation represents general costs in the country in question as well as macroeconomic stability, both potentially important for exporter performance.

The countries in question have also reformed other aspects of their economies during the period of study. If such other reforms and policy changes that took place in our period affected export diversification or unit values, and if at the same time they were correlated with our infrastructure reforms, then our estimated coefficients could be driven by those reforms rather than by the infrastructure reforms. To capture other reforms, we follow Eschenbach and Hoekman (2006) and construct an index reflecting general business climate reforms by combining the following six indices published by the European Bank for Reconstruction and Development (EBRD): large-scale privatization, small-scale privatization, governance and enterprise restructuring, price liberalization, trade and foreign exchange systems and competition policy. To avoid our estimates of infrastructure effects being affected by reforms in these six areas, we include this investment climate variable as a control variable.

We also include country–sector (η_{ci}) and sector–year (η_{it}) fixed effects in all diversification estimations, and country–sector (λ_{ci}) and product–year (λ_{pt}) fixed effects in all unit value estimations. Country–sector fixed effects control for all time-invariant characteristics that affect the average level of export diversification or unit values in a specific sector in a specific country. For instance, if the Czech Republic has systematically different export values on car parts because of their geographical proximity to Germany, this will be completely absorbed by the country–sector fixed effects. Put differently, including country–sector fixed effects makes us only investigate changes in diversification and unit values within each country–sector over time. Sector–year fixed effects control for the fact that different sectors have different levels of diversification. Similarly, product–year fixed

effects control for the fact that products have different unit value levels; for instance, pencils and computers. They also control for shocks in sector diversification and product unit values, respectively, that are common to all countries. For instance, if there is a global downward shock in the price of computer chips from one year to the next, this will be completely controlled for by the product–year fixed effects.[14] The same goes for shocks in global demand. Standard errors are clustered at the country–year level, because our variables of interest are available at the country–year level. The variables and their sources are described below.

3.2 The country setting and the EBRD indices

To investigate the link between infrastructure and exports, we take advantage of the transition experience of 10 Eastern European countries.[15] Since around 1990, they have gone from being centrally planned economies to becoming open market economies. Eschenbach and Hoekman (2006) describe how Marxist thinking focused on material inputs, while service inputs were left with low priority. Bottlenecks in transportation and low-quality telecommunications were two consequences of these policies. In other words, the potential for improvements in these sectors seems to have been large, and the transition experience through the 1990s involved reforms of sectors providing infrastructure services. The European Bank for Reconstruction and Development (EBRD) has published yearly indices of the extent of such reforms for each of the 10 countries. These indices vary from a minimum score of 1 to a maximum score of 4.3. A description of what these indices measure is found in the appendix of Eschenbach and Hoekman (2006). For instance, an electric power sector achieving a score of 4.3 on the index would be characterized by tariff charges reflecting costs, large-scale private player involvement, and being well regulated as well as fully liberalized in both network access and electricity generation. For roads, 4.3 includes a decentralized road administration, competitively awarded maintenance assignments to private companies and user charges reflecting full costs. Telecommunications ranked at 4.3 incorporate a coherent regulatory and institutional framework for dealing with tariffs, interconnection rules, licensing, concession feed and spectrum allocation and reflect that the sector is regulated by an effective, independent entity. EBRD also publishes indices for rail and water and waste water. We do not investigate the effects of rail because of few observations. The role of water and waste water for export unit values is not clear to us and is therefore not investigated specifically. All sectors mentioned above are, however, included in an aggregate measure of infrastructure reform that is calculated as a simple average of the five.

[14] A shock that hits all countries in the sample equally is sufficient to be called "global" in our context.
[15] The 10 countries in our analysis are Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Bulgaria and Romania joined the European Union on January 1 2007, while the other eight countries joined on May 1 2004. Cyprus and Malta also joined on May 1 2004, but these are not included in our study.

As a robustness check, we also estimate our model with reforms in financial sectors instead of infrastructure sectors. The financial sector index is constructed as an average of EBRD indices on "banking and interest rate liberalization" and "securities markets and non-bank financial institutions", also as suggested by Eschenbach and Hoekman (2006). Figure 1 shows the indices measuring the extent of reforms in infrastructure services and financial services, as well as the investment climate index. All data necessary to construct the indices mentioned (subcomponents of infrastructure, financial and investment climate) are published by EBRD (EBRD, 2007).[16]

3.3 Other data

Following Harding and Javorcik (2007a), we use four-digit SITC Rev. 2 classified export data compiled by Feenstra et al. (2005), which are available from before our period start of 1989 until 2000.[17] We exclude products from agriculture and natural resource extraction activities. Table 3 shows the sectors included. The data set used to analyze diversification at the sector level includes the same countries, sectors and years as the product-level data set, as it is only an aggregation of the product-level data set. Unit values are calculated by dividing the export value by the quantity of exports. Value of exports is measured in current USD.[18] GDP per capita is measured in current USD and is found in the *World Development Indicators* (WDI)[19] provided by the World Bank. Inflation figures are measured in shares—0.01 means one-percent inflation—and their source is the *International Financial Statistics* provided by the IMF.[20] Tariffs are country and sector specific and calculated as a simple average of the tariffs a specific country meets in high-income OECD countries in a specific year. They are measured in percentage points and linearly interpolated to avoid unnecessary loss of observations (WITS, 2007).[21] We use the classification of Rauch (1999) to identify differentiated products.

4. Results: Infrastructure Reforms and the Diversification of Export Baskets

Reforms leading to provision of better infrastructure services such as electric power, roads and telecommunications may decrease the costs of producing and transporting potential export products. This can induce exports of new products, higher quantities sold of already exported products and higher unit values on exported products. All these changes can make the export bundle of the given

[16] For data description and downloading, see: http://www.ebrd.com/country/sector/econo/stats/index.htm.
[17] For additional information on the data set, see http://cid.econ.ucdavis.edu/data/undata/FAQ_on_NBER-UN_data.pdf and http://cid.econ.ucdavis.edu/data/undata/undata.html. We classify sectors according to the NAICS 1997 classification, and the concordance between four-digit SITC Rev. 2 and NAICS 1997 is found at: http://www.nber.org/lipsey/sitc22naics97.
[18] When there are multiple observations on value and corresponding quantities for a certain product-country-year observation (the quantity can be measured differently, for instance a part by weight and a part by number of units), we calculate the unit value as a weighted average. Shares of the total country-product-year value are used as weights. This is the strategy followed by Schott (2004).
[19] http://publications.worldbank.org/WDI/
[20] http://ifs.apdi.net/imf/
[21] See http://wits.worldbank.org/witsweb/ for downloading.

country more diversified, as measured with our export diversification measure, 100-H. In Table 4, we present results suggestive of a positive effect of reforming telecommunications services on export diversification. The results for electric power are not convincing, as there is only one incidence of significance at the 10-percent level. Telecommunications reforms seem to make a change quickly, as the largest coefficient is estimated for the same year as the reform takes place. The coefficient is reduced as we use more lags, but also one- and two-period lags are significant. This may be reasonable, as changes in, for instance, telecommunications regulations could turn up as increased efficiency almost immediately. The size of the contemporaneous coefficient for telecommunications is 1.8, which implies that a one-index-point increase in the reform index raises export diversification by 1.8 points (the dependent variable 100-H runs from 0 to 100, with an average of 74). Reforming telecommunications by one index point would, according to our measures, imply a 2.5-percent more-diversified export basket for an average export sector.

The process of implementing a policy reform to improve infrastructure services that again improve conditions for exporters may take some time. There could be important differences in the link between such reforms and exporter performance between the short and the long run. We estimate error correction (ECM) versions of the models described above to better take into account potential dynamic adjustments. The error-correction setup separates out short- and long-run effects. We still include sector–year fixed effects. Table 5 shows that the ECM results are much in line with our baseline results in Table 4. Telecommunications may still show the clearest effect, and the estimated (long-run) coefficient is a little larger, about 2.2.[22] The interesting difference compared with Table 4 is the coefficient of roads, which is now clearly significant for three lags (corresponding to the situation with two lags in Table 4).[23]

Although in the results described above there are traces of links between infrastructure reforms and export diversification, our overall assessment is that the evidence is not overwhelming at this stage. Clearer support for such links is found when we let the effect vary across sectors. The idea is that diversification contains several aspects that could be differently influenced by different infrastructure services. Our diversification measure is a function of value shares of different products exported by a

[22] We only estimate models using zero, one and two lags in Table 4 as more lags make our sample rather short (the ECM setup adds one lag to all level variables). First we observe that there is robust support for cointegration between our dependent variable and our independent variables, as the coefficient of the lagged dependent variable in level form is negative in all the estimations. We then focus on the coefficients of the level forms of the variables, which represents the "long-run" relation estimated. To find the size of the effect, we divide the coefficient of interest on the (negative) of the coefficient in front of the lagged level of the dependent variable.

