Specialization in the Presence of Trade and Financial Integration: Explorations of the Integration-Specialization Nexus☆

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Abstract

In this paper we investigate the economic integration - industrial specialization nexus and unravel the relationship between trade and financial openness and industrial specialization. For a panel of 31 countries over the period 1970 to 2005, we find that trade and financial integration relate positively to industrial specialization. Furthermore, the relationship between trade (financial) integration and specialization is further strengthened by the level of financial (trade) integration. Lastly, trade integration has a stronger connection to industrial specialization in countries with a high degree of intra-industry trade, whereas financial integration has a stronger connection to specialization in countries with a relatively underdeveloped financial system. Our findings are robust to various measures and alternative model specifications.

Keywords: Industrial Specialization, Trade Integration, Financial Integration, Manufacturing
JEL: C23, F14, F15, G29, L60

1. Introduction

The past few decades have witnessed an accelerated pace of economic integration, reflected by a very rapid growth in cross-border commercial trade and capital flows.[1] Trade and capital flows have increased dramatically during the period 1970-2005, as shown in Figure (1a). Indeed, capital flows have shown a three-fold increase since the early 1990s. At the same time, industrial specialization - the domination of (national) economies by a limited number of industries - has steadily increased since 1990, as shown in Figure 1b.

The reduction or, in some cases, the complete elimination of trade and financial barriers has significantly reduced the costs of international transactions. The resulting enhanced mobility of production factors has facilitated the re-location of production across sectors and geographical spaces. The recent increases in specialization suggest that the effect of trade and financial integration has been a reorientation of most economies towards a more concentrated industry structure.

An interesting question that arises, is what are the linkages between economic integration, in particular trade and financial integration, and industrial specialization? Increased specialization is desirable as it enhances efficiency and competitiveness and consequently has significant welfare implications (Eckel, 2008).[2] However, countries with specialized production structures are more vulnerable to asymmetric shocks - an issue of particular importance when countries form a monetary union. Trade and financial integration can both shape the dynamics of industrial specialization, creating potentially more asymmetric responses to the presence of a shock and at the same time can reduce the adverse impact of asymmetric shocks by diversifying the risk.[3] Therefore, understand-

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[1] The term trade, hereafter, unless specified otherwise, denotes the merchandise trade in goods.

[2] According to Eckel (2008), if specialization falls and the losses from specialization are large, compared to gains from increases in firm size due to globalization, the per capita output can decrease and welfare can actually decline.

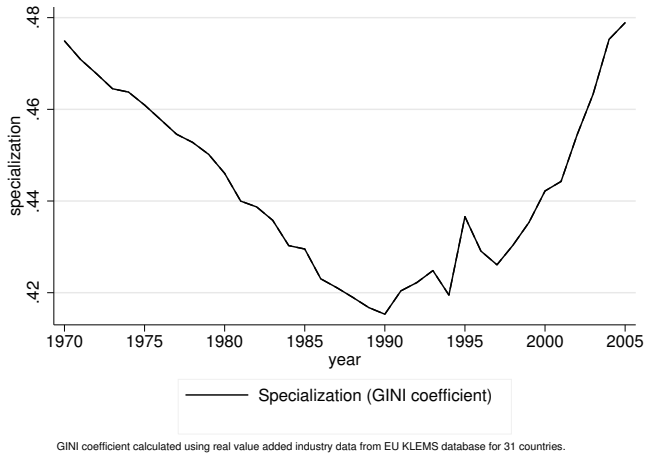
[3] Financial integration, for example, may contribute to industrial specialization as firms can borrow from abroad to differentiate their production, but it also facilitates better risk sharing opportunities as the borrowing risk is shared across different countries. A number of studies, for example, Greenwood and Jovanovic (1990), Saint-Paul (1992), and Acemoglu and Zilibotti (1997) have investigated the impact of insurance-induced-specialization on economic growth and development.

Figure 1: Developments in integration and specialization

(a) Development of trade and financial integration



(b) Development of industry specialization



Note: both graphs are based on authors' own calculations from a sample of 31 countries, see Table A.1 in the Appendix.

ing the nature of the relationship between economic integration and industrial specialization is important, both for economists and policy makers.

So far, the literature has offered a piecemeal approach to the economic integration - industrial specialization nexus. The roles of trade and financial integration have typically been studied in isolation. A large strand of the literature has explored the relationship between trade openness and specialization. Early trade theories predict that the reduction of trade costs tends to increase inter-industry trade, i.e., trade of goods across industries. The main argument is that the former facilitates the way countries exploit comparative advantages due to cross-country differences in technology or factor endowment (Ricardo, 1817; Ohlin, 1933), which in turn results in divergence of production structures across countries. New trade theories (Krugman, 1979, 1980; Krugman and Venables, 1990), however, stress the importance of increasing returns to scale and product differentiation in facilitating intra-industry trade, i.e., trade of goods across countries that belong to the same industry. As a result, these theories predict that trade integration will induce a shift of increasing-return industries towards countries with good market access ("the core"), i.e. the home market effect. Theories of new economic geography (Krugman, 1991; Venables, 1996) emphasize spatial agglomeration forces in shaping specialization patterns and suggest a non-monotonic relationship between trade liberalization and location of economic activities, depending on the level of trade costs.[4]

A separate strand of literature investigates the relationship between financial integration and industrial specialization, arguing that the former can facilitate better risk sharing opportunities among countries via cross-holdings of portfolio assets and international borrowing and lending.[5] Consequently, countries are protected against idiosyncratic risks and therefore can 'afford' to specialize more (Brainard and Cooper, 1968; Kemp and Liviatan, 1973; Ruffin, 1974; Helpman and Razin, 1978).[6] The seminal study of Kalemli-Ozcan et al. (2003) investigates the relationship between risk sharing from financial integration and production specialization. The authors find a positive and robust link between risk sharing and specialization among regions in the US, as well as across some OECD countries. Basile and Girardi (2010) use more advanced estimation methods, allowing for non-linearity and spatial dependence, and confirm a similar positive relationship across European regions. Although Kalemli-Ozcan et al. (2003) acknowledge and control for the potential impact of trade integration on specialization, the effect of trade integration in conjunction with financial integration as joint determinants of specialization is not

[4] In the presence of high trade costs, industry structures remain unaltered, whereas the reduction of trade costs results in the agglomeration of economic activities into fewer locations. When trade costs drop below a threshold, these agglomerations become smaller and more dispersed across space.

[5] Recent work by Kose et al. (2009b) examines the impact of financial integration on the evolution of risk sharing in a large panel of countries. The authors find support for a modest degree of risk sharing among countries, however, far from what is predicted by theory. Artis and Hoffmann (2007) and Sorensen et al. (2007) find improved risk sharing among industrialized countries as financial integration increases. Other studies find little evidence of improved risk sharing, despite massive financial integration (Moser and Scharler, 2004; Bai and Zhang, 2006). See Kose et al. (2009b) for an extensive literature survey.

[6] Obstfeld (1994) shows that financial market integration provides insurance through a globally diversified portfolio of investments, thereby encouraging countries to simultaneously shift from low-return, safe investments toward high-return, risky investments promoting higher growth.

explicitly examined in both studies.[7]

Research on the determinants of specialization typically faces a difficult choice, either to (try to) infer causality by studying a small sample for which appropriate instruments are available, or to study patterns for a broad sample, thus benefiting from a large cross-sectional variation. In a recent paper, Kalemli-Ozcan and Nikolsko-Rzhevskyy (2010) clearly opt for the former, studying trade and financial flows between three source countries (Germany, France, the UK) and one host country (the Ottoman Empire) over 1859-1913. The authors find that trade indeed *causes* capital flows.

