LUND UNIVERSITY
School of Economics and Management

Trade and Economic Growth

- Is trade with large trading partners beneficial for growth?

Abstract: Trade and economic growth have boomed over the latest centuries, and trade has for long been seen as an engine of economic growth. Research over the years has been consistent of the fact that there is a relationship between the two but it has not been established how this relationship works. This study contributes to earlier research by examining whether it is beneficial for domestic economic growth to trade with larger trading partners. In order to examine this we use a Solow-type model on a sample consisting of 34 OECD countries during the time period 1995-2012. Besides confirming the convergence hypothesis and somewhat a positive relationship between trade and growth the results show some signs of trade with larger economies having a positive impact on growth. However, more research is needed on this topic before we can conclude a statistically significant relationship.

Keywords: trade, growth, technological progress, innovation, OECD

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Abbreviations

The abbreviations are presented in order of appearance

RTA – Regional trade agreements

OECD – Organization for Economic Co-Operation and Development

GDP – Gross Domestic Product

SUR – Seemingly Unrelated Regressions

3SLS – Three-stage-least-squares

2SLS – Two-stage-least-squares

OLS – Ordinary least squares

1. Introduction

Economic growth and trade are two phenomena having flourished during the latest centuries (Van den Berg & Lewer 2007). There has been an extensive amount of research of the relationship between the two over the years, and there seems to be a common view among economists that trade has a positive impact on economic growth (Baldwin 2004). Though, how this relationship actually works has not been as well established as the existence of the relationship. In order to achieve economic growth it is important to know what causes growth, and if trade has a positive impact then it is important to understand how this impact works. Even small increases in the growth rate have a great impact in the long-run due to compounding effects (Van den Berg & Lewer 2007). Thus, even if trade only has a small impact on the growth rate the effect will be substantial in the long-run, and trade can be seen as an important contribution to growth.

Trade openness implies a larger market size since the available market does not only imply the domestic market but also the markets of trading partners (Alesina, Spolaore & Wacziarg 2005). Earlier research focusing on market size has concentrated on country size of the domestic market and its interaction with openness (Alesina, Spolaore & Wacziarg 1997, 2005; Spolaore & Wicziarg 2005). Both country size and openness were found to have a positive impact on growth, but the benefits of a large country decrease with openness. Besides a larger market size the interaction with trading partners makes it reasonable to assume that a country's trading partners have an impact on the country itself, for example regarding economic growth. Among earlier studies regarding the impact of trading partners we find studies focusing on the economic situation, output shocks and diversification of trading partners, which all show a positive relationship with economic growth (Arora & Vamvakidis 2001, 2004; Ahmed & Luongani 1999; Önder & Yilmazkuday 2014). An area that is not, to our knowledge, well studied so far is whether the size of trading partners has an impact on domestic economic growth. Thus, is it more beneficial to trade with larger countries? However, while studying the impact of regional trade agreements (RTAs) on economic growth Vamvakidis (1998) found that large and open neighbour countries have a positive impact on growth. Despite this result we do not know whether this is true for the size of trading partners in general. The aim of this study is therefor to extend and contribute to existing research of the relationship between trade and economic growth by focusing on whether larger trading partners has an impact on domestic economic growth.

Trade induces growth since it opens up for knowledge and technology to transfer across borders and thereby enhance innovation, which is the driving force of economic growth (Van den Berg & Lewer 2007; Romer 1990; Aghion & Howitt 2009). Besides a larger demand from export markets the larger market size also increases competition from foreign innovators and producers, forcing domestic ones to improve productivity and efficiency in order to compete with its foreign counterparts (Van den Berg & Lewer 2007; Melitz 2003; Melitz & Ottaviano 2008). Larger trading partners imply a greater market size than trade with smaller countries, and the competition could then be assumed to be even stronger. The impact of trade can also be assumed to be larger with larger trading partners since they have more resources available, lowering the opportunity costs of innovation and contributing to available profits for successful innovations (Van den Berg & Lewer 2007). It is thus valuable to examine whether the size of trading partners matters regarding economic growth.

In order to examine this we use a methodology in line with earlier studies focusing on growth and convergence using a Solow-type regression where we include trade weights in order to capture the impact of trading with larger economies. We use a time period of 1995-2012, which is chosen due to data access. Data for earlier years reduces rapidly in both access and quality. The sample of 34 countries in the Organization for Economic Co-Operation and Development (OECD) is chosen due to consistency with the convergence hypothesis of the Solow growth model (Sala-i-Martin 1996; Dowrick & Rogers 2002).

This study is structured as follows. We begin with a short overview of trade and growth and also present earlier research of the impact of market size on growth. We then present the theoretical motivation relevant for this study. Thereafter we present the chosen empirical methodology as well as data and descriptive statistics. After this we present the regression results from using our main model. Next we perform a sensitivity analysis in order to see if changes of the model will change the outcome. This is followed by a discussion of the results and regarding some difficulties one comes across when studying trade and growth. We end by concluding our findings and giving some suggestions for future research within this topic.