[23] Two caveats should be kept in mind regarding our ECM results. First, the long-run relationship should be interpreted as the *within-sample* long-run relationship, indicating the relation between these variables over the 12 years or so we include in our sample. That is not necessarily equal to a long-run "steady-state" relationship between these variables. Second, we do only have a maximum of 12 years in the time dimension here. This is likely to be on the border line for fixed-effects estimations to be unbiased, because the fixed effects by definition are correlated with the lagged dependent variable. This problem diminishes with increasing sample length. With these caveats, overall the ECM results of Table 5 support the findings of Table 4.

particular country-sector in a particular year. The export value of each product is a product of quantity and unit values. In Table 6 we investigate heterogeneity in the infrastructure estimates according to variation in export quantity for a *given export value*. Our idea is that there are likely to be differences in the impact of infrastructure reforms across inherent product characteristics. Our split into "quantity-intense" vs. "quality-intense" products is only a first attempt at investigating whether there are such characteristics that matter in our context. Export "quantity-intense" sectors seem to be more diversified in their exports as roads reforms are implemented (Table 6). The roads reforms interacted with the sum of export quantity at the sector level are significant in all four models, three of them at the one-percent level. The variation in quantity can here be driven both by differences across sectors and changes within country–sectors over time. The sizes of the coefficients are between 1.6 and 2.1. Electric power reforms are, if anything, linked to export diversification through the general term. For telecommunications, the picture is a little more complicated. The main message seems to be that telecommunications reforms are linked to diversification through the general term. The sizes of the coefficients, roughly around 1.5, are recognizable from Table 4.

We also conducted the analogues exercise of differentiating along "unit-value-intensive" sectors, by interacting average unit values by country–sector–year with the infrastructure indices (see Appendix table 1 and Appendix table 2). For this, we used both a value-share-weighted average and the simple average. When the value-weighted average is used in the interactions, we find results very similar to Table 4 and no significant heterogeneity. When the simple average of the unit values is used, there are indications of heterogeneity across sectors in the links between electric power services reform and export diversification. Interactions of the simple average of sector unit values and roads services reforms are significantly negative in two of the four models. The indications of heterogeneity in the infrastructure links according to "quantity-intense" and "quality-intense" sectors suggest that there may be interesting effects of infrastructure on export diversification that our analyses are not fully capable of revealing. Further research is needed to uncover more precisely which sectors or product characteristics we have seen traces of above.[24]

Finally we present results indicating that infrastructure reforms in general seemed to be positively associated with export diversification in our 10 countries, while that is not the case for reforms of financial services. Table 7 presents the results. General service sector reform—including financial and

[24] An example of such a characteristic could perhaps be transportation costs, for which we do not have any data available for the countries analyzed. For instance, say, exports of stone or food—sectors that have high transport costs according to Bernard, Jensen and Schott (2006)—may benefit more from improved roads than, say, computer parts. Investigation of heterogeneity across sectors according to other characteristics has not led us to find any systematic pattern in the estimated infrastructure effects. The cross-sectional sector characteristics investigated are research-and-development intensity, marketing intensity, and financial external dependency.

infrastructure services—is positively associated with diversification, but it seems like the effect is driven by the infrastructure component rather than the financial services component.

5. Results: Infrastructure Reforms associated with Higher Unit Values

We have argued that there are reasons to expect better infrastructure services to increase the quality and therefore the unit values of products exported. Table 8 shows our estimates of the effects of electric power, roads and telecommunications services on unit values of exports. The sizes of the estimated coefficients imply that a one-index-point increase, say from 2 to 3, would increase unit values by between 5.3 and 7.0 percent.[25] For roads, we find that an increase in the road index of one point increases unit values by 6.5 percent, while for telecommunications, we estimate that a one-point increase leads to an increase of between 5.5. and 7.6 percent in unit values. In other words, the size of the effects compared across the three infrastructure sectors is rather similar. For electric power, the estimated coefficients are significant when the index is included contemporaneously and with one and two lags. Roads are significant only with one lag, while telecommunications-reform is manifested within the year of reform and the following year.

To take dynamic adjustment in export unit values in relation to the infrastructure reforms into account we estimate error correction-versions of the models in Table 8. The estimated significant coefficients imply long-run coefficients of around 0.12 and 0.10 for electric power and telecommunications, respectively (Table 9). These are larger than the estimates in Table 8. It is reasonable that all effects do not show up immediately. For roads, the error correction specification does not produce significant results. We note that the error correction setup chosen is demanding as it includes product–year fixed effects that remove much of the time variation that the ECM is designed to capture.

To investigate further exactly what is at work, we look at heterogeneity across products. Rauch (1999) classifies products into differentiated and homogenous products.[26] We replicate the estimations of Table 8 but now also include a variable interacting with the infrastructure index in question and a dummy variable indicating whether the product is a differentiated product or not. These estimations, presented in Table 10, indicate that the relationship between roads and unit values is present only for differentiated products. The interaction variable turns out to be significant at the one-percent level in all three versions (zero, one and two lags), while the roads variable turns out to be insignificant. The size varies between 5.0- and 6.6-percent increase in unit values for a one-point increase in the index.

[25] This is found by the following calculation (we let U indicate unit values and use column 2 as an example):
$\ln U_t = 0.07 * \text{Index}_t \Rightarrow (U_t - U_{t-1}) / U_{t-1} = (e^{0.07*\text{Index}_t} - e^{0.07*\text{ndex}_{t-1}}) / e^{0.07*\text{Index}_{t-1}} = (e^{0.07*3} - e^{0.07*2}) / e^{0.07*2} = e^{0.07} - 1.$

[26] Rauch divides products into three categories: differentiated products, products with a reference price and products traded on organized exchanges. The latter two are, in other words, seen as homogeneous goods. We apply Rauch's conservative classification, which minimizes the number classifications: reference priced or organized exchange.

For electric power the interactions are insignificant and the other coefficients about the same as before. Telecommunications services do not work differently for differentiated products either, as the interaction variable is always insignificant. The estimated coefficients for zero and one lag are still significant, although a little smaller than before.

To examine the differentiated products further, we replicate the estimations of Table 8 with two changes: we include the interaction variables described in the last paragraph and we include country–year fixed effects instead of explicit country controls.[27] We can now only identify the interaction variables, which turn out to be very similar to the estimations described above (see Table 11). They are all significant at the one-percent level, with magnitudes varying between a 5.5 and 7.2 percent unit value increase for a roads index increase of one point. These results make us more confident in the estimated effect of roads on differentiated products.

Conceivably of greater importance, the results also strengthen our confidence in our other estimates. A reason for caution toward the estimation results in Table 8 is that there could be other changes at the country level affecting unit values that are not included in our regressions. We recognize that controlling for other reforms—correlated with the infrastructure reforms, which may have affected the export characteristics in question—may be the most important identification challenge in this paper. A policy change not captured by our investment climate index could be an example. If such a policy change is correlated with our infrastructure measure, we could wrongly assign its effect to infrastructure. The country–year fixed effects used in Table 11 control for any country-wide change over time and should completely remove the possibility of omitted variable bias caused by omitted time-varying country-wide variables. The fact that the results for roads are almost identical given country–year fixed effects as with country controls gives us more comfort that our results are not driven by omitted variables.

Understanding exactly why roads matter more for differentiated products than for other products is a matter for future research. Rauch (1999) uses trade costs between Japan and the US to get some insights on the transportability of different products. This measure suggests that differentiated products are roughly twice as tradable as homogeneous products. On the one hand, such products are likely to be traded more. On the other hand, we would perhaps expect that infrastructure such as roads should matter more for products that are expensive to transport.