In the present paper, we opt for the latter approach, and provide further empirical evidence on the relationship between economic integration and industrial specialization. Using a detailed sample of manufacturing industries across industrialized countries, a large set of robustness analyses, various instruments and the two-step GMM estimation technique, we shall *try* to approximate a causal test to the best of our abilities. But our first and foremost objective is to investigate the relationship between trade and financial integration and industrial specialization in a comprehensive manner for a large set of countries and industries.

More specifically, the paper aims to answer three important questions. The first, and most basic question is how does economic integration relate to industrial specialization? We consider two separate channels of economic integration, that of trade openness and financial integration, and examine their relationship with production specialization.

The second question is to what extent financial integration acts as a *moderator* to the effect of trade integration on industrial specialization, and vice versa?[8] For instance, the effect of increases in financial integration on industrial specialization may depend (positively or negatively) on the level of trade integration, and vice versa. To answer this question, we examine the relationship between trade (financial) integration on specialization, *conditional* on the level of financial (trade) integration. This could shed more light on issues such as complementarity versus substitutability between these two channels and threshold effects, i.e., the level of financial (trade) integration required so that trade (financial) integration has an impact on industrial specialization; issues of importance especially for policy makers.

The third question is to what extent intra- (or inter-) industry trade and financial development act as *mediators* for the effect of trade and financial integration on industrial specialization?[9] Changes in trade integration may have a larger effect on specialization in countries with a low level of intra-industry trade intensity.[10] Changes in financial integration may exert a bigger impact on industrial specialization in countries with a high level of financial development (Masten et al., 2008).[11] To answer this question, we therefore examine the relationship between trade and financial integration and specialization, *conditional* on the level of intra-industry trade intensity and financial development.

Our work relates to various strands of literature. It relates and contributes to the literature that explores the patterns of industrial structures across countries and infers whether changes of patterns reflect ongoing economic integration (Krugman, 1991; Sapir, 1996; Brülhart, 2001; Longhi et al., 2003; Riet et al., 2004).[12] In this literature, trade and financial integration are mostly latent, at best, captured by a linear time trend (Longhi et al., 2003). Our paper explicitly considers the channels of economic integration and specialization and allows for interaction between both channels.

We further relate to a number of recent studies that investigate the dynamic impact of trade integration on specialization patterns. For instance, Beine and Coulombe

[7] Kalemli-Ozcan et al. (2003) control for the gravity determinants of trade.

[8] "[A] moderator is a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (Baron and Kenny, 1986, p. 1174).

[9] "[A] given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the criterion. [...] Whereas moderator variables specify when certain effects will hold, mediators speak to how or why such effects occur" (Baron and Kenny, 1986, p. 1176).

[10] Trade-induced specialization should be less prevalent if intra-industry trade dominates as specialization in the latter case occurs mainly within the same industry. Krugman (1980) argues that trade allows countries to specialize in a limited variety of production without reducing the variety of goods available for consumption.

[11] Masten et al. (2008) argues that countries with a higher level of financial development may benefit from improved risk sharing, as well as a reduced cost of intermediation and higher efficiency.

[12] The seminal study of Krugman (1991) constructs locational Gini coefficients for four large US regions (Northeast, Midwest, South, West) and four large EU countries (France, Germany, Italy, UK). It concludes that the EU has a more dispersed production structure than the US. It also finds that US regions are less specialized and manufacturing activities become less geographically concentrated between 1947 and 1985. In the EU context, studies using production and employment data, albeit different samples and specialization measures, generally confirm the cross-country heterogeneity in the degree of specialization, corroborating an inverse relationship between specialization and country size. Accordingly, the EU countries tend to be more specialized within manufacturing sectors and big countries are more specialized at regional level (Brülhart, 2001; Riet et al., 2004). (Small) countries experience increased specialization over the past three decades. The increase is more pronounced from the 1980s onwards(Amiti, 1999; Brülhart, 2001; Riet et al., 2004). Longhi et al. (2003) study the regional specialization and concentration patterns for five Central and Eastern European (CEEC) countries over the period 1990-1999. They find that regional manufacturing specialization as measured by the Krugman index has increased significantly in Bulgaria and Romania but has not significantly changed in Estonia, Hungry and Slovenia. In contrast, studies using trade data document a decreased specialization trend across EU countries over time (Sapir, 1996; Brülhart, 1998). Brülhart (2001) reports that the degree of specialization seems higher when using export data rather than employment data. A "puzzle" is found since specialization in exports has actually decreased even though specialization in employment has increased. For a more extensive analysis of EU manufacturing, see Midelfart-Knarvik et al. (2000) and European Commission (2007).

(2007) study the impact of trade liberalization between Canada and the US, measured by the decrease of trade-weighted tariffs, on the degree of industrial specialization for Canadian regions. They disentangle the short-run from the long-run impact, motivated by the distinction between short-run adjustment costs and long-run efficiency gains associated with trade liberalization. Their results favor a positive short-run relationship and a negative long-run relationship between trade integration and industrial specialization, i.e., short-run specialization and long-run diversification. Crabbé et al. (2007) perform a similar analysis for thirteen CEEC countries and show that trade integration leads to long-run specialization.[13] An important element missing in all aforementioned papers is financial openness, which we explicitly take into account.

Lastly, we also relate to a handful of studies that have attempted to unify different strands of literature to analyze the effect of trade and financial openness on specialization. For example, the study of Imbs (2004) examines the complex relationships between trade, finance, specialization, and business cycle synchronization in the context of a system of simultaneous equations based on a cross-sectional country-pair setting in 24 countries.[14] Our paper builds on these earlier contributions, mainly on that of Imbs (2004) and Kalemli-Ozcan et al. (2003, 2004). It departs, however, from that literature in a number of ways. It treats trade and financial integration as multilateral rather than bilateral phenomena (Imbs, 2006) and chooses country-year instead of country-pair as the unit of our analysis. In contrast to past attempts (Kalemli-Ozcan et al., 2003), this paper discusses channels and conditional effects of trade (finance) on specialization. Finally, the panel-based estimation techniques used here exploit both time-series as well as cross-section variations and are well-suited to solve endogeneity issues, thus yielding more efficient estimates.

Our empirical analysis is based on a sample that consists of manufacturing industries, twice as disaggregated as those used in past related studies (Kalemli-Ozcan et al., 2003), and a time span that is more extensive than that of previous studies (Imbs, 2004; Basile and Girardi, 2010). Our sample consists of 20 manufacturing industries in 31 countries over the period 1970-2005.

Our results reveal that trade and financial integration jointly relate to industrial specialization. Trade integration has a negative relationship with specialization (Beine and Coulombe, 2007), whereas financial integration has a positive one (Kalemli-Ozcan et al., 2003; Basile and Girardi, 2010; Imbs, 2004). We also demonstrate that both types of integration act as moderators to each other. The relationship of trade (financial) integration with specialization is more pronounced when the level of financial (trade) integration is high, pointing to a complementary relationship between them. Moreover, the negative relationship between trade integration and specialization is only relevant in countries with very low levels of financial integration, whereas the positive relationship between financial integration and specialization is only meaningful when countries are sufficiently open to trade. These findings extend and complement those of Imbs (2004). Furthermore, for the Eurozone countries, regional trade integration coincides with increased diversification, while global trade integration corresponds to more specialization. Lastly, intra-industry trade acts as a mediator to lower the effectiveness of the trade integration channel as an increase in trade integration has a less negative relationship with specialization in cases where intra-trade intensity is high. Financial development acts as a mediator for the effect of financial integration on specialization as higher levels of financial development make the financial integration channel less effective, in support of the substitution among them in driving specialization. The results are robust to alternative model specifications and the use of a range of different measures of specialization, trade and financial openness.