2. Trade and growth

In this chapter we present a short overview of trade and growth as well as earlier research regarding the impact of market size on domestic economic growth.

As was mentioned in the introduction trade and economic growth have boomed during the latest centuries (Van den Berg & Lewer 2007). Though, this pattern has not always been the case. Before the 19th century the global growth rate was basically zero. It took off during the 1800s and had an astonishing development until the 1970s when it slowed down. Trade is an older phenomenon than growth, but it also took of during the 1800s towards a substantial level of world production today.[1] Since growth and trade have had similar developments it is easy to assume a relationship. It is however not possible to conclude that there is a relationship just from a correlation between the two, and if there is a relationship whether growth spurs trade or the other way around. Trade has been seen as an engine of growth ever since Adam Smith and the relationship has been well examined over the years (Baldwin 2004). Even though there are some disagreements among economists there is a consensus that trade has a positive impact on growth. However, we know less of the channels through which trade actually affects growth. Studies have shown different results, differences that might occur due to different methodologies, data access or focus of the studies. The impact of market size on growth has had some focus, but mostly from the perspective of the domestic market size and its interaction with openness, and not in the way size of trading partners matter. Focus has been on the domestic market size despite the fact that there are studies showing that trading partners affect the growth outcome for the domestic economy.[2] As an example of the impact trading partners might have it can be mentioned that the economic situation, output shocks and number of trading partners all have shown to have a positive relationship with domestic growth (Arora & Vamvakidis 2001, 2004; Ahmed & Luongani 1999; Önder & Yilmazkuday 2014). These studies show that domestic economic growth tends to be affected by trading partners in several aspects. This along with the earlier mentioned impact of market size shows that there is an interest in studying the impact trading partners has on market size and on growth. In the next section we present earlier research regarding the impact of market size on growth.

[1] Trade reached 25 per cent of world Gross Domestic Product (GDP) in 2005.
[2] We will use country and economy as synonyms throughout this study.

2.1. Earlier research

When studying the impact of RTAs on economic growth Vamvakidis (1998) examined whether a country benefits from having large open neighbours. The results showed that larger open neighbour countries have a positive impact on domestic economic growth compared to smaller open neighbours having less of an impact or no impact at all. Since the focus is on neighbouring countries the study does not give a general impact of size of trading partners. Other studies examining the impact of market size on growth have focused on the size of the domestic market and its interaction with openness. Alesina, Spolaore and Wacziarg (1997, 2005) in two studies examine the impact of country size and openness on growth and found that there are economic benefits from domestic country size but that country size and openness are substitutes. The impact of country size decreases with openness. Thus, market size matters but it matters less whether the market is a large domestic market or a larger market due to including trading partners. A large country gains less from openness since it has many advantages of a large market in the domestic market, while a small country have access to the benefits of a large market due to trade openness. Spolaore and Wacziarg (2005) confirmed these findings when estimating a hypothetical removal of national borders of country pairs. The results of Kahnamoui (2013) are not fully consistent with the above conclusion of the impact of market size on growth. They also focus on domestic country size when examining whether market size affects the impact of trade policy on growth, using trade openness as a measure of trade policy. Their findings show that trade openness has a positive impact on growth, while different measures of market size and the interaction between openness and market size show varying impacts on growth. Önder and Yilmazkuday (2014) also perform a study touching the topic of market size but from another angle, namely whether more trading partners is positive for economic growth. They find that trade partner diversification has a positive impact on growth.

These studies are summarized in table 1 in order to give an overview of their methodologies and results. What they have in common is that they all examine the impact of market size, but from different angles. The majority concludes that market size does matter for domestic economic growth, even though the results are not fully consistent. The fact that large countries and openness show to be substitutes implies that it is the market size that matters, not specifically the domestic country size. Trade creates a larger market and larger trading partners imply an even larger market. In the next chapter we present the theoretical motivation for examining the relationship of large trading partners and growth.

Table 1 – Earlier studies of market size and growth.

Year	Author	Topic	Data/sample	Method	Results
1997	Alesina, Spolaore & Wacziarg	The impact of economic and political integration on economic growth.	Countries not specified in paper. Time period 1960-1989.	Multivariate regression. SUR and 3SLS estimations.	There is a trade-off between domestic market size and openness. The benefits from country size decrease with openness.
1998	Vamvakidis	The impact of neighbour countries on domestic economic growth.	Not specified in paper.	Not specified in paper.	Large and open neighbour countries have a positive impact on domestic growth.
2005	Alesina, Spolaore & Wacziarg	The impact of domestic country size and openness on domestic growth.	113 countries for the time period 1960-2000.	SUR and 3SLS estimations.	Market size matters for economic growth, but for an open economy the domestic market matters less.
2005	Spolaore & Wacziarg	Studies growth effects of increased domestic market size by estimating a hypothetical removal of national borders of country pairs.	92 countries for the time period 1960-1989.	3SLS estimations and SUR regressions.	Country size has a positive impact on growth, but the impact is decreasing with openness.
2013	Kahnamoui	Examine whether market size affects the impact of trade policy on growth.	60 countries for the time period 1970-2009	OLS regressions	Different measures of market size give different impacts on growth.
2014	Önder & Yilmazkuday	Examine the impact of trade partner diversification on growth.	83 countries for the time period 1965-2004.	2SLS estimations.	Trade partner diversification has a positive impact on growth.