[27] We can only include country-year fixed effects when we consider variation in the effect of infrastructure across sectors or products, which is the case when, through the interaction variables, we open up the possibility that infrastructure affects differentiated products differently than other products. We also investigated heterogeneity across sectors because of their differences in intensity of marketing and research and development expenses and because of their dependency on external financing. No systematic patterns were found.

In this paper, we have focused our attention on infrastructure services rather than financial services. In Table 12, we replace infrastructure with a variable capturing the extent of service sector reforms in general. We find a positive association between general service reforms and unit values. When we break down this general service sector reform measure into its two subcomponents, namely the aggregate indices on financial and infrastructure sectors, we see that infrastructure is significant while the financial sector is not. In other words, the positive association estimated between the extent of general service sector reform and unit values seems to be driven by the infrastructure component. This also supports the view that our results are not driven by some other, correlated, reform.

6. Discussion and Concluding Remarks

Evidence presented in Section 4 is consistent with the existence of a positive relationship between infrastructure policy reforms and export diversification as measured by a Herfindahl index.[28] Dennis and Shepherd (2007) employ export cost data from the World Bank's Doing Business database and find that a one-percent reduction in export costs is associated with 0.3-percent more diversified exports. A one-percent reduction in international transportation costs is associated with 0.4-percent higher export diversification. We estimate that a 1.8-percent change in export diversification requires a one-reform-index-point change for telecommunications. This should then correspond to about six percent lower export costs and four-percent lower international transport costs, according to the estimates of Dennis and Shepherd (2007). Cost reductions of such magnitudes do not seem implausible given, for instance, the reported reductions in transportation costs seen since the 1950s (Hummels, 2001).

Francois (2007) estimates the contribution of infrastructure, institutions and tariffs in explaining trade volumes across countries and finds the first two to be considerably more important in magnitude than the latter. A one-standard-deviation increase in communications and transport infrastructure implies in his full sample estimations nine- and four-percent increases in the volume of trade, respectively.[29] The corresponding number for a tariff change is two percent. Although our reform indices are not directly comparable with the infrastructure measures employed by Francois (2007), infrastructure in his

[28] For empirical analyses of variation in export baskets along different dimensions (intensive vs. extensive margin etc), see Hummels and Klenow (2005), Brenton and Newfarmer (2007), Amurgo-Pacheco and Pierola (2008). Brenton and Newfarmer (2007) argue that a key policy concern should be "lowering the costs of backbone services"

[29] The infrastructure measures of Francois (2007) are based on information from the World Development Indicators database and include, for instance, telephone coverage and air transport freight.

estimations is found to be potent in increasing trade. Cadot, Carrère and Strauss-Kahn (2007) seem to find effect magnitudes comparable with our estimates.[30]

Schott (2004) shows that unit values of the same export product vary greatly across countries. In their exports, countries seem to specialize within products rather than across products.[31] Unit values within products are found to increase by 1.3, 4.4, and 5.0 percent for a 10-percent increase in GDP per capita, capital per worker and skill per worker, respectively (Schott, 2004, p. 669). Our estimates of unit value increases linked to a one-index-point increase in the infrastructure reform indices are about 5.5 to 7.5 percent. In other words, a one-index-point increase in our reform indices corresponds very roughly to about a 40-percent increase in GDP per capita, a 15-percent increase in capital per worker and a 10–15-percent increase in skill per worker. The comparable changes necessary in for instance GDP per capita may seem large. However, we should keep in mind that Schott estimates these figures in a cross-country panel setting (48 countries, including low-, middle- and high-income countries, 1972–1994). Product–year fixed effects are included, but not country fixed effects. Variation between countries is therefore also driving Schott's results. As we include country-sector fixed effects, focusing on within-country-sector changes, the results are not exactly comparable.

We are not aware of other studies specifically estimating the relationship between infrastructure and unit values. The results of Harding and Javorcik (2007) suggest that inflows of foreign direct investments (FDI) (proxied by actively performed investment promotion policies) can increase the unit values of developing countries by about 11 percent. FDI can therefore contribute to bridge the gap between developing countries' and developed countries' unit values. The size of their estimates is comparable to the ones presented in this chapter. For developing countries, they do not find systematic differences in the FDI-unit value relationship between differentiated and homogenous products. For developed countries, however, the link found—if any—between FDI and unit values seems to go through differentiated products.

[30] Cadot, Carrère and Strauss-Kahn (2007) estimate public infrastructure—measured as a composite of World Development Indicator (WDI) data on the proportion of paved roads and densities of telephones, railroads and roads—to reduce export concentration along the intensive but not the extensive margin. In their estimations, applying a Herfindahl index as a concentration measure, they seem to find (based on our reading of their Table 9) that a one-index-point increase in their infrastructure index (which varies between 0.02 to 2.35, with an average of 1.02 and a standard deviation of 0.622) leads to a three-point increase in an export diversification measure comparable to our 100-H.[30] A one-standard-deviation increase in their infrastructure measure (about 0.6 index points) leads to about a 1.8-point increase in diversified exports, while the corresponding figure for telecommunications reforms in our estimations is also about 1.8 (mean 2.49, standard deviation 0.98 and coefficient 1.789 in column 7, Table 4). The indices in question are not directly comparable The magnitudes of our estimates do not seem unreasonable.

[31] Schott (2004) mentions as an example that both Japan and the Philippines export cotton shirts for men, but Japan achieves a price 30 times higher than the Philippines.

Based on the analyses of unit values provided by Schott (2004) and Harding and Javorcik (2007), we consider our estimates of the link between unit values and infrastructure reforms to be of reasonable magnitudes.

During the 1990s, the 10 new EU members studied in this paper underwent massive policy changes aimed at improving infrastructure services. We found the extent of these changes to be positively correlated with the unit value of products exported from these countries, which we interpret to be consistent with better infrastructure services increasing the quality of the products exported. There is also some support for positive correlations between these reforms and export diversification. For countries with less than perfect infrastructure policies, the findings of this paper therefore suggest that reform of infrastructure policies is one measure available to policy makers with the potential of inducing upgrading of the country's export basket.

As the debate on exports and growth is turning away from exports as such, and toward the quality and sophistication of export products, identification of policy measures available to developing and transitional countries capable of raising export product quality appears to us as an important task for research. The results of this paper point to some possible areas for further research. First, there seems to be heterogeneity across sectors in the relation between infrastructure reforms and export diversification. Which characteristics drive this heterogeneity is not yet fully explored. A second open question is what lies behind the estimated strong link between unit values and roads reforms for differentiated products. Third, Arnold, Javorcik and Mattoo (2007) find foreign direct investment to be an important channel through which service sector reforms enhance manufacturing productivity. The role of FDI and other factors in accommodating and generating the effects of infrastructure reforms is another interesting avenue for future research.

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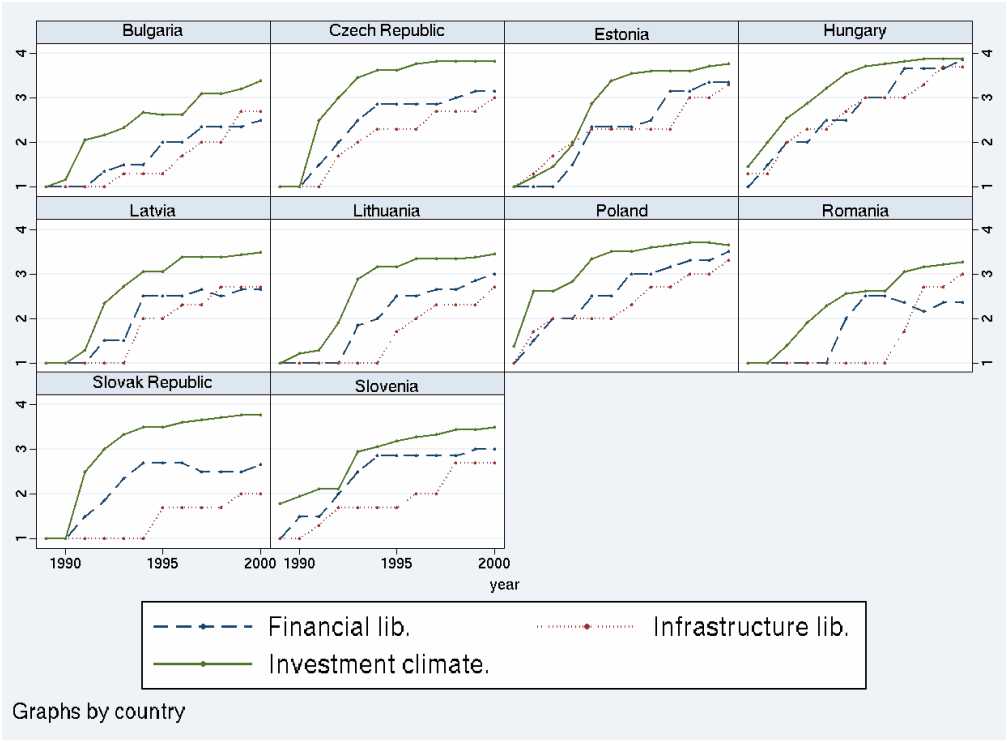
8. Figures