Our findings highlight that policies for (further) trade and financial integration should be jointly designed for countries to fully seize the benefits of specialized production structures, economies of scale and increased efficiency. However, countries with specialized production structures are more vulnerable to asymmetric shocks. The latter, is of particular interest for the Eurozone, where well-functioning risk-sharing mechanisms can secure the benefits of specialization.

The remainder of the paper proceeds as follows. Section 2 exposes the model(s) under estimation and the econometric strategy. Section 3 presents the data and the measures proposed. Section 4 discusses the results. Finally, Section 5 summarizes and concludes.

2. Methodology

This section presents the empirical specifications and theoretical considerations according to the questions raised in the previous section and discusses the estimation strategies followed.

2.1. Model Specification and Theoretical Considerations

A general investigation of the relationship of economic integration and specialization starts with the following

[13] Crabbé et al. (2007) interpret the different results as evidence of a possible non-monotonic relationship between trade integration and industrial specialization along the development path. A closely related study in this respect is that of Imbs and Wacziarg (2003), who demonstrate a U-shaped pattern between the specialization of a country and the level of its per capita income. Countries initially diversify to reduce the risk of sector-specific shocks, while in the later stage of development, countries start to specialize when their per capita income has grown to a critical level.

[14] Similar investigations are performed by Frankel and Rose (1998), Kalemli-Ozcan et al. (2004), Imbs (2006), Calderón et al. (2007), Inklaar et al. (2008).

specification:[15]

$$S_{it} = \mu_i + \beta_1 T_{it} + \beta_2 F_{it} + \beta' Z_{it} + \varepsilon_{it}, \quad (1)$$

where i denotes the country and t time; S is a specialization index; μ_i is country-specific fixed effect; T_{it} and F_{it} capture the degree of trade and financial integration, respectively; β' is a $1 \times n$ parameter vector; Z is an $n \times 1$ vector of control variables; and, finally, ε_{it} is the error term. All variables are in logs.[16]

Most classical trade theories, with reference to the theory of comparative advantage, predict that trade integration leads to more (industrial) specialization and accordingly one should expect a positive β_1. Falling trade costs result in a narrowing non-traded sector and therefore it is cheaper to import goods rather than produce them domestically Dornbusch et al. (1977). Thus resources are freed up and used more intensely in fewer activities.

Financial integration may induce specialization through risk-sharing. Open and well integrated financial markets offer a broader range of financial instruments and permit the diversification of ownership via two types of insurance. First, if residents in one country hold debt and equity claims on the output of the other country, then the dividend, interest, and rental income derived from these holdings contribute to smoothing of shocks across countries. It is thus a form of *ex ante* international insurance. Second, to achieve consumption smoothing, households in each country can *ex post* adjust their asset portfolios, following the occurrence of shocks in the region. Again, this will lead to income smoothing in all countries. Once insurance is available through trade in financial assets, each country will have a stronger incentive to specialize in fewer forms of production (or technology) in order to fully exploit economies of scale or technological competitive advantages. Therefore, β_2 is expected to carry a positive sign (Kalemli-Ozcan et al., 2003; Basile and Girardi, 2010).

The vector Z contains a number of control variables that have been commonly used in the relevant literature. These variables capture the size of the manufacturing sector and the stage of the economic development. More specifically, the size of the manufacturing sector (*Size*) is measured as the manufacturing value added divided by the total value added of all sectors. A large manufacturing sector may foster a broader range of industrial productions and thus has a more balanced industrial structure, whereas the opposite could be the case with a small manufacturing sector. Consequently, the coefficient of the size of the manufacturing sector is expected to bear a positive sign, as countries with a relatively small manufacturing sector are more likely to specialize. The stage of economic development is measured as the GDP per capita ($GDPpc$), and GDP per capita squared ($GDPpc2$) to allow for possible nonlinear effects between economic development and specialization. For instance, Imbs and Wacziarg (2003) argue that specialization is likely to change along the development path of a country. They provide robust evidence that countries experience two stages of diversification. At low levels of per capita income, countries reduce their overall specialization to mitigate the adverse effect of sector-specific shocks, while when per capita income reaches a high level, countries specialize again to fully exploit the comparative advantage.[17]

The specification above has been employed in the literature and will also be used in our paper to answer our first question, which concerns the impact of trade and financial integration on specialization of production. A drawback with this specification is that it treats trade and financial integration as independent channels and does not allow for any interaction between them. Recent evidence (e.g. Kose et al., 2006, 2009a) has demonstrated that trade and financial integration are closely related phenomena as they tend to move closely together and countries often cannot opt for trade (financial) integration independently of their degree of financial (trade) integration.

Therefore, to address our second question, which is to what extent financial (trade) integration acts as a moderator to the effect of trade (financial) integration on specialization, we include an interaction term ($T \times F$) in the equation (2a):

$$S_{it} = \mu_i + \beta_1 T_{it} + \beta_2 F_{it} + \beta_3 T_{it} \times F_{it} + \beta' Z_{it} + \varepsilon_{it}. \quad (2a)$$

In the equation above, we allow the relationship of one type of integration with specialization to be moderated by the other type of integration. The marginal effect of trade (financial) integration then becomes the partial derivative of specialization with respect to trade (financial) integration in equations (2b) and (2c), respectively:

$$\frac{\partial S_{it}}{\partial T_{it}} = \beta_1 + \beta_3 F_{it}, \quad (2b)$$

$$\frac{\partial S_{it}}{\partial F_{it}} = \beta_2 + \beta_3 T_{it}. \quad (2c)$$

According to classical theories of trade, trade openness works as a substitute for capital flows as trade integration reduces the incentives for capital to flow to capital-scarce countries. However, recent theoretical and empirical evidence offers and confirms a number of reasons that

[15] See, for example, Kalemli-Ozcan et al. (2003), Basile and Girardi (2010).

[16] There is no theoretical guidance on whether to use levels or logs of variables in our specifications. Ultimately, we choose logs as they yield a better fit and make the results easier to interpret as elasticities. See, for example, Baltagi et al. (2009) for a similar treatment regarding the functional form.

[17] From a theoretical point of view, Imbs and Wacziarg (2003) argue that this pattern is consistent with models featuring endogenous stages of specialization to both trade and economic growth.

support the complementarity between trade and financial integration. On the one hand, trade integration may foster financial integration, either by creating demands for symmetric financial flows, or by promoting foreign direct investment (FDI) in export-oriented sectors. The rapid growth of FDI and the establishment of multinational firms further drive the demand for financing, as those firms increasingly turn to foreign banks and the stock exchange to raise their necessary funds, thus leading to growing financial flows.[18] On the other hand, financial integration may promote specialization via risk sharing or facilitate the reallocation of capital to sectors that have a comparative advantage, therefore increasing the opportunities for trade (Feeney, 1994a,b). Antràs and Caballero (2009) model trade and capital flows as complements, especially in less financially developed economies, as trade integration increases the return to capital and capital inflows to these countries. This complementary relationship has also been confirmed empirically by a number of studies.[19] In line with this literature, we expect the impact of trade (financial) integration on specialization to increase with the degree of financial (trade) integration, i.e., a positive β_3 in equations (2b) and (2c).