Note: SUR: Seemingly Unrelated Regressions, 3SLS: three-stage-least-squares, OLS: ordinary least squares, 2SLS: two-stage-least-squares.

3. Theoretical motivation

In this chapter we present a theoretical motivation for the relationship between domestic growth, trade and size of trading partners. We begin with underlying factors behind economic growth using an extended version of the neoclassical Solow model where we consider technological progress to be driven by innovation. Thereafter follows a discussion of how trade has an impact on growth, and also more specifically the impact of large trading partners.

3.1. Underlying factors of economic growth

The seminal growth model of Solow emphasizes the role of capital accumulation as a driving force of output and economic growth (Van den Berg & Lewer 2007; Aghion & Howitt 2009). An increase in capital per person implies an increase in output per person and the economy grows. It is common within economics to use per capita terms since an increase in total capital and output does not necessarily translate to an improvement for the individual. Capital accumulation is determined by investments in new productive capital, depreciation of existing capital and population growth. Investments, in turn, are dependent on society's eagerness to save (Van den Berg & Lewer 2007). Savings is a constant fraction of income from the previous period and translates directly to investments of new capital, although with diminishing returns. The previous period is a determinant also for depreciation since capital depreciates at a constant rate of existing capital. Population growth implies, ceteris paribus, lower capital per person since more people share the capital stock. When investments exceed depreciation and the cost of population growth capital per person grows, leading to increased output per person. Though, due to diminishing returns there will be a point where investments only manage to cover these costs and capital per person is constant (Jones 2002). The economy has then reached a steady state equilibrium where the growth rate of capital and output per person is zero. Capital accumulation by itself is thus not enough to achieve long-run permanent growth. Technological progress is included for this purpose since it is assumed to offset diminishing returns to capital, keeping investments above the amount required to keep capital per person constant. Technological progress is thus the driving force of capital accumulation and long-run growth. However, since the Solow model assumes technological progress to be exogenous we need to extend the model in order to find what causes such progress and to be able to understand how trade can affect growth. We do this by considering the impact innovation is assumed to have on technological progress. In the aftermath of the

Solow model technological progress has been assumed to be driven by innovations creating new methods, technologies and contributing to more knowledge, all of which enhances further innovation and further technological progress in an on-going process (Van den Berg & Lewer 2007; Aghion & Howitt 2009). Innovations occur if expected profits from successful innovations exceed costs of innovating. Costly resources and efforts are employed to create new products, methods or techniques in order to gain advantage over existing producers and reach market power (Van den Berg & Lewer 2007; Romer 1990; Aghion & Howitt 2009). This process is known as creative destruction since the creation of new and improved innovations will destroy and replace out-dated ones. Fixed costs of innovating, such as research costs, imply imperfect competition and positive profits serving as a reward for innovating. Imperfect competition, in turn, implies scale economies and more specialized innovation and production with increased efficiency (Van den Berg & Lewer 2007; Krugman 1981; Aghion & Howitt 2009).

Innovation is enhanced by knowledge, research and technology, which exist to a larger extent in an economy with more resources (Van den Berg & Lewer 2007). The more resources an economy has the lower is their opportunity cost of conducting research, and the lower is the cost of innovating. The rates of technological progress will be faster for wealthier economies. A larger population can also be argued to have a larger source of knowledge and ideas that can be combined when innovating, and is thus also a source of faster growth. Before we move on to how trade impacts growth we will devote some attention to the concept of convergence.

3.1.2. Convergence

Due to diminishing returns there is an inverse relationship between growth rate and initial capital per person, meaning that a poorer economy is assumed to grow at a faster rate than a richer economy (Sala-i-Martin 1996). This implies an assumption of convergence among poor and rich countries. Equation (1) can be used to examine convergence from this perspective.

$$ln\frac{y_{i,t}}{y_{i,t-1}} = \beta_0 + \beta_1 lny_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

On the left hand side we have the growth rate for country i from time t-1 to t. On the right hand side we have, besides an intercept and an error term, GDP per capita in country i at time t-1. Due to diminishing returns we would expect the coefficient for β_1 to be negative, showing

that a higher initial position would have a negative impact on the growth rate. This would imply that poor countries grow at a faster rate, converging to rich countries. This, however, relies on initial capital being the only factor that differs between countries. Empirics show that we do not see convergence among poor and rich countries in a global perspective. Though, convergence among countries more similar to each other, such as the OECD countries, has been shown (Sala-i-Martin 1996; Dowrick & Rogers 2002). Convergence occurs if countries share the same steady state. This concept is called conditional convergence since convergence is conditional on steady state determining factors (Sala-i-Martin 1996; Jones 2002; Aghion & Howitt 2009). When controlling for these factors equation (1) is extended to equation (2), where $Z_{i,t}$ is a vector of factors that determine the steady state, such as trade. Conditional convergence is present if the coefficient for β_1 is negative.