Figure 1: Extent of reforms in financial and infrastructure services sectors and investment climate



9. Tables: About the Data

Table 1: Descriptive statistics, sector level analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
100-H	1771	73.433	20.716	0	97.383
Average unit values (levels)	1768	21.350	82.653	0.036	1317.881
Average unit values (log)	1768	1.911	1.252	0.035	7.185
Weighted average unit values (level)	1768	6.837	64.918	0.009	1317.881
Weighted average unit values (log)	1768	0.481	0.794	0.009	7.185
Sum of export value by sector (log)	1781	–2.320	1.969	–9.171	1.884
Sum of export quantity by sector (log)	1768	0.339	0.552	0.000001	4.643

Note: This table uses data from the sample corresponding to columns 1, 4 and 7 of Table 4.

Table 2: Descriptive statistics, product level analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
ln u (unit values)	32603	0.936	1.817	–9.028	9.786
u (unit values)	32603	16.055	176.244	0.0001	17781.000
Electric power	32603	2.313	0.768	1.000	4.000
Roads	32603	2.283	0.683	1.000	3.300
Telecommunications	32603	2.541	0.984	1.000	4.000
EBRD reform infrastructure	32603	2.205	0.706	1.000	3.700
EBRD reform financial	32603	2.558	0.666	1.000	3.850
EBRD reform services in general	32603	2.382	0.649	1.000	3.775
EBRD investment climate	32603	3.229	0.629	1.000	3.867
Tariffs hiOECD simple average	32603	4.443	5.729	0.000	74.440
L.Export value of product	32603	0.017	0.045	0.000	1.274
L.GDP per capita	32603	8.049	0.571	7.004	9.288
Inflation	32603	0.547	1.348	0.008	10.584
Year	32603			1989	2000

Note: The table uses data from the sample corresponding to columns 1, 4 and 7 of Table 8. Export values and GDP per capita are measured in logs. LX means lagged X periods.

Table 3: Countries and sectors included

NAICS97	NAICS97 description	Bulgaria	Czech Rep	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovak Re	Slovenia	Total
311	Food manufacturing	420	411	118	658	142	216	659	323	350	372	3669
312	Beverage and tobacco product manufacturing	51	45	17	64	21	12	51	29	51	41	382
313	Textile mills	184	197	65	276	69	108	285	193	156	186	1719
314	Textile product mills	110	91	48	169	30	42	160	117	73	70	910
315	Apparel manufacturing	277	182	176	308	154	168	310	243	174	205	2197
316	Leather and allied product manufacturing	75	80	44	120	40	42	112	80	62	85	740
321	Wood product manufacturing	121	88	92	152	75	82	159	120	87	86	1062
322	Paper manufacturing	118	108	53	144	31	51	163	69	103	110	950
323	Printing and related support activities	19	42	24	65	11	14	63	21	39	48	346
324	Petroleum and coal products manufacturing	54	56	33	94	37	38	80	64	54	43	553
325	Chemical manufacturing	658	621	136	943	168	177	996	575	507	517	5298
326	Plastics and rubber products manufacturing	101	97	44	138	23	23	147	94	90	101	858
327	Nonmetallic mineral product manufacturing	174	196	79	303	55	83	321	191	148	183	1733
331	Primary metal manufacturing	290	261	124	347	128	164	393	257	194	229	2387
333	Machinery manufacturing	489	537	183	790	139	173	835	481	453	512	4592
334	Computer and electronic product manufacturing	192	253	106	384	50	91	402	154	225	222	2079
335	Electrical equipment, appliance, and component manufacturing	149	116	52	189	44	51	183	117	104	131	1136
336	Transportation equipment manufacturing	142	224	81	254	84	78	329	213	185	186	1776
337	Furniture and related product manufacturing	24	14	16	24	16	16	24	20	14	16	184
483	Water transportation	8	0	0	0	1	3	12	8	0	0	32
	Total	3656	3619	1491	5422	1318	1632	5684	3369	3069	3343	32603

Note: For agricultural products, there are typically important tariff and nontariff barriers restricting trade flows. We exclude the following NAICS-sectors: Crop production (111), animal production (112), forestry and logging (113), fishing, hunting and trapping (114), oil and gas extraction (211), mining (except oil and gas) (212). For the sectors fabricated metal product manufacturing (332), motion picture and sound recording industries (512), professional, scientific, and technical services (541) and utilities (221), we do not have observations.

10. Tables: Results Diversification

Table 4: Diversification and specific infrastructure

	1 100-H	2 100-H	3 100-H	4 100-H	5 100-H	6 100-H	7 100-H	8 100-H	9 100-H
Electric power	0.521								
	[0.714]								
L. Electric power		**1.285***							
		[0.664]							
L2. Electric power			0.978						
			[0.597]						
Roads				–0.886					
				[0.904]					
L. Roads					–0.599				
					[1.123]				
L2. Roads						0.145			
						[1.021]			
Telecommunications							**1.789****		
							[0.757]		
L. Telecommunications								**1.179***	
								[0.659]	
L2. Telecommunications									**1.142***
									[0.588]
L. Sum of export value by sector	0.916	0.757	0.881	0.881	0.845	0.986	0.869	0.798	0.799
	[0.754]	[0.785]	[0.791]	[0.690]	[0.718]	[0.739]	[0.796]	[0.758]	[0.730]
Tariffs hiOECD simple average	–0.010	–0.011	0.022	0.001	–0.002	0.018	–0.023	–0.007	0.027
	[0.083]	[0.084]	[0.083]	[0.085]	[0.084]	[0.082]	[0.082]	[0.086]	[0.084]
L. GDP per capita	–1.129	–2.791**	–4.099***	–0.989	–2.572*	–4.118***	–1.365	–3.093***	–4.426***
	[1.208]	[1.127]	[1.181]	[1.300]	[1.376]	[1.490]	[1.042]	[1.161]	[1.279]
EBRD investment climate	0.198	–1.079	0.185	1.182	–0.491	–0.399	–0.341	–1.232	–1.027
	[2.134]	[1.705]	[1.862]	[1.701]	[1.728]	[2.040]	[1.878]	[1.635]	[1.775]
Inflation	–0.492**	–0.391**	–0.370**	–0.529*	–0.450**	–0.344**	–0.527**	–0.430**	–0.394**
	[0.240]	[0.187]	[0.171]	[0.270]	[0.210]	[0.168]	[0.237]	[0.187]	[0.180]
Observations	1771	1713	1653	1771	1713	1653	1771	1713	1653
R-squared	0.91	0.92	0.92	0.91	0.92	0.92	0.92	0.92	0.92

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. 100-H, where H is a Herfindahl index based on export value shares, as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000.