It is widely agreed that the EU is the most developed form of regional integration across national borders that currently exists (Laffan, 1998; Murray, 2004). Like global trade and financial integration, regional integration may also have an enormous impact on industrial structures across this group of countries. Eurozone countries trade heavily with each other. Approximately 50 percent of trade flows of these countries take place within the Eurozone and over time there is a tremendous increase in their trade among each other as, on average, intra-Eurozone trade as a percentage of each member country's GDP has steadily increased from 20 percent in 1970 to 40 percent in 2005.[20]

We investigate the relationship between *regional* trade integration on specialization by means of equation ($2a'$), where in place of global trade integration T in (2a), we place an index of regional trade integration, INT, which is the amount of trade a eurozone country trades with the rest of the Eurozone members scaled by the country's GDP:[21]

$$S_{it} = \mu_i + \beta_1 INT_{it} + \beta_2 F_{it} + \beta_3 INT_{it} \times F_{it} + \beta' Z_{it} + \varepsilon_{it}, \quad (2a')$$

The sign of the estimated coefficients is expected to be the same as those in equation (2a) since the same reasoning applies here as well, while the coefficients are expected to be of greater magnitude as the Eurozone countries' proximity and institutional homogeneity are expected to strengthen the economic integration - industrial specialization nexus.

With our third and final question, we aim to examine to what extent intra-(inter-) industry trade intensity (IIT) and financial development (FD) act as mediators to facilitate trade and financial integration. To this end, we estimate equations (3a) and (3b) below:

$$S_{it} = \mu_i + \beta_1 T_{it} + \beta_2 F_{it} + \beta_3 T_{it} \times IIT_{it} + \beta_4 IIT_{it} + \beta' Z_{it} + \varepsilon_{it}, \quad (3a)$$

$$S_{it} = \mu_i + \beta_1 T_{it} + \beta_2 F_{it} + \beta_3 F_{it} \times FD_{it} + \beta_4 FD_{it} + \beta' Z_{it} + \varepsilon_{it}. \quad (3b)$$

In equation (3a), we depart from our baseline specification (1) by controlling for the *type* of trade. The inclusion of an IIT index allows for a more explicit test on the impact of the nature of trade, i.e., intra- vs. inter-trade integration, on industrial specialization. The index ranges from 0, indicating pure inter-industry trade, to 1, indicating pure intra-industry trade. Classical trade theories postulate that further trade integration is likely to result in more specialization if trade is predominantly the inter-industry type. On the contrary, if trade is of the intra-industry type, trade-induced specialization may be weaker as trade leads countries to concentrate on the production of a limited number of products within the industry. Therefore, specialization in this case occurs mainly within the industry rather than across industries (Krugman, 1981). Accordingly, β_3 is expected to carry a negative sign, suggesting that trade integration leads to a lesser degree of specialization if the intra-industry trade intensity is high.

Next, equation (3b) explores the role of financial development as a moderator to the relationship between financial integration and specialization. We again deviate from equation (1), this time by introducing an interaction term between financial integration and financial development

[18] For example, a number of studies show that multinational or foreign firms have easier access to international source of external financing and face lower financing obstacles (Schiantarelli and Sembenelli, 2000; Harrison and McMillan, 2003; Beck et al., 2006).

[19] For example, Aizenman and Noy (2009) postulate a two-way feedback between trade and financial integration, i.e. *de facto* trade (financial) openness is associated with larger future financial (trade) openness, asserting that trade and financial integration are complements rather than substitutes. Chambet and Gibson (2008) decompose countries' trade openness measure into its natural and residual components and find that both measures contribute positively to stock market integration for a large panel of emerging economies. Chow et al. (2005) confirm the interdependence of trade and financial integration in East Asian countries. Kalemli-Ozcan and Nikolsko-Rzhevskyy (2010) confirm that trade *causes* capital flows, using historical evidence from trade and financial flows between three source countries (Germany, France, the UK) and one host country (the Ottoman Empire) over 1859-1913, whereas García-Herrero and Ruiz (2008) argue that trade linkages do not seem to be significantly affected by financial linkages, nor promoting financial linkages in the country of their investigation, Spain.

[20] Authors' own calculation based on the data from the United Nations Conference on Trade and Development (UNCTAD) *Handbook of Statistics*, 2008.

[21] Due to data limitations, it is notoriously difficult to find a good measure to quantify *regional* financial integration for these countries. Although the Organization for Economic Cooperation and Development (OECD) *International Direct Investment Statistics Database* for 2008 provides cross-country flows of inward and outward FDI, these data are only available after 1985 and the coverage is rather poor. Therefore we mainly focus on regional trade integration.

(FD), together with a separate (FD) term to control for the direct impact of financial development on specialization. Financial development, as a source of comparative advantage, can directly influence the degree of specialization by promoting finance-dependent sectors (Beck, 2002, 2003; Svaleryd and Vlachos, 2005; Hur et al., 2006). A vast body of existing literature has strongly emphasized that benefits associated with financial integration only become significant at higher level of financial development.[22] The interaction between financial development and financial integration is complex and depends on the mechanism at work. On the one hand, financial development facilitates financial integration as domestic financial intermediaries, which distribute international assets, offer a local channel by which investors can gain foreign exposure. The latter may also increase the desire for international diversification. Furthermore, a well-developed financial system, in particular the strength or effectiveness of domestic financial regulation, is attractive to foreign investors: foreign investors will stay away from markets that do not protect their interests. Thus, financial integration and financial development may be complements in shaping specialization. On the other hand, financial development may represent an alternative channel in diversifying sector-specific risks within countries (King and Levine, 1993; Levine, 1997; Beck et al., 2000). As a consequence, countries are less prone to idiosyncratic production risks, which leaves less scope for cross-country risk sharing via financial integration. In this case, financial integration and financial development may be a substitute in driving specialization. Therefore, the sign of α_3 is *a priori* ambiguous.

2.2. Estimation Procedure

We use the two-step GMM estimator to extract consistent and efficient estimates of the various model specifications discussed above. Compared to past related studies, which rely mainly on cross-section analysis, we make efficient use of the data as we exploit both time-series and cross-section dimensions without wasting valuable information. With the two-step GMM estimation procedure, we can control for country-specific heterogeneity, non-stationarity of variables and possible endogeneity (reverse causality) of the regressors.[23] As a result, we are able to examine causal effects that other related studies ignore. In particular, the reverse causality that runs from specialization to trade could pose serious challenges to the validity and inferences of the estimates. We alleviate this concern by using lagged levels to instrument the endogenous variable in the first-difference equation.