$$ln\frac{y_{i,t}}{y_{i,t-1}} = \beta_0 + \beta_1 lny_{i,t-1} + \beta_2 Z_{i,t} + \varepsilon_{i,t} \quad (2)$$

3.2. General impact of trade on economic growth

We know from above that technological progress is necessary for long-run growth and that innovation is the driving force of technological progress. Hence, if trade is to facilitate growth it needs to have a positive impact on innovations. There are several ways for trade to accomplish this. Firstly, trade enhances the stock of knowledge available for innovators since knowledge and ideas can transfer across borders (Van den Berg & Lewer 2007; Rivera & Romer 1990). The more knowledge there is, the easier it is to increase knowledge further and to innovate. Importing new products and services is a direct channel for transferring knowledge, ideas and technology from abroad and use in domestic innovation or production (Van den Berg & Lewer 2007). Secondly, an integrated market implies that there are more resources available for production and innovative activity. A larger demand for output and larger supply of resources imply more rapid innovation compared to the situation of non-trading economies. More resources also give larger expected profits available compared to an autarky situation, serving as motivation for innovations. Thirdly, trade increases competition for domestic producers. They are forced to increase productivity and efficiency, and to innovate and apply innovations more rapidly, in order to keep the domestic market and to be able to compete on foreign markets. The stronger competition from abroad enhances the effect of less productive and efficient innovators and producers leaving the market (Melitz 2003; Melitz & Ottaviano 2008).

Trade and imperfect competition encourages economies of scale and increased specialization in innovation and production (Krugman 1981; Kahnamoui 2013). Scale economies in turn enhance intraindustry trade (Krugman 1981). This corresponds quite well to global trade today, which to a large extent takes place between countries with similar endowments. Increased specialization drives innovation further, and the resulting technology growth drives specialization even further, which then stimulates further innovation, and so on (Van den Berg & Lewer 2007). Increased specialization also contributes to increased competition where successful innovators will gain market power over out-dated innovations and the latter will exit the market, keeping technological progress moving forward.

3.3. Larger trading partners

It was mentioned above that larger economies, both regarding wealth and population, are assumed to experience a faster technological and economic growth than smaller economies (Van den Berg & Lewer 2007). It should then be reasonable to assume that trading with larger economies should have an even greater positive impact on domestic growth. Knowledge and technology transfer can be assumed to be stronger since larger economies have more knowledge and a stronger technological progress. Larger trading partners should therefore imply a larger access to knowledge and technology that can be used in domestic innovation and production, moving domestic technology forward and enhancing long-run growth. Larger trading partners should also imply more resources available for innovative activities as well as for available profits for successful innovators (Van den Berg & Lewer 2007). It should also be reasonable to assume a stronger competition effect, where domestic innovation and production needs to be efficient and productive enough to compete with their foreign counterparts (Melitz 2003; Melitz & Ottaviano 2008). Thus, the ways for trade to have an impact on technological progress and economic growth can be assumed to be stronger with larger trading partners. We will now move on to the empirical part of this study, where we begin by presenting the methodology we will use.

4. Assessing trade effects

In this chapter we present the empirical approach used in this study. We begin by introducing the empirical specification and thereafter present data and descriptive statistics.

4.1. Empirical specification

In line with the theoretical reasoning described above as well as with earlier studies focusing on growth and convergence we use a Solow-type regression model when examining the impact of larger trading partners on domestic growth (Aghion & Howitt 2009; Alesina, Spolaore & Wacziarg 2005). OLS regressions are performed using equation (3).

$$ln\frac{y_{i,t}}{y_{i,t-1}} = \beta_0 + \beta_1 lny_{i,t-1} + \beta_2 lntrade\_size_{i,t} + \beta_3 openness_{i,t} + \beta_3 Z_{i,t} + \varepsilon_{i,t} \qquad (3)$$

As is common when studying growth the dependent variable is the change in GDP per capita from time t-1 to t (Van den Berg & Lewer 2007; Alesina, Spolaore & Wacziarg 2005). As for the explanatory variables GDP per capita$_{t-1}$ is included to address the issue of convergence (Kahnamoui 2013; Sala-i-Martin 1996; Dowrick & Rogers 2002). We assume an increase in GDP per capita$_{t-1}$ to have a negative impact on growth. The variable of special interest is *lntrade_size*, capturing the impact of size of trading partners on domestic growth. We will refer to this variable as the trade_size variable. Equation (4) gives an overview of the procedure we have used when creating this variable. We created trade weights in such a way that imports from country j to country i is divided with total imports from the OECD countries to country i. This weight is then multiplied with the size of country j.