Table 5: Diversification and specific infrastructure, ECM

	1	2	3	4	5	6	7	8	9
	d(100-H)	d(100-H)	d(100-H)	d(100-H)	d(100-H)	d(100-H)	d(100-H)	d(100-H)	d(100-H)
L. 100-H	−0.573***	−0.573***	−0.560***	−0.573***	−0.569***	−0.560***	−0.577***	−0.572***	−0.560***
	[0.049]	[0.051]	[0.052]	[0.048]	[0.050]	[0.051]	[0.048]	[0.051]	[0.051]
L. dElectric power	**1.011***								
	[0.599]								
L2. Electric power	1.008								
	[0.609]								
L2. dElectric power		0.452							
		[0.530]							
L3. Electric power		0.818							
		[0.555]							
L3. dElectric power			0.863						
			[0.520]						
L4. Electric power			−0.094						
			[0.570]						
L. dRoads				−0.197					
				[0.965]					
L2. Roads				1.184					
				[1.131]					
L2. dRoads					0.973				
					[1.052]				
L3. Roads					**1.859****				
					[0.769]				
L3. dRoads						0.965			
						[0.874]			
L4. Roads						1.178			
						[0.997]			
L. dTelecommunications							0.794		
							[0.552]		
L2. Telecommunications							**1.284****		
							[0.581]		
L2. dTelecommunications								**0.813***	
								[0.452]	
L3. Telecommunications								**0.909***	
								[0.475]	
L3. dTelecommunications									0.437
									[0.494]
L4. Telecommunications									−0.359
									[0.523]
L. dSum of export value by sector	−1.664	−1.765	−1.841	−1.693	−1.692	−1.806	−1.692	−1.759	−1.842
	[1.204]	[1.247]	[1.309]	[1.205]	[1.277]	[1.315]	[1.203]	[1.263]	[1.328]
L2. Sum of export value by sector	−0.325	−0.300	−0.505	−0.309	−0.188	−0.435	−0.354	−0.304	−0.406
	[0.791]	[0.837]	[0.907]	[0.812]	[0.850]	[0.922]	[0.791]	[0.877]	[0.969]
dTariffs hiOECD simple average	−0.032	−0.026	−0.041	−0.021	−0.024	−0.036	−0.021	−0.019	−0.028
	[0.083]	[0.084]	[0.085]	[0.082]	[0.085]	[0.085]	[0.083]	[0.083]	[0.085]
L. Tariffs hiOECD simple average	−0.066	−0.047	−0.071	−0.043	−0.049	−0.078	−0.054	−0.043	−0.074
	[0.135]	[0.135]	[0.136]	[0.132]	[0.134]	[0.136]	[0.136]	[0.134]	[0.136]
L. dGDP per capita	−4.255**	−1.179	−1.059	−4.050*	−2.402	−1.919	−4.633**	−1.463	−2.251
	[2.064]	[3.357]	[3.391]	[2.326]	[2.983]	[3.370]	[2.023]	[3.169]	[3.619]
L2. GDP per capita	−4.544***	−2.304	−2.670	−5.060***	−4.081**	−4.718**	−4.886***	−2.710	−4.462**
	[1.089]	[2.016]	[2.233]	[1.089]	[1.599]	[1.848]	[1.029]	[1.901]	[2.174]
dEBRD investment climate	−2.144	−0.433	−1.463	−3.362	−2.033	−1.308	−2.831	−1.295	−2.485
	[1.953]	[2.332]	[2.540]	[2.476]	[2.410]	[2.585]	[1.754]	[1.912]	[2.289]
L. EBRD investment climate	−3.458*	−0.872	−0.484	−3.078*	−3.122*	−1.515	−3.657**	−2.228	−1.774
	[1.811]	[1.959]	[2.218]	[1.659]	[1.677]	[2.163]	[1.732]	[1.657]	[2.109]
dInflation	−0.195	−0.108	−0.012	−0.021	−0.038	−0.066	−0.213	−0.132	−0.015
	[0.163]	[0.172]	[0.196]	[0.180]	[0.187]	[0.227]	[0.167]	[0.159]	[0.199]
L. Inflation	−0.309	−0.256	−0.142	−0.149	−0.134	−0.191	−0.386**	−0.298	−0.166
	[0.186]	[0.204]	[0.221]	[0.209]	[0.244]	[0.282]	[0.192]	[0.193]	[0.229]
Observations	1513	1455	1378	1513	1455	1378	1513	1455	1378
R-squared	0.51	0.48	0.48	0.51	0.48	0.48	0.51	0.48	0.48

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. d (100-H), where H is a Herfindahl index based on export value shares, as dependent variable. d in front of variable name means first difference. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000.

Table 6: Diversification, heterogeneity with respect to quantity

	1	2	3	4	5	6	7	8	9
	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H
Electric power	0.336								
	[0.726]								
Electric power x L. Sum of export quantity by sector	0.724								
	[0.668]								
L. Electric power		**1.156***							
		[0.688]							
L. Electric power x L. Sum of export quantity by sector		0.460							
		[0.691]							
L2. Electric power			0.762						
			[0.609]						
L2. Electric power x L. Sum of export quantity by sector			0.738						
			[0.761]						
Roads				−1.488					
				[1.011]					
Roads x L. Sum of export quantity by sector				**1.594*****					
				[0.571]					
L. Roads					−1.202				
					[1.212]				
L. Roads x L. Sum of export quantity by sector					**1.870*****				
					[0.654]				
L2. Roads						−0.545			
						[1.074]			
L2. Roads x L. Sum of export quantity by sector						**2.073*****			
						[0.691]			
Telecommunications							**1.467***		
							[0.767]		
Telecommunications x L. Sum of export quantity by sector							**1.514****		
							[0.659]		
L. Telecommunications								**1.179***	
								[0.672]	
L. Telecommunications x L. Sum of export quantity by sector								0.064	
								[0.503]	
L2. Telecommunications									**1.496*****
									[0.553]
L2. Telecommunications x L. Sum of export quantity by sector									−1.099*
									[0.623]
L. Sum of export quantity by sector	−0.662	0.072	−0.493	−2.503	−2.831	−3.062*	−3.403*	0.889	3.118
	[1.804]	[1.954]	[1.980]	[1.966]	[1.872]	[1.748]	[1.773]	[2.117]	[2.408]
L. Sum of export value by sector	0.871	0.696	0.836	0.837	0.827	0.985	0.867	0.718	0.640
	[0.770]	[0.815]	[0.820]	[0.698]	[0.729]	[0.747]	[0.801]	[0.788]	[0.746]
Tariffs hiOECD simple average	−0.013	−0.014	0.018	−0.003	−0.008	0.014	−0.028	−0.010	0.028
	[0.083]	[0.084]	[0.084]	[0.084]	[0.084]	[0.082]	[0.082]	[0.086]	[0.084]
L. GDP per capita	−1.324	−2.852**	−4.237***	−1.427	−3.099**	−4.717***	−1.863*	−3.072**	−4.078***
	[1.250]	[1.183]	[1.256]	[1.359]	[1.462]	[1.578]	[1.099]	[1.169]	[1.312]
EBRD investment climate	0.226	−0.920	0.346	1.559	−0.051	0.066	−0.343	−1.136	−1.298
	[2.134]	[1.727]	[1.889]	[1.715]	[1.766]	[2.057]	[1.880]	[1.654]	[1.794]
Inflation	−0.507**	−0.408**	−0.393**	−0.543*	−0.474**	−0.354*	−0.543**	−0.446**	−0.393**
	[0.244]	[0.193]	[0.182]	[0.275]	[0.222]	[0.178]	[0.242]	[0.194]	[0.186]
Observations	1771	1713	1653	1771	1713	1653	1771	1713	1653
R-squared	0.91	0.92	0.92	0.91	0.92	0.92	0.92	0.92	0.92

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. 100-H, where H is a Herfindahl index based on export value shares, as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000. Export quantity, q, is calculated as: q = (Export value of product)/(unit value of product), and then aggregated by summing up at the sector level.