To check the consistency of our estimates, a range of diagnostic tests are employed. First, we perform a Durbin-Wu-Hausman (DHW) endogeneity test in order to examine whether trade is indeed endogenous in our specifications.[24] Then, we ensure the validity of the instruments used to overcome reverse causality issues. The key exogeneity assumption in our context is that a country's historical levels of trade are orthogonal to current shocks on specialization, i.e., lagged variables must be uncorrelated with the error term in the level equations. We do so by applying the Arellano-Bond serial correlation test.[25] The usage of multiple instruments allows us to perform a Hansen test of over-identifying restrictions.[26] Then, the Kleibergen-Paap *rk* test is used to examine whether the endogenous regressor is well-identified by the instruments.[27] Lastly, we employ the Anderson-Rubin test of weak-identification-robust test.[28] The last two tests ensure the relevance and strength of our instruments.[29]

3. Data

In answering the three questions posed in this paper, we face a number of data considerations. First, having a sufficiently disaggregated set of industries is important to avoid aggregation issues when measuring specialization. Put bluntly, at a higher level of aggregation, countries' industrial structures will appear alike by construction. A second consideration for the purpose of our analysis, is the fact that we require a relatively broad set of countries to ensure sufficient variation in specialization patterns. Thirdly, trade and financial openness are complex processes that require time to develop.[30] In addition,

[22] See, for example, the studies of Masten et al. (2008) and Klein and Olivei (2008).

[23] More specifically, the two-step GMM estimator utilizes an optimal weighting matrix that minimizes the asymptotic variance of the estimator. It takes the first differences of the variables to remove unobserved country-specific effects and any endogeneity bias arising from the correlation of these fixed-effects with explanatory variables. First-differencing also ensures the stationarity of variables. Since the time dimension of our panel is relatively long, we need to adequately consider the non-stationary nature of regression variables in order to avoid running a spurious regression.

[24] The test posits the null hypothesis that the introduction of instruments has no effect on the estimates of the regression's coefficients.

[25] If there is no serial correlation (in the level equation), one should reject the null hypothesis of absence of serial correlation in the first differences. In this case, any historical values of trade, beyond period $t-2$ are potentially valid instruments. In contrast, if serial correlation is present, one needs to take deeper lags from period $t-3$ as instruments. In principle, the number of lags available as instruments increase with the time dimension T. To alleviate the potential problems arising from a disproportional large number of instruments, we limit the number of lags to three. Our choice is also motivated by a practical reason that some countries are covered in our sample for a relatively short period of time. We limit the number of lags in order not to lose a significant amount of observations.

[26] The Hansen test yields a J-statistic which is distributed as χ^2 under the null hypothesis that all instruments are valid.

[27] The null hypothesis is that the equation is under-identified, i.e. the excluded instruments are not correlated with the endogenous regressor.

[28] The rejection of the null hypothesis indicates that the endogenous regressors are relevant.

[29] For a comprehensive discussion of our methodology, see Baum et al. (2003).

[30] This holds even more for studies that use *de jure* (by law) measures of trade and finance, where one needs a considerable time span to see

a short time span, not covering several cycles, may turn out not to be very representative. Since reverse causality may be an issue, a longer time span allows for a deeper lag structure and more appropriate instruments.

In measuring trade and financial integration, we face the choice between *de facto* measures of trade and financial integration, which quantify a country's actual degree of openness through realized trade and financial flows, or *de jure* measures, which indicate the extent of government restrictions on trade and capital flows. Arguably, *de facto* measures are more suitable for our analysis than *de jure* measures. First, *de facto* measures capture the actual effects of liberalization policies. A country with very liberal (i.e., no) capital restrictions does not necessarily engage heavily in international transactions. Likewise, a country with tight capital controls may find them ineffective in the presence of a capital flight (Kose et al., 2006, 2009a).[31] Second, *de facto* measures provide variations across countries and over time and hence are suitable for panel-based analysis. Third, although *de jure* measures may be preferred because they are theoretically grounded and reflect the decision to 'open up' more closely than the *de facto* measures, this weakness of the latter is also their strength as they are less susceptible to endogeneity. *De facto* openness measures carry some exogenous elements, owing to historical, geographical or political reasons, which are less affected by government policies.[32]. The analysis in this paper will therefore focus largely on *de facto* measures of trade and financial integration.[33]

Our empirical analysis covers an unbalanced panel of 20 two-digit manufacturing industries in 31 countries during the period 1970-2005, the longest period for which data are available for the largest amount of countries.[34] We focus on manufacturing industries on the premise that these industries, in contrast to services, are involved in trade, and are therefore more responsive to trade integration. We ensure that the number of sectors available through time is constant across countries, while coverage across time varies per country. This way, both within-country and cross-country changes in specialization can be compared and interpreted in a consistent manner. Table A.1 in the Appendix lists the 31 countries and the corresponding time span. Table A.2 in the Appendix reports the 20 industries and their NACE codes considered in our analysis. Annual raw data are retrieved from various sources. Below, we explain how the variables are constructed and the sources of our data.

Industrial Specialization

Our primary index of specialization (S) is the Gini coefficient, which measures the degree of concentration or inequality of the distribution of sector shares in an economy(Gini, 1921) and is defined as follows:[35]

$$S = \frac{2}{n^2 \bar{s}} \sum_{j=1}^{n} j(s_j - \bar{s}) \tag{4}$$

where j denotes the sector, n denotes the number of sectors, s represents the share of each sector, and $\bar{s}$ refers to the average sector share. The index ranges from zero, where all sectors have an equal share of total manufacturing value added implying a perfectly diversified economy, to one hundred, where only one sector produces all manufacturing value added, reflecting a strongly specialized economy.

To check the robustness of our results, we also use two other indices of industrial specialization. These indices are the Herfindahl-Hirschman index (HRI), which sums up the square of each sector's share in the total manufacturing value added of a country, and the coefficient of variation of sector shares (VSI), which is defined as the ratio of the standard deviation to the mean of sector shares in one country. Since all three indices are highly correlated, we rely primarily on the Gini coefficient as our baseline index, and do not report the results using the

these policies to be realized.

[31] The distinction between *de jure* and *de facto* integration measures is of particular relevance in understanding the differences between the terms liberalization, openness and integration. Broadly speaking, (*de jure*) liberalization is a necessary condition for (*de facto*) openness, but not a sufficient condition. Countries maintaining very liberalized current and capital accounts may not necessarily attract sufficient trade and capital flow (for example, the African countries). Similarly, financial openness is a necessary but not sufficient condition for integration. Integration requires openness as the first step, consequently ensures domestic financial markets effectively become part of the world market, synchronizing interest rate movements, saving and investment activities, and the accumulation of physical capital stocks. In this sense, financial openness is the means, while financial integration is the goal. In this paper, as we measure trade and financial integration by means of *de facto* openness, we use the terms "integration" and "openness" interchangeably.

[32] For example, countries with a more specialized production structure are more prone to open up to trade and/or capital flows to promote specialized sectors. See a similar line of argument in Baltagi et al. (2009)

[33] One of the most comprehensive *de jure* measures of trade integration is constructed by Wacziarg and Welch (2003), extending the work of Sachs and Warner (1995). It takes a value of one when a country's trade regime is liberalized, and zero otherwise. Wacziarg and Welch (2003) argue that the date of trade liberalization captures major changes in trade policy, thus it is more reliable than current account restrictiveness measures published in the IMF's Annual Report on Exchange Arrangement and Exchange Restrictions (AREAER). Based on the Wacziarg and Welch (2003) measure, all countries in our sample are considered as "liberalized" over the whole period. When it comes to financial integration, Chinn and Ito (2006) compile a composite index of capital account liberalization based on four AREAER's binary dummies that codify restrictions on cross-border financial transactions. Although this *de jure* measure offers some (but limited) variations over time, it is constructed using a principle component analysis and thus produces results that are difficult to interpret. Therefore, we only use this measure as robustness check.