$$trade\_size_i = \sum_j \frac{imports_{ji}}{imports_{OECDi}} * country\ size_j \qquad (4)$$

As size of countries we use both aggregated GDP and population. By doing this we examine the impact both of economic and demographic size (Alesina, Spolaore & Wacziarg 2005). A positive regression coefficient implies that increasing imports from larger countries would have a positive impact on growth. We use two measures of openness: trade as percentage of GDP and imports as percentage of GDP. An increase in openness is assumed to have a positive impact on growth. $Z_{i,t}$ is a vector of control variables, where we have included interaction terms between *lntrade_size* and *openness* to see if the impact of large trading

partners changes with openness. A positive interaction term would imply that a more open country has larger benefits from trading with larger trading partners. We also include additional control variables commonly used in growth models as a robustness test (Alesina, Spolaore & Wacziarg 2005). We then control for male and female human capital, fertility rate, the rate of government consumption to GDP and the rate of investment to GDP. An error term is also included in the regressions. We include dummy variables for each year, except for the first year to avoid the dummy variable trap, in order to capture growth differences due to time varying factors that may affect growth. We provide a description of all variables in table 2.

4.2. Data and descriptive statistics

The chosen sample consists of 34 OECD countries.[3] The choice of countries is motivated by the fact that the Solow model with its convergence hypothesis has been shown more accurate for countries relatively similar to each other, such as the OECD members (Sala-i-Martin 1996; Dowrick & Rogers 2002). The time period consists of the years 1995-2012. It would of course have been preferable to study a longer time period since it is the long-run that is of importance, but for years before 1995 the availability and quality of data reduces rapidly. When examining growth effects it is common to use five- or ten-year averages in order to avoid short-run fluctuations (Busse & Königer 2012). We follow this procedure focusing on five-year averages due to the relatively short time period. Since our time period is 18 years we use three five-year averages for the first fifteen years and a three-year average for the last three years. Hence, the time dummy variables mentioned above are period dummies. We present descriptive statistics of the variables in table 2. We thereafter move on to the next chapter where we present the regression results.

[3] Included member countries are those being or becoming a member country during the time period of 1995-2012 (OECD 2016). The member countries are listed in Table i in the appendix, where it is also stated which countries that are included and not.

Table 2 – Descriptive statistics.

Variable	Description	Mean	Minimum	Maximum
growth	GDP per capita at time t divided by GDP per capita at time t-1.	1.252	0.737	2.540
$GDPpc_{t-1}$	GDP per capita at time t-1.	27733.06	2896.091	11.545
trade_size, GDP	Weighted imports multiplied with country size, where aggregated GDP is the measure of country size.	3100000000000	1200000000000	11300000000000
trade_size, pop	Weighted imports multiplied with country size, where population is the measure of country size.	83900000	41700000	233000000
open_trade	Openness: total trade as percentage of GDP.	0.868	0.189	3.382
open_imports	Openness: imports as percentage of GDP.	0.425	0.088	1.536
inter_GDPtrade	open_trade multiplied with trade_size, GDP.	2510000000000	346000000000	9720000000000
inter_GDPimp	open_imports multiplied with trade_size, GDP.	1220000000000	196000000000	4410000000000
inter_poptrade	open_trade multiplied with trade_size, pop.	67200000	14900000	216000000
inter_popimp	open_imports multiplied with trade_size, pop.	216000000	7985041	216000000
fertility	Fertility: births per woman.	1.698	1.158	3.02
female_edu	Female education: enrolment rates at secondary level of education.	1.049	0.515	1.575
male_edu	Male education: enrolment rates at secondary level of education.	1.038	0.621	1.562
expenditure	Rate of government consumption to GDP	0.189	0.107	0.271
investments	Rate of investment to GDP.	0.234	0.149	0.327

Note: the number of observations is 136. Import data used to create trade weights is gathered from the UN Comtrade database, and data of total GDP and population, as well as data for the other variables, are collected from the World Development Indicator. While some variables are logged in the regressions they are not logged in this table for the convenience of the reader.

5. Results

In this section we present the regression results from using our main model where we include the variables of most interest for this study.

5.1. Regression results

Table 3 and table 4 are identical besides the trade_size measure that is used. In the regressions presented in table 3 we have used aggregated GDP as country size while population is used as country size in table 4. In the first two columns the regressions include GDP per capita in time period t-1, the trade_size measure and openness as explanatory variables, and in the last two columns we also include our interaction terms. Focusing on table 3 we see that all four regressions show the expected negative impact of initial GDP per capita. These coefficients are highly significant and thereby confirm the convergence hypothesis discussed in the theoretical section. The trade_size measure is positive in all regressions and thus in line with our theoretical approach of trade with larger economies having a positive impact on growth.