Table 7: Diversification and financial vs. infrastructure services

	1	2	3	4	5	6	7	8	9
	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H
EBRD reform services in general	2.103								
	[1.859]								
L. EBRD reform services in general		**3.559****							
		[1.601]							
L2. EBRD reform services in general			**3.746****						
			[1.450]						
EBRD reform financial				1.166					
				[1.282]					
L. EBRD reform financial					**2.134***				
					[1.158]				
L2. EBRD reform financial						1.732			
						[1.235]			
EBRD reform infrastructure							1.207		
							[1.208]		
L. EBRD reform infrastructure								**1.896***	
								[1.056]	
L2. EBRD reform infrastructure									**2.567*****
									[0.961]
L. Sum of export value by sector	0.914	0.655	0.617	0.907	0.697	0.772	0.952	0.786	0.792
	[0.778]	[0.793]	[0.815]	[0.748]	[0.741]	[0.798]	[0.752]	[0.787]	[0.795]
Tariffs hiOECD simple average	–0.016	–0.017	0.014	–0.008	–0.014	0.014	–0.013	–0.008	0.019
	[0.083]	[0.086]	[0.081]	[0.084]	[0.086]	[0.080]	[0.084]	[0.086]	[0.083]
L. GDP per capita	–1.532	–3.941***	–6.014***	–1.368	–3.495***	–4.969***	–1.343	–3.401***	–5.362***
	[1.165]	[1.182]	[1.476]	[1.200]	[1.203]	[1.533]	[1.193]	[1.151]	[1.308]
EBRD investment climate	–0.148	–1.778	–1.654	0.778	–0.910	–1.212	–0.178	–1.714	–0.827
	[2.074]	[1.840]	[2.172]	[1.604]	[1.665]	[2.141]	[2.223]	[1.859]	[1.979]
Inflation	–0.475**	–0.326**	–0.320*	–0.496**	–0.365**	–0.342**	–0.491**	–0.378**	–0.324*
	[0.215]	[0.158]	[0.167]	[0.227]	[0.168]	[0.162]	[0.224]	[0.171]	[0.168]
Observations	1771	1713	1653	1771	1713	1653	1771	1713	1653
R-squared	0.91	0.92	0.92	0.91	0.92	0.92	0.91	0.92	0.92

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. 100-H, where H is a Herfindahl index based on export value shares, as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000.

11. Tables: Results Unit Values

Table 8: Unit values and specific infrastructure reforms

	1 ln u	2 ln u	3 ln u	4 ln u	5 ln u	6 ln u	7 ln u	8 ln u	9 ln u
Electric power	0.053*								
	[0.029]								
L. Electric power		0.070**							
		[0.029]							
L2. Electric power			0.060**						
			[0.028]						
Roads				–0.005					
				[0.033]					
L. Roads					0.065**				
					[0.032]				
L2. Roads						–0.008			
						[0.031]			
Telecommunications							0.076***		
							[0.020]		
L. Telecommunications								0.055***	
								[0.018]	
L2. Telecommunications									0.014
									[0.017]
L. Export value of product	0.546***	0.543***	0.564***	0.549***	0.558***	0.577***	0.555***	0.557***	0.577***
	[0.095]	[0.095]	[0.096]	[0.095]	[0.097]	[0.096]	[0.096]	[0.096]	[0.096]
Tariffs hiOECD simple average	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
L. GDP per capita	0.141***	0.168***	0.192***	0.143***	0.127***	0.183**	0.130***	0.148***	0.174***
	[0.033]	[0.048]	[0.072]	[0.036]	[0.047]	[0.071]	[0.031]	[0.043]	[0.060]
EBRD investment climate	0.032	0.106	0.243**	0.125	0.105	0.216*	0.051	0.106	0.205*
	[0.057]	[0.076]	[0.110]	[0.084]	[0.076]	[0.110]	[0.076]	[0.088]	[0.104]
Inflation	–0.003	–0.004	–0.003	–0.005	–0.005	–0.003	–0.007	–0.006	–0.003
	[0.007]	[0.007]	[0.007]	[0.007]	[0.006]	[0.006]	[0.007]	[0.007]	[0.006]
Observations	32603	31588	30529	32603	31588	30529	32603	31588	30529
R-squared	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.

Table 9: Unit values and specific infrastructure, ECM

	1	2	3	4	5	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
L. Unit value	−0.467***	−0.471***	−0.463***	−0.467***	−0.471***	−0.462***	−0.467***	−0.471***	−0.462***
	[0.021]	[0.022]	[0.022]	[0.021]	[0.022]	[0.022]	[0.021]	[0.022]	[0.022]
dElectric power	−0.017								
	[0.021]								
L. Electric power	0.034								
	[0.031]								
L. dElectric power		**0.046***							
		[0.023]							
L2. Electric power		**0.056***							
		[0.031]							
L2. dElectric power			**0.050***						
			[0.029]						
L3. Electric power			0.059						
			[0.040]						
dRoads				−0.005					
				[0.051]					
L. Roads				0.037					
				[0.032]					
L. dRoads					0.012				
					[0.042]				
L2. Roads					−0.016				
					[0.049]				
L2. dRoads						−0.010			
						[0.034]			
L3. Roads						−0.050			
						[0.030]			
dTelecommunications							**0.035***		
							[0.019]		
L. Telecommunications							**0.045****		
							[0.020]		
L. dTelecommunications								0.026	
								[0.018]	
L2. Telecommunications								0.010	
								[0.020]	
L2. dTelecommunications									0.001
									[0.021]
L3. Telecommunications									−0.006
									[0.022]
L. dSum of export value by sector	0.682**	0.696**	0.667**	0.692**	0.691**	0.677**	0.686**	0.706**	0.685**
	[0.306]	[0.307]	[0.308]	[0.304]	[0.306]	[0.307]	[0.304]	[0.306]	[0.308]
L2. Export value of product	0.032	0.057	0.051	0.040	0.066	0.056	0.042	0.067	0.058
	[0.115]	[0.115]	[0.118]	[0.116]	[0.116]	[0.118]	[0.117]	[0.116]	[0.117]
dTariffs hiOECD simple average	0.005	0.005	0.005	0.005	0.005	0.004	0.005	0.005	0.004
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
L. Tariffs hiOECD simple average	0.004	0.004	0.005	0.004	0.004	0.004	0.004	0.004	0.004
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
L. dGDP per capita	0.179*	0.300**	0.573***	0.168*	0.307**	0.493***	0.148	0.284**	0.462***
	[0.096]	[0.132]	[0.203]	[0.098]	[0.118]	[0.174]	[0.100]	[0.124]	[0.159]
L2. GDP per capita	0.091	0.174**	0.393**	0.075	0.185**	0.350***	0.083	0.165**	0.298**
	[0.056]	[0.086]	[0.151]	[0.056]	[0.073]	[0.126]	[0.059]	[0.077]	[0.115]
dEBRD investment climate	0.090	0.140	0.267**	0.035	0.133	0.222**	0.037	0.125	0.202**
	[0.073]	[0.088]	[0.114]	[0.069]	[0.105]	[0.096]	[0.077]	[0.081]	[0.088]
L. EBRD investment climate	0.150	0.233*	0.393**	0.172	0.319**	0.376**	0.130	0.275*	0.338*
	[0.092]	[0.121]	[0.196]	[0.122]	[0.138]	[0.177]	[0.126]	[0.142]	[0.170]
dInflation	0.001	0.009	0.017**	0.006	0.011	0.015*	0.001	0.011*	0.016*
	[0.007]	[0.007]	[0.008]	[0.007]	[0.007]	[0.009]	[0.007]	[0.006]	[0.008]
L. Inflation	−0.005	0.008	0.014	−0.002	0.006	0.009	−0.007	0.007	0.012
	[0.010]	[0.008]	[0.010]	[0.009]	[0.008]	[0.010]	[0.010]	[0.008]	[0.010]
Observations	27585	26620	25620	27585	26620	25620	27585	26620	25620
R-squared	0.48	0.48	0.46	0.48	0.47	0.46	0.48	0.47	0.46

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. First difference of log unit values as dependent variable. d in front of variable names means first difference. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.