[34] Even though there is a November 2009 update to the EU-KLEMS database, running to 2007, the new data include only a limited number of variables and industries. For reasons explained above, our analysis ends in 2005, and we rely on the two-digit disaggregation throughout.

[35] The Gini coefficient is commonly used in the empirical literature to measure industrial specialization (Krugman, 1991; Amiti, 1999; Imbs, 2004).

other indices, but describe them in the robustness analysis.[36] Table A.1 in the Appendix shows the average Gini coefficient over time for each country in our sample. We find that Latvia, Ireland and Cyprus are the most specialized countries, whereas Austria, Slovenia and United Kingdoms are the least specialized ones.

For our industrial specialization index, we use industry-specific data from the EU KLEMS database and the *60-Industry database*.[37] We extract annual raw data on sectoral value added at the market price, divided by the sectoral value added deflator to obtain real value added per sector in each country. We also extract employment (total number of hours worked) data from EU KLEMS to compute the same specialization indices ($GINIEMP$, $HRIEMP$, $VSIEMP$). Since output-based (e.g., value added) measures provide a more general representation of industries and thus are more suitable and appropriate than those based on labor inputs (e.g., employment), we use employment-based specialization measures as a robustness check.[38]

Trade Integration, Financial Integration and Financial Development

Our primary measure for trade integration is the ratio of imports plus exports divided by GDP (T). This continuous measure is widely used in the empirical literature. For robustness purposes, we also use the share of imports to GDP (IMP) and the share of exports to GDP (EXP), as well as manufacturing trade as a share of total manufacturing output ($MANT$), a much a narrower measure of trade openness.[39] As an additional check for the validity of using lagged levels of trade openness as instruments, for each country, we construct the average of its neighboring countries' trade openness (AT) as an alternative instrument. This instrument allows us to exploit the (time-varying) exogeneity of this variable to identify the effects of trade integration on specialization, following Baltagi et al. (2009). Country-level data of trade volume, imports, exports, manufacturing trade and GDP have been taken from the World Bank (2008) *World Development Indicators* (WDI). Data on total manufacturing output have been obtained from the EU KLEMS database.

The intra-industry trade intensity (IIT) indicator is the Grubel-Lloyd index (Grubel and Lloyd, 1975), calculated as follows:

$$IIT_{it} = 1 - \frac{\sum_j \mid EXPO_{jit} - IMPO_{jit} \mid}{\sum_j (EXPO_{jit} + IMPO_{jit})}, \qquad (5)$$

where i denotes country, j sector and t year. It ranges from 0, indicating pure inter-industry trade, to 1, indicating pure intra-industry trade. This measure allows for a more explicit test on the impact of trade integration, controlling for the nature of trade. We take an aggregate country-level IIT indicator (for OECD countries in our sample) from the OECD (2006) *Structural Analysis database* (STAN), which is computed using detailed trade data of two- and three-digit manufacturing sectors.

Lastly, to assess the impact of trade openness on specialization among highly integrated countries, we construct another measure of trade intensity for each Eurozone country, that of the intra-Eurozone trade (INT), which is computed as the fraction of trade of a Eurozone member with the rest of the group scaled by the country's GDP. Data on the intra-Eurozone trade have been taken from the UNCTAD *Handbook of Statistics*, 2008.

We follow the same approach with financial integration, where our primary measure F is the ratio of total foreign assets and total foreign liabilities as a percentage of GDP. This stock-based measure is constructed, following Lane and Milesi-Ferretti (2007), by aggregating data on assets and liabilities on FDI, equity portfolio, debt, financial derivatives and official reserves adjusted for valuation issues.[40] As a robustness check, we consider three other measures. The first measure counts only the amount of total liabilities divided by GDP (LIB) as a country is more financially integrated if it is able to attract foreign capital flows. The second one is the assets and liabilities on FDI and portfolio investments as a percentage of GDP ($FDIEQU$). The debt component of our primary financial integration measure includes, however, sovereign debt and other debt with official creditors like the International Monetary Fund (IMF), and may prove misleading regarding a country's degree of financial integration. For example, countries imposing restrictions on capital flows to private agents may hold a large proportion of foreign debt and therefore could be considered as 'integrated' with the global financial market. This narrower measure aims to circumvent the problem associated with the debt component. All three stock-based measures are retrieved from the Lane and Milesi-Ferretti

[36] Pairwise and Spearman rank correlations are at least 0.947, and always significant at the 1 percent level.

[37] We extract data for 29 countries from the EU KLEMS database, while data for Canada and Norway are derived from the *60-Industry database*, which was succeeded by the EU KLEMS database. Both databases are maintained by Groningen Growth and Development Center (GGDC).

[38] As an additional check, we also compute specialization measures using sectoral export data from the OECD (2006) *Structural Analysis database* (STAN). The results are broadly consistent with those presented later using production data. Since we primarily focus on production specialization in this paper, results based on export data are available upon request.

[39] For Norway, we use total manufacturing trade divided by value added instead of output as output data are not available in the *60-Industry Database* and Norway is no longer included in the subsequent EU KLEMS database.

[40] Unlike a flow-based measure, like gross capital inflow plus outflows divided by GDP, this stock-based measure takes into account the history of a country's financial integration and its changes over time. It is typically less prone to short-run changes in the political and economic climate, and is thus a preferred measure for our purpose. See Edison et al. (2002) for the discussion of flow-based vs. stock-based measures.

Table 1: Descriptive Statistics

	Variable	Description	Source	Mean	Min	Max	Std	Obs
Main Variables	S	Gini Coefficient of Specialization (0 to 100)	KLEMS	44.239	26.891	77.039	8.343	808
	T	Trade openness, % of GDP	WDI	73.776	11.254	203.539	39.826	930
	INT	Trade with Eurozone, % of GDP	UNCTAD	27.741	18.518	107.54	6.597	396
	F	Financial openness,% of GDP	LMF07	164.288	9.811	1854.411	177.094	882
	IIT	Intra-industry trade intensity (0 to 1)	STAN	0.673	0.172	0.993	0.155	833
	FD	Liquid liability, % of GDP	Beck et al. (1999)	69.051	30.106	242.215	32.987	776
	Size	Size of manufacturing sector, % of total value added	KLEMS	21.897	8.276	67.621	6.348	808
	GDPpc	Per capita real GDP (2000 $K)	WDI	14.794	1.853	40.618	8.526	951
Variables in Robustness Analysis	HRI	Herfindahl-Hirschman index	KLEMS	0.096	0.061	0.404	0.044	808
	VSI	Coefficient of variation	KLEMS	0.924	0.489	2.729	0.328	808
	GINIEMP	Gini coefficient, employment	KLEMS	41.567	6.867	0.620	0.069	811
	HRIEMP	Herfindahl-Hirschman index, employment	KLEMS	0.086	0.062	61.958	6.867	811
	VSIEMP	Coefficient of variation, employment	KLEMS	0.840	0.500	1.538	0.213	811
	IMP	Imports, % of GDP	WDI	37.468	5.444	112.766	20.418	930
	EXP	Exports, % of GDP	WDI	36.308	5.658	100.031	19.838	930
	MANT	Manufacturing trade, % of manufacturing output	WDI, KLEMS	64.296	38.429	204.558	8.779	815
	AT	Average trade openness of neighboring countries, % of GDP	WDI	67.420	11.254	229.334	30.537	1013
	LIB	Liabilities,% of GDP	LMF07	10.357	0.023	208.541	20.710	814
	FDIEQU	Assets and liabilities of FDI and portfolio investment, % of GDP	LMF07	88.459	3.697	936.932	88.145	882
	Fjure	*De jure* financial openness index	CHIN08	0.977	-1.808	2.541	1.485	881
	PRI	Private Credits, % of GDP	Beck et al. (1999)	0.715	0.017	3.451	0.412	911
	HHI	Bank concentration index (0 to 1)	Beck et al. (1999)	0.680	0.201	0.992	0.194	471
	SizeEMP	Size of manufacturing sector % of manufacturing employment	KLEMS	23.735	10.774	40.876	6.144	811

Luxembourg is excluded. KLEMS refers to the EU KLEMS database. UNCTAD refers to the United Nations Conference on Trade and Development *Handbook of Statistics*, 2008. WDI refers to the World Development Indicator database. LMF07 refers to Lane and Milesi-Ferretti (2007). CHIN08 refers to Chinn and Ito (2008).