Table 3 – Regression results using GDP as country size in the trade_size measure.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.110***	-0.107***	-0.109***	-0.105***
	(0.020)	(0.020)	(0.021)	(0.021)
lntrade_size, GDP	0.004	0.005	0.025	0.036
	(0.036)	(0.037)	(0.075)	(0.079)
open_trade	0.052*		0.879	
	(0.021)		(2.218)	
open_imports		0.102*		2.694
		(0.046)		(4.923)
inter_GDPtrade			-0.029	
			(0.078)	
inter_GDPimp				-0.091
				(0.173)
R^2	0.652	0.650	0.652	0.650

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

However, the coefficients are not significant so we cannot put too much emphasize on their results. Both openness measures show a positive and significant impact on growth in columns (1) and (2), implying that an increase in openness would have a positive impact on growth. In column (3) and (4) openness is insignificant, as are the interaction terms. In table 4 the results are similar to those in table 3. Columns (1) and (2) show the same pattern while in columns (3) and (4) the trade_size measures and openness become negative and the interaction terms positive. However, neither trade_size, openness nor the interaction terms are significant.

Table 4 – Regression results using population as country size in the trade_size measure.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.110***	-0.107***	--0.111***	-0.108***
	(0.020)	(0.020)	(0.020)	(0.020)
lntrade_size, pop	0.007	0.007	-0.021	-0.017
	(0.041)	(0.042)	(0.108)	(0.114)
open_trade	0.053*		-0.682	
	(0.021)		(2.216)	
open_imports		0.103*		-1.182
		(0.046)		(4.892)
inter_poptrade			0.040	
			(0.124)	
inter_popimp				0.071
				(0.273
R^2	0.651	0.650	0.652	0.650

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

So far the convergence hypothesis is confirmed in all regressions and openness is shown by several regressions to have a positive impact on growth. The impact of trade with large trading partners cannot be ensured despite that several regressions show a positive impact since the coefficients are insignificant. In addition to the factors we have controlled for in these regressions there are other factors that might have an impact on the outcome. We will therefore perform a sensitivity analysis where we change the model in different ways to see if the outcome changes.

6. Sensitivity analysis

We begin this analysis by controlling for country specific effects, and thereafter continue by including more control variables to our main model and lastly we perform regressions using ten-year averages.

6.1. Country specific effects

In table 5 and 6 we see the regression results from including controls for country specific effects, where table 5 show results from using aggregated GDP as country size in our trade_size measure and table 6 population. The convergence hypothesize is again confirmed in table 5, and the other variables show the same pattern as in table 3 but none of them are significant. We see on the R^2 values that controlling for country specific effects increases the explanatory power of the model compared to the earlier regressions.

Table 5 – Regression results controlling for country specific effects.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.622***	-0.620***	-0.624***	-0.617***
	(0.100)	(0.100)	(0.102)	(0.101)
lntrade_size, GDP	0.213	0.209	0.384	0.346
	(0.228)	(0.229)	(0.306)	(0.331)
open_trade	0.135		3.615	
	(0.098)		(3.835)	
open_imports		0.217		6.011
		(0.219)		(9.562)
inter_GDPtrade			-0.120	
			(0.131)	
inter_GDPimp				-0.200
				(0.326
R^2	0.803	0.802	0.805	0.803

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Moving on to table 6 we see the same pattern for the impact of initial GDP per capita as earlier, and openness being positive and significant in column (1). What stands out in these

regressions is that the trade_size coefficients show a positive and significant impact on growth. Increasing trade with economies having large populations would have a positive impact on growth. Thus, these regressions support the theoretical motivation of trading with larger economies. Just as was seen in table 5 the model's explanatory power is higher compared to our main model. Country specific effects thus seem to have an impact on a country's growth performance. These effects may correlate with trade_size in a way that omitted variables problems arise without them (Verbeek 2012).

Table 6 – Regression results controlling for country specific effects

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.650***	-0.647***	-0.670***	-0.667***
	(0.095)	(0.095)	(0.099)	(0.101)
lntrade_size, pop	0.610*	0.604*	0.857*	0.894*
	(0.266)	(0.268)	(0.367)	(0.397)
open_trade	0.173†		3.939	
	(0.101)		(3.351)	
open_imports		0.310		9.615
		(0.222)		(8.521)
inter_poptrade			-0.211	
			(0.187)	
inter_popimp				0.521
				(0.475)
R^2	0.812	0.810	0.814	0.813

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows:† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.2. Adding control variables

Next we include more control variables to our main model. The regression results are presented in table 7 and table 8, where the first presents the results using GDP as country size in the trade_size measure and the latter uses population. For the variables of most interest we see the same pattern as in our main model. The convergence hypothesis is again confirmed, as well as the positive impact of openness in columns (1) and (2). The trade_size measures are in some regressions negative and positive in others but stays insignificant. The interaction terms

are not significant. Most of the control variables are in line with results found in other growth studies, but neither one of them is significant (Alesina, Spolaore & Wacziarg 2005).