Table 10: Specific infrastructure reforms and differentiate products

	1	2	3	4	4	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
Electric power	0.057*								
	[0.030]								
Electric power*Diff. prod. con.	–0.009								
	[0.013]								
L. Electric power		0.072**							
		[0.031]							
L. Electric power*Diff. prod. con.		–0.004							
		[0.015]							
L2. Electric power			0.051*						
			[0.030]						
L2. Electric power*Diff. prod. con.			0.013						
			[0.016]						
Roads				–0.043					
				[0.034]					
Roads*Diff. prod. con.				0.058***					
				[0.014]					
L. Roads					0.024				
					[0.034]				
L. Roads*Diff. prod. con.					0.066***				
					[0.013]				
L2. Roads						–0.039			
						[0.033]			
L2. Roads*Diff. prod. con.						0.050***			
						[0.014]			
Telecommunications							0.058***		
							[0.021]		
Telecommunications*Diff. prod. con.							0.009		
							[0.012]		
L. Telecommunications								0.042*	
								[0.022]	
L. Telecommunications*Diff. prod. con.								0.008	
								[0.012]	
L2. Telecommunications									0.012
									[0.021]
L2. Telecommunications*Diff. prod. con.									0.002
									[0.012]
L. Export value of product	0.511***	0.514***	0.532***	0.509***	0.519***	0.539***	0.519***	0.525***	0.544***
	[0.088]	[0.090]	[0.090]	[0.088]	[0.089]	[0.089]	[0.090]	[0.090]	[0.089]
Tariffs hiOECD simple average	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
L. GDP per capita	0.139***	0.172***	0.195***	0.141***	0.129***	0.186***	0.130***	0.153***	0.179***
	[0.034]	[0.048]	[0.066]	[0.035]	[0.046]	[0.067]	[0.033]	[0.043]	[0.055]
EBRD investment climate	0.034	0.111	0.250**	0.125	0.109	0.225**	0.062	0.115	0.213**
	[0.057]	[0.077]	[0.108]	[0.084]	[0.077]	[0.109]	[0.077]	[0.089]	[0.104]
Inflation	–0.006	–0.007	–0.005	–0.008	–0.007	–0.005	–0.009	–0.008	–0.005
	[0.008]	[0.008]	[0.008]	[0.008]	[0.007]	[0.007]	[0.008]	[0.008]	[0.007]
Observations	30238	29281	28282	30238	29281	28282	30238	29281	28282
R-squared	0.88	0.88	0.87	0.88	0.88	0.87	0.88	0.88	0.87

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. “Diff. prod. con.” means a dummy taking one if the product in question is a differentiated product according to Rauch’s (1999) conservative strategy. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. The infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.

Table 11: Unit values and specific infrastructure, differentiated products, country–year FE

	1	2	3	4	5	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
Electric power*Diff. prod. con.	–0.004								
	[0.014]								
L. Electric power*Diff. prod. con.		0.002							
		[0.015]							
L2. Electric power*Diff. prod. con.			0.016						
			[0.016]						
Roads*Diff. prod. Con.				**0.062*****					
				[0.014]					
L. Roads*Diff. prod. con.					**0.072*****				
					[0.013]				
L2. Roads*Diff. prod. con.						**0.055*****			
						[0.014]			
Telecommunications*Diff. prod. con.							0.011		
							[0.012]		
L. Telecommunications*Diff. prod. con.								0.008	
								[0.013]	
L2. Telecommunications*Diff. prod. con.									0.001
									[0.012]
L. Export value of product	0.593***	0.592***	0.626***	0.588***	0.587***	0.623***	0.592***	0.592***	0.628***
	[0.092]	[0.095]	[0.096]	[0.092]	[0.094]	[0.095]	[0.092]	[0.094]	[0.095]
Tariffs hiOECD simple average	–0.002	–0.002	–0.002	–0.002	–0.002	–0.002	–0.002	–0.002	–0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Observations	30726	29520	28282	30726	29520	28282	30726	29520	28282
R-squared	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. “Diff. prod. con.” Means a dummy taking one if the product in question is a differentiated product according to Rauch’s (1999) conservative strategy. The infrastructure measures are included as indices going from 1 to 4.3. Differentiated products classified according to Rauch’s conservative definition. All estimations include product–year, country–sector and country–year fixed effects. Period: 1989–2000.

Table 12: Unit values and financial vs. infrastructure services

	1	2	3	4	5	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
EBRD reform services in general	0.046								
	[0.043]								
L. EBRD reform services in general		**0.106****							
		[0.049]							
L2. EBRD reform services in general			**0.113****						
			[0.046]						
EBRD reform financial				–0.018					
				[0.026]					
L. EBRD reform financial					0.012				
					[0.026]				
L2. EBRD reform financial						0.041			
						[0.027]			
EBRD reform infrastructure							**0.071****		
							[0.032]		
L. EBRD reform infrastructure								**0.099****	
								[0.049]	
L2. EBRD reform infrastructure									**0.083****
									[0.037]
L. Export value of product	0.544***	0.544***	0.568***	0.553***	0.552***	0.572***	0.548***	0.551***	0.575***
	[0.095]	[0.096]	[0.096]	[0.095]	[0.095]	[0.096]	[0.095]	[0.096]	[0.096]
Tariffs hiOECD simple average	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
L. GDP per capita	0.135***	0.132***	0.126**	0.144***	0.154***	0.158**	0.127***	0.131***	0.141**
	[0.036]	[0.046]	[0.062]	[0.034]	[0.046]	[0.062]	[0.035]	[0.044]	[0.060]
EBRD investment climate	0.096	0.102	0.176*	0.125	0.137	0.193*	0.047	0.077	0.196**
	[0.075]	[0.077]	[0.094]	[0.078]	[0.089]	[0.105]	[0.077]	[0.067]	[0.095]
Inflation	–0.005	–0.004	–0.002	–0.006	–0.006	–0.002	–0.004	–0.004	–0.001
	[0.006]	[0.006]	[0.006]	[0.007]	[0.008]	[0.006]	[0.006]	[0.006]	[0.006]
Observations	32603	31588	30529	32603	31588	30529	32603	31588	30529
R-squared	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. The infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.

12. Appendix

Appendix table 1: Diversification, heterogeneity with respect to weighted average of unit values

	1	2	3	4	5	6	7	8	9
	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H
Electric power	0.441								
	[0.766]								
Electric power x L. Weighted average unit values	0.100								
	[0.467]								
L. Electric power		**1.306***							
		[0.708]							
L. Electric power x L. Weighted average unit values		–0.089							
		[0.433]							
L2. Electric power			1.062						
			[0.643]						
L2. Electric power x L. Weighted average unit values			–0.177						
			[0.499]						
Roads				–0.843					
				[0.921]					
Roads x L. Weighted average unit values				–0.123					
				[0.455]					
L. Roads					–0.382				
					[1.115]				
L. Roads x L. Weighted average unit values					–0.381				
					[0.533]				
L2. Roads						0.400			
						[0.999]			
L2. Roads x L. Weighted average unit values						–0.508			
						[0.625]			
Telecommunications							**1.943****		
							[0.835]		
Telecommunications x L. Weighted average unit values							–0.388		
							[0.411]		
L. Telecommunications								**1.329***	
								[0.684]	
L. Telecommunications x L. Weighted average unit values								–0.301	
								[0.385]	
L2. Telecommunications									**1.063***
									[0.603]
L2. Telecommunications x L. Weighted average unit values									0.194
									[0.403]
L. Weighted average unit values	–0.960	–0.578	–0.432	–0.605	–0.146	0.028	–0.011	–0.225	–1.007
	[0.901]	[0.719]	[0.754]	[0.801]	[0.821]	[0.862]	[0.796]	[0.642]	[0.644]
L. Sum of export value by sector	0.923	0.760	0.881	0.880	0.835	0.987	0.840	0.794	0.785
	[0.749]	[0.777]	[0.781]	[0.678]	[0.703]	[0.731]	[0.779]	[0.746]	[0.726]
Tariffs hiOECD simple average	–0.006	–0.008	0.024	0.004	0.002	0.020	–0.019	–0.003	0.028
	[0.082]	[0.083]	[0.082]	[0.083]	[0.082]	[0.081]	[0.080]	[0.084]	[0.083]
L. GDP per capita	–0.990	–2.646**	–3.961***	–0.870	–2.480*	–4.008***	–1.331	–2.992**	–4.235***
	[1.206]	[1.150]	[1.213]	[1.287]	[1.393]	[1.496]	[1.057]	[1.186]	[1.315]
EBRD investment climate	0.176	–1.103	0.162	1.129	–0.491	–0.380	–0.391	–1.237	–1.081
	[2.114]	[1.696]	[1.840]	[1.678]	[1.713]	[2.009]	[1.868]	[1.619]	[1.739]
Inflation	–0.487**	–0.387**	–0.366**	–0.522*	–0.444**	–0.339**	–0.523**	–0.426**	–0.390**
	[0.238]	[0.187]	[0.171]	[0.269]	[0.208]	[0.167]	[0.236]	[0.187]	[0.180]
Observations	1771	1713	1653	1771	1713	1653	1771	1713	1653
R-squared	0.91	0.92	0.92	0.91	0.92	0.92	0.92	0.92	0.92

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. 100-H, where H is a Herfindahl index based on export value shares, as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000. A weighted average of unit values u, wu, are calculated using the product value weights per country-sector as weights: $wu_{cit} = \sum_{p \in i} s_{cpt} u_{cpt}$.