(2007) database. Lastly, a *de jure* measure of capital account liberalization ($Fjure$) is obtained from Chinn and Ito (2008).

Furthermore, to examine how financial development mediates the effect of financial integration on specialization, we take liquid liabilities (currency plus demand and interesting-bearing liabilities), scaled to GDP as a proxy for financial development (FD). This measure includes liabilities from three types of financial institutions: the central bank, deposit money banks and other financial intermediaries. It is the broadest available indicator of financial development, commonly described as "financial depth" in the literature (Levine, 1997). For robustness purpose, we also choose an alternative measure that describes the size of financial intermediation: the value of credits provided by deposit money banks and other financial intermediaries to the private sector divided by GDP (PRI). This measure isolates credits issued to the private sector as opposed to credits issued to governments, government agencies, and public enterprises and excludes credits issued by the central bank. Another measure for financial development is the Herfindahl-Hirschman bank concentration index (HHI). In contrast to size-based measures, this bank concentration index captures the structure of the banking sector, which is of importance in influencing the industrial structure and in facilitating risk sharing through international borrowing and lending.[41] The use of both measures allows us to explore which aspect of financial development, financial depth or the structure of banking sector, is important. All measures of financial development are obtained from the Beck et al. (1999) database.

Other Variables

The vector Z includes the size of the manufacturing industry ($Size$), calculated as manufacturing value added divided by the total value added of all sectors, as well as GDP per capita ($GDPpc$) and its squared term ($GDPpc2$) to characterize the stage of economic development. For robustness purposes, we also calculate the size

[41] For example, Cetorelli and Gambera (2001) find that bank concentration promotes growth of those industrial sectors that are more in need of external finance by improving credit access for younger firms. They also argue that a concentrated banking system may impose a growth penalty across all sectors and firms.Cetorelli and Strahan (2006) demonstrate that potential entry firms face greater difficulty in obtaining bank credit in a concentrated banking market.

of the manufacturing industry (*SizeEMP*) as manufacturing employment divided by the total employment of all sectors. The value added and employment data come from KLEMS, while GDP per capita (constant 2000 US dollars) is taken from the World Bank (2008) *World Development Indicators* (WDI). Table 1 summarizes the definitions, sources and descriptive statistics of main variables as well as those used in robustness analysis, respectively.

Having presented the model specifications and measures of trade and financial integration and specialization, as well as the related control variables, we can now embark on the estimation of our specifications, in order to find answers to the set of questions raised in this paper. The presentation and discussion of the empirical findings is the task of the next section.

4. Empirical Results

This section presents the empirical results. We examine, first, how trade and financial integration relate to industrial specialization individually and, second, jointly. Third, we explore the role of intra-industry trade and financial development in facilitating the relationship of trade and financial integration and specialization, respectively. Table 2, accompanied by a set of diagnostic tests, is organized accordingly and summarizes our findings. Table A.3 in the Appendix presents all robustness checks.

4.1. Do trade and financial integration affect industrial specialization?

We start by investigating the independent impact of trade and financial integration on industrial specialization. Column (I) in Table 2 reports the two-step GMM results of the baseline model defined by equation (1).

As the results show, we find a statistically significant (at 1 percent) negative relationship between trade integration and specialization, indicating that further openness to foreign trade coincides with a more diversified industrial structure - a finding in contradiction to the prediction of classical trade theories based on comparative advantage. One the one hand, this contradiction may be driven by forces not captured in standard neoclassical trade theories, including the presence of trade costs, factor price inequality, and difference in technology and productivity across countries(Bernard et al., 2007). For example, our finding corroborates with López and Sánchez (2005), who find a negative relationship between openness and specialization for ten European countries. They assert that the convergence of industrial structures following the openness to foreign trade is consistent with the prediction of the Hechscher-Ohlin-Vanek theory: when factor prices are equalizing, the sources of comparative advantage arising from relative differences in factor prices disappear. On the other hand, trade integration implies the creation of new exporting industries, which in turn leads to the expansion of aggregate production in those industries. This process could be driven by agglomeration forces and forward (larger market)-backward (large input variety) linkages pointed out by new economic geography theories (Fujita et al., 2001). This result is also in line with Beine and Coulombe (2007), who find a long-run positive impact of trade integration on export diversification of Canadian regions, but in contrast with Crabbé et al. (2007), who employ the same estimation strategy and show the opposite for thirteen CEEC countries.

Turning to the role of financial integration, we observe a statistically significant (at 1 percent) positive effect of financial integration on specialization, in line with the risk-sharing rationale put forward by Kalemli-Ozcan et al. (2003). By allowing access to foreign markets, financial integration can bring a wider range of financing sources and investment opportunities, permitting the decoupling of production and consumption via cross-country risk sharing mechanisms and making it less costly for countries to achieve greater specialization.

In terms of magnitude, the negative impact of trade openness dominates the positive effect of financial openness in driving specialization. Ceteris paribus, a one standard-deviation increase in (the log of) trade openness results in a decrease in the log Gini index equivalent to 2.4 standard deviations, whereas a standard-deviation increase in (the log of) financial openness is associated with a increase in log Gini coefficient of roughly 0.65 standard deviations.

Contrary to past evidence (Imbs, 2004; Basile and Girardi, 2010), our findings so far suggest that increases in the size of the manufacturing sector (*Size*) coincide with an increase in specialization, suggesting that such an increase might concentrate on a few industries in which countries already specialize, resulting in rising inequality of the distribution of industry shares, i.e. more specialization. In line with Imbs and Wacziarg (2003), we find a U-shaped relationship between GDP per capita and specialization. In the early stages of development, countries diversify and hold a more balanced structure of economic activities in order to reduce the negative impact of sector-specific shocks. At the later stages of development, countries begin to specialize to fully exploit comparative advantages. The threshold level where countries re-specialize occurs when the level of GDP per capita reaches 17,172 in constant 2000 US dollars, which is above the sample average of 15,371 (roughly the level of Spain in 2005). Our estimate, corresponding to 13,623 in constant 1995 U.S. dollars is higher than that of Imbs (2004), who reports thresholds ranging from 9,000 to 11,000 (in constant 1995 US dollars). [42]

[42] We take the average inflation rate of 31 countries in our sample from 1995-1999 (7.238, 5.366, 4.607, 2.894, 2.394 percent) to convert 17,172 constant 2000 U.S. dollars into 13,623 constant 1995 U.S. dollars. The inflation data have been retrieved from the World Bank (2008) *WDI*. The same calculation procedure is used in the following sections.