Table 7 – Regression results including more control variables.

Variable	(1)	(2)	(3)	(4)
lnGDPpc$_{t-1}$	-0.109***	-0.106***	-0.107***	-0.103***
	(0.024)	(0.023)	(0.024)	(0.024)
lntrade_size, GDP	-0.017	-0.018	0.004	0.015
	(0.040)	(0.040)	(0.078)	(0.082)
open_trade	0.053*		0.915	
	(0.022)		(2.221)	
open_imports		0.102*		2.906
		(0.048)		(4.889)
inter_GDPtrade			-0.030	
			(0.078)	
inter_GDPimp				-0.098
				(0.172)
fertility	0.054	0.054	0.054	0.056
	(0.052)	(0.053)	(0.052)	(0.052)
female_edu	-0.080	-0.071	-0.082	-0.074
	(0.201)	(0.201)	(0.203)	(0.203)
male_edu	0.179	0.168	0.183	0.175
	(0.253)	(0.252)	(0.254)	(0.253)
expenditure	-0.203	-0.231	-0.218	-0.254
	(0.518)	(0.518)	(0.518)	(0.518)
investments	0.580	0.572	0.564	0.544
	(0.450)	(0.453)	(0.456)	(0.459)
R^2	0.662	0.656	0.662	0.660

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.3. Ten-year averages

Lastly we regress our main model using ten-year averages, where the results are shown in table ii and table iii in the appendix. Since our time period consists of 18 years we have one

ten-year period for 1995-2004 and one eight-year period for 2005-2012, implying that the number of observations is now 68. The results are mostly in line with the corresponding results from using five-year averages shown earlier in table 3 and 4. The convergence hypothesis is confirmed, and there are signs of openness having a positive and significant impact on growth while the trade_size measures and interaction terms are not significant. In the next chapter we discuss the results from both the main model and the sensitivity analysis.

Table 8 – Regression results including more control variables.

Variables	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.109***	-0.106***	-0.109***	-0.107***
	(0.024)	(0.023)	(0.024)	(0.116)
lntrade_size, pop	-0.015	-0.017	-0.043	-0.038
	(0.046)	(0.046)	(0.110)	(0.116)
open_trade	0.053*		-0.669	
	(0.022)		(2.230)	
open_imports		0.102*		-1.048
		(0.049)		(4.912)
inter_poptrade			0.040	
			(0.124)	
inter_popimp				0.064
				(0.274)
fertility	0.052	0.052	0.052	0.052
	(0.052)	(0.053)	(0.053)	(0.053)
female_edu	-0.082	-0.072	-0.082	-0.071
	(0.201)	(0.202)	(0.202)	(0.203)
male_edu	0.177	0.167	0.175	0.164
	(0.252)	(0.252)	(0.252)	(0.252)
expenditure	-0.190	-0.222	-0.187	-0.220
	(0.526)	(0.526)	(0.527)	(0.527)
investments	0.576	0.569	0.586	0.575
	(0.451)	(0.453)	(0.460)	(0.462)
R^2	0.662	0.659	0.661	0.660

Note: The number of observations is 136. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7. Discussion

In this section we discuss our findings, focusing on the variables of most interest. We will also devote some attention towards difficulties one comes across when studying the relationship between trade and growth.

Starting with the impact of GDP per capita in time t-1 all regressions show a negative impact on growth. The existence of conditional convergence, besides confirming the convergence hypothesis, supports the choice of a Solow-type model over endogenous growth models despite our extension of the Solow model (Sala-i-Martin 1996). Endogenous models often exclude the assumption of diminishing returns and then do not assume convergence to occur. The existence of convergence in our results is also in line with what has been found in earlier studies about convergence among the OECD countries (Sala-i-Martin 1996; Dowrick & Rogers 2002). Moving on to the impact of large trading partners the trade_size coefficients do not show consistency in the regressions. In most regressions the coefficients are not significant, meaning that we cannot interpret them or draw any conclusions from them. However, when controlling for country specific effects there is a positive and significant impact of trading with economies having a large population, which supports the theoretical reasoning of the impact of large trading partners. This result is interesting since a model with country fixed effects can be argued being more demanding due to controlling for everything that does not change over time (Verbeek 2012). The fact that it controls for all time-invariant factors also makes it difficult to speculate on what it is that influences the results. This control does however reduce potential endogeneity in the form of omitted variable bias, which might be the reason for the explanatory power to be higher for the regressions where we control for these effects. The fixed effects could correlate with trade_size, and other variables, in a way that omitted variable bias appears when a control for fixed effects is not included. Even though there is a positive and significant impact of trading with economies having a large population we cannot conclude a relationship since several regressions show an insignificant impact. It does however support the need for more research within this topic. Both when controlling for country specific effects and in our other regressions it would have been preferable to have more observations per country. A longer time period would also imply that the long-run could be studied. It would also have been interesting to use a sample consisting of a larger number of countries relatively similar to each other. The next variable of interest is openness and its impact on growth. We have to be careful when interpreting the positive and