Appendix table 2: Diversification, heterogeneity w.r.t. average unit values

	1	2	3	4	5	6	7	8	9
	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H	100-H
Electric power	0.955								
	[1.237]								
Electric power x L. average unit values	−0.226								
	[0.391]								
L. Electric power		**2.777*****							
		[1.014]							
L. Electric power x L. average unit values		−0.782**							
		[0.348]							
L2. Electric power			**2.473****						
			[0.990]						
L2. Electric power x L. average unit values			−0.787**						
			[0.344]						
Roads				−0.149					
				[1.106]					
Roads x L. average unit values				−0.426					
				[0.258]					
L. Roads					0.666				
					[1.433]				
L. Roads x L. average unit values					−0.757**				
					[0.345]				
L2. Roads						1.609			
						[1.443]			
L2. Roads x L. average unit values						−0.838*			
						[0.441]			
Telecommunications							1.947		
							[1.199]		
Telecommunications x L. average unit values							−0.084		
							[0.336]		
L. Telecommunications								1.462	
								[0.958]	
L. Telecommunications x L. average unit values								−0.152	
								[0.270]	
L2. Telecommunications									1.277
									[0.882]
L2. Telecommunications x L. average unit values									−0.073
									[0.258]
L. Average unit value	0.539	1.477**	1.390**	0.874*	1.438**	1.449**	0.317	0.425	0.265
	[0.786]	[0.605]	[0.625]	[0.480]	[0.577]	[0.714]	[0.720]	[0.532]	[0.470]
L. Sum of Export value by sector	0.894	0.737	0.870	0.814	0.745	0.920	0.838	0.770	0.775
	[0.786]	[0.824]	[0.830]	[0.723]	[0.747]	[0.773]	[0.830]	[0.793]	[0.770]
Tariffs hiOECD simple average	−0.013	−0.015	0.021	0.003	0.001	0.019	−0.024	−0.008	0.026
	[0.082]	[0.083]	[0.083]	[0.084]	[0.084]	[0.082]	[0.082]	[0.086]	[0.085]
L. GDP per capita	−1.116	−2.761**	−4.127***	−0.970	−2.525*	−3.995***	−1.387	−3.118***	−4.446***
	[1.220]	[1.101]	[1.150]	[1.324]	[1.359]	[1.447]	[1.056]	[1.171]	[1.284]
EBRD investment climate	0.187	−1.042	0.225	1.252	−0.376	−0.355	−0.337	−1.224	−1.046
	[2.138]	[1.697]	[1.863]	[1.703]	[1.706]	[2.034]	[1.868]	[1.629]	[1.786]
Inflation	−0.487**	−0.371**	−0.359**	−0.525*	−0.442**	−0.346**	−0.524**	−0.426**	−0.393**
	[0.238]	[0.178]	[0.163]	[0.270]	[0.204]	[0.163]	[0.237]	[0.186]	[0.180]
Observations	1771	1713	1653	1771	1713	1653	1771	1713	1653
R-squared	0.91	0.92	0.92	0.91	0.92	0.92	0.92	0.92	0.92

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. 100-H, where H is a Herfindahl index based on export value shares, as dependent variable. LX. means lagged X periods. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. Infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include sector–year and country–sector fixed effects. Period: 1989–2000. Average unit values are calculated as simple averages across products per sector.

Appendix table 3: Unit values and specific infrastructure reforms, controlled for contemporaneous export quantity

	1	2	3	4	5	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
Electric power	0.062**								
	[0.030]								
L. Electric power		0.068**							
		[0.028]							
L2. Electric power			0.050*						
			[0.027]						
Roads				0.003					
				[0.033]					
L. Roads					0.051				
					[0.031]				
L2. Roads						–0.018			
						[0.034]			
Telecommunications							0.077***		
							[0.019]		
L. Telecommunications								0.046***	
								[0.017]	
L2. Telecommunications									0.004
									[0.017]
Export quantity of product	–1.503***	–1.531***	–1.557***	–1.507***	–1.536***	–1.560***	–1.504***	–1.534***	–1.560***
	[0.124]	[0.127]	[0.129]	[0.123]	[0.126]	[0.128]	[0.123]	[0.125]	[0.128]
Tariffs hiOECD simple average	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
L. GDP per capita	0.160***	0.169***	0.186***	0.160***	0.136***	0.191***	0.150***	0.151***	0.177***
	[0.033]	[0.048]	[0.067]	[0.038]	[0.048]	[0.069]	[0.032]	[0.043]	[0.058]
EBRD investment climate	–0.024	0.050	0.172	0.077	0.051	0.157	0.008	0.053	0.144
	[0.063]	[0.076]	[0.106]	[0.080]	[0.078]	[0.108]	[0.074]	[0.085]	[0.101]
Inflation	–0.001	–0.002	–0.001	–0.003	–0.003	–0.001	–0.004	–0.004	0.000
	[0.008]	[0.008]	[0.007]	[0.007]	[0.007]	[0.007]	[0.008]	[0.008]	[0.006]
Observations	36268	35106	33939	36268	35106	33939	36268	35106	33939
R-squared	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. “Diff. prod. con.” means a dummy taking one if the product in question is a differentiated product according to Rauch’s (1999) conservative strategy. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. The infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.

Appendix table 4: Unit values and specific infrastructure reforms, controlled for lagged export quantity

	1	2	3	4	5	6	7	8	9
	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u	ln u
Electric power	0.052*								
	[0.029]								
L. Electric power		0.069**							
		[0.029]							
L2. Electric power			0.060**						
			[0.028]						
Roads				–0.003					
				[0.033]					
L. Roads					0.065**				
					[0.032]				
L2. Roads						–0.010			
						[0.031]			
Telecommunications							0.076***		
							[0.020]		
L. Telecommunications								0.054***	
								[0.018]	
L2. Telecommunications									0.013
									[0.017]
L. Export quantity product	–0.637***	–0.637***	–0.643***	–0.638***	–0.641***	–0.645***	–0.638***	–0.639***	–0.645***
	[0.107]	[0.112]	[0.117]	[0.107]	[0.112]	[0.117]	[0.107]	[0.112]	[0.117]
Tariffs hiOECD simple average	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
L. GDP per capita	0.144***	0.170***	0.193***	0.146***	0.129***	0.187***	0.133***	0.150***	0.176***
	[0.032]	[0.048]	[0.072]	[0.036]	[0.047]	[0.071]	[0.030]	[0.042]	[0.059]
EBRD investment climate	0.022	0.093	0.231**	0.113	0.092	0.205*	0.040	0.094	0.193*
	[0.057]	[0.075]	[0.108]	[0.083]	[0.075]	[0.109]	[0.075]	[0.088]	[0.103]
Inflation	–0.002	–0.004	–0.002	–0.005	–0.004	–0.002	–0.006	–0.005	–0.002
	[0.007]	[0.007]	[0.007]	[0.007]	[0.006]	[0.006]	[0.007]	[0.007]	[0.006]
Observations	32603	31588	30529	32603	31588	30529	32603	31588	30529
R-squared	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87

Note: Robust standard errors in brackets (std. errors are clustered on country–year.). * significant at 10%; ** significant at 5%; *** significant at 1%. Log unit values as dependent variable. LX. means lagged X periods. “Diff. prod. con.” means a dummy taking one if the product in question is a differentiated product according to Rauch’s (1999) conservative strategy. Tariffs are included in percent and linearly interpolated for missing values. Export values and GDP per capita are in log form. The infrastructure measures and the investment climate measure are included as indices going from 1 to 4.3. Inflation is included as percent/100. All estimations include product–year and country–sector fixed effects. Period: 1989–2000.