significant impact found in several regressions, not just because not all regressions show a significant impact but also since endogeneity could be present. When examining the relation between trade and growth one large difficulty is how to measure openness (Alesina, Spolaore & Wacziarg 2005; Andersen & Babula 2008; Busse & Königer 2012). Trade as a percentage of GDP, which we have used in this study, is a common measure to use. However, we cannot conclude a causal relationship where trade enhances growth. Trade might spur growth or there might be a bidirectional relationship between the two, causing biased OLS estimates (Andersen & Babula 2008). Potential endogeneity in this form is a problem when studying trade and growth and economists have tried to avoid this issue in different ways, such as using other openness measures or different methodologies. Among openness measures there have been, for example, an openness index created by Sachs & Warner (1995) or using trade or imports as share of lagged GDP as openness as argued by Busse & Königer (2012). Another way to address this issue has been to use an instrumental variable approach, such as the study by Frankel and Romer (1999) where they use geographical instruments and then compare these regression results to OLS estimates. They however find that the OLS estimates do not overestimate the impact of trade on growth. An instrumental approach in line with theirs has been argued to be a promising way to address potential endogeneity (Andersen & Babula 2008). Though, all of these approaches, both regarding openness and methodologies, have their own difficulties and problems and there is yet today no consensus among economists about which way to go. It would however be interesting for future studies of this specific topic to try to address potential endogeneity in order to see if the results stabilize. Even though it is not possible for us to conclude a causal relationship where trade spurs growth the positive and significant impacts do confirm a positive correlation between trade and growth, which is in line with earlier studies as has been mentioned earlier. Lastly among the variables of special interest we have the interaction variables, capturing the impact of whether a more open economy benefits more from trade with larger trading partners. All regressions show insignificant coefficients and they can thus not contribute to any conclusions regarding the impact of openness and trade with larger trading partners. We will now conclude our findings in the next section.

8. Conclusion

The aim for this study was to examine whether trade with large economies has a positive impact on domestic economic growth. In order to do this we used a Solow-type model where we included trade weights capturing the impact of trading with large economies. We used a sample consisting of 34 OECD countries during the time period 1995-2012. While supporting the convergence hypothesis and somewhat also a positive relationship between openness and growth, the regression results regarding the impact of trade with large economies do not show consistency. Most regressions show insignificant impacts but when controlling for country specific effects one of our measures of trade_size show a positive and significant impact on growth. However, since this was only for one version of the model we cannot conclude that trade with large economies has a positive impact on growth. This specific research area is still rather unexplored and it would be interesting for future studies to use a similar approach but for a longer time period, and also for a larger sample of countries. It would also be valuable for future studies to address the issue of potential endogeneity regarding openness and growth by using, for example, an instrumental approach or other openness measures.

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Appendix

Table i – An overview of the OECD member countries.

OECD member countries	
Australia	Korea
Austria	Latvia*
Belgium	Luxembourg
Canada	Mexico
Chile	Netherlands
Czech Republic	New Zealand
Denmark	Norway
Estonia	Poland
Finland	Portugal
France	Slovakia
Germany	Slovenia
Greece	Spain
Hungary	Sweden
Iceland	Switzerland
Ireland	Turkey
Israel	United Kingdom
Italy	USA
Japan	

*Latvia is excluded from the sample since it became a member in 2013, which is after the time period for this study. Source: OECD (2016).

Table ii – Ten-year averages. GDP as country size in the trade size measure.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.201***	-0.197***	-0.199***	-0.193***
	(0.033)	(0.033)	(0.035)	(0.036)
lntrade_size, GDP	0.004	0.004	0.034	0.058
	(0.055)	(0.056)	(0.155)	(0.167)
Open_trade	0.093*		1.350	
	(0.044)		(5.741)	
Open_imports		0.182		4.730
		(0.098)		(12.758)
Inter_trade			-0.044	
			(0.202)	
Inter_imports				-0.160
				(0.450)
R^2	0.527	0.521	0.527	0.523

Note: The number of observations is 68. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table iii – Ten-year averages. Population as country size in the trade size measure.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
lnGDPpc$_{t-1}$	-0.201***	-0.197***	-0.204***	-120***
	(0.033)	(0.033)	(0.035)	(0.034)
lntrade_size, pop	0.001	0.001	-0.077	-0.071
	(0.066)	(0.067)	(0.222)	(0.237)
Open_trade	0.092*		-1.966	
	(0.044)		(5.502)	
Open_imports		0.180†		-3.688
		(0.099)		(12.162)
Inter_trade			0.115	
			(0.308)	
Inter_imports				0.215
				(0.680)
R^2	0.527	0.522	0.529	0.523

Note: The number of observations is 68. Period dummies are included. Robust standard errors are presented within parenthesis. Significance level is presented as follows: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.