Table 2: Empirical Results

Column	(I)	(II)	(III)	(IV)	(V)
Specification	equation (1)	equation (2a)	equation (2a')	equation (3a)	equation (3b)
T	-0.743***	-0.587***		-1.666***	-0.524***
	(0.243)	(0.193)		(0.573)	(0.157)
INT			-0.705***		
			(0.134)		
F	0.145***	-0.630***	-0.345***	0.136***	0.298***
	(0.043)	(0.208)	(0.065)	(0.034)	(0.105)
TxF		0.154***			
		(0.047)			
INTxF			0.122***		
			(0.022)		
TxIIT				1.471*	
				(0.893)	
FxFD					-0.047**
					(0.022)
IIT				-5.951*	
				(3.588)	
FD					0.257**
					(0.123)
Size	0.555***	0.145**	0.192***	0.516***	0.479***
	(0.135)	(0.0681)	(0.071)	(0.112)	(0.103)
GDPpc	-0.597**	-0.527***	0.523	-0.617	-0.381
	(0.294)	(0.159)	(0.417)	(0.420)	(0.281)
GDPpc2	0.105**	0.064**	-0.110	0.091	0.069
	(0.051)	(0.032)	(0.079)	(0.073)	(0.049)
Endogeneity	0.005	0.097	0.045	0.039	0.025
AR(1)	0.050	0.045	0.159	0.076	0.093
AR(2)	0.316	0.111	0.253	0.747	0.899
Over-identification	0.920	0.059	0.333	0.445	0.317
Under-identification	0.073	0.001	0.131	0.032	0.058
Weak-identification	0.002	0.000	0.000	0.000	0.000
Observations	671	704	350	517	646

All models are estimated in first difference using the two-step GMM estimator. Variables are expressed in logs, except IIT. The dependent variable is *S*, the GINI specialization index. Other variables are defined as follows: *T* is trade openness, defined as total imports plus exports/GDP; *INT* is the share of intra-Eurozone trade, defined as imports plus exports of a country with other Eurozone countries/country's GDP; *F* is Financial openness, defined as total financial assets plus liabilities/GDP; *IIT* is intra-industry trade intensity, defined as Grubel-Lloyd index; *FD* is financial development, defined as liquid liabilities/GDP; Size is the share of total manufacturing value added in the economy; *GDPpc* is per capita real GDP (Constant 2000 U.S. dollars); *GDPpc*2 is per capita GDP squared; Endogeneity is the Durbin-Wu-Hausman test; AR(1), AR(2) are Arellano-Bond serial correlation tests; Over-identification is the Hansen *J* statistic; Under-identification is the Kleibergen-Paap *rk* test; Weak-identification is the Anderson-Rubin test. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

To ensure the validity of our results, we perform a range of diagnostic tests. The DHW statistic rejects the null hypothesis that introducing instruments has no effect on the estimated coefficients and confirms that trade integration is indeed endogenous in column (I).[43] Therefore, we use lagged levels of trade from $t-3$, $t-4$ and $t-5$ as instruments. The validity of lagged levels of trade integration as instruments is guaranteed by rejecting the absence of first-order serial correlation and not rejecting the absence of second-order serial correlation. Moreover, the Hansen *J* test does not reject the over-identifying restrictions, confirming the validity of our instruments. Finally, the Kleibergen-Paap *rk* test and the Anderson-Rubin test confirm that specification (1) is properly identified and does not suffer from under- and weak-identification problems.

To summarize, a key finding that emerges from our analysis so far is that trade and financial integration are both important in explaining variations in industrial specialization across countries.

4.2. Are trade and financial integration moderators of each other's relationship with specialization?

So far, we have neglected the possible connection between trade and financial integration in affecting special-

[43] Financial integration is also likely to be an endogenous variable based on the argument that more specialized countries might demand more international insurance, therefore more likely to engage in financial integration. We apply the DHW endogeneity tests to check the endogeneity of financial integration in both specifications and do not find evidence that financial integration should be treated endogenously. Moreover, similar test results appear in later specifications. In line with past studies (Kalemli-Ozcan et al., 2003), we rely on the assumption that the causality runs from financial integration to specialization and choose not to instrument financial integration.

ization. We now proceed by examining the join effect of trade and financial integration, as described in equation (2a). The results are shown in column (II) of Table 2. To see the role of each type of integration, we have to also consider the interaction effect, which enters with a positive sign, suggesting a complementary relationship between trade and financial integration. In other words, the effect of trade (financial) integration is further enhanced by the degree of (financial) trade integration. The one percent significance level indicates a very strong association between them.

In order to further assess the strength of each type of integration, we calculate the marginal effect of one type of integration *conditional* on the other type, based on equations (2b) and (2c). Figures (2a) and (2b) illustrate these conditional marginal effects and the corresponding confidence 95 percent intervals (Brambor et al., 2006).[44]

Threshold effects are present in both figures. Figure (2a) demonstrates that trade integration has a negative relationship with specialization for lower levels of financial integration. Above a threshold level of financial integration, the relationship between trade and specialization turns positive. The threshold level corresponds to a financial openness ratio above 45 percent of GDP, which is slightly above the 10th percentile of the distribution of financial openness, suggesting that the diversification effect of trade is only relevant when countries are not financially integrated.[45]

To shed more light on the economic nature of the relationship between trade integration and specialization, we can now evaluate equation (2b) at the mean, minimum and maximum value of financial integration. The marginal effect of trade integration on specialization at the mean level of financial integration is 0.052. When financial integration is at its lowest and we reach the bottom left corner of Figure (2a), the marginal effect of trade integration is -0.214. Finally, when financial integration peaks and we reach the top right corner of Figure (2a), the effect of trade integration is 0.231.[46] Summing up, specialization decreases with trade when risk-sharing opportunities - captured by the low level of financial integration - are limited. Once there are sufficient risk sharing opportunities, trade openness appears to induce specialization. One possible explanation is that countries diversify their production to reduce output volatility that is associated with trade openness. A number of cross-country studies have documented that greater trade openness is accompanied by higher aggregate volatilities of various macroeconomic variables, e.g. volatility of GDP growth (Kose et al., 2003; di Giovanni and Levchenko, 2009), income and consumption growth (Bekaert et al., 2006). This diversification effect of trade openness is likely to diminish as financial integration progresses.

The story is somewhat similar for the role of trade integration as a moderator to the financial integration and industrial specialization relationship. In Figure (2b), we show the effect of financial integration on specialization *conditional* on trade integration. It is immediately clear that the positive effect of financial integration on specialization through risk sharing can only be realized when countries are sufficiently open to international trade. The marginal effect of financial integration becomes positive when the log of trade integration is slightly more than four, corresponding to a trade openness ratio of approximately 60 percent of GDP. At the mean level of trade openness, the impact of financial integration on specialization is 0.1. When evaluated at the minimum level, the impact takes the value of -0.278, while it becomes 0.528 when the level of trade openness reaches its maximum.[47] This finding provides evidence that growing trade flows (perhaps more inter-industry trade) create extra demands for international insurances and enlarge the scope for financial integration to have a bigger impact on specialization. Our results also relate to a strand of recent research documenting that the level of trade openness matters for the effects of financial openness.[48] For example, more open economies are found to be less vulnerable to financial crises (Calvo et al., 2004; Edwards, 2004a; Cav-

[44] The magnitude and significance of β_1 and β_2 in equation (2a) do not bear direct interpretation regarding the impact of trade and financial integration on specialization as the interaction term, i.e.β_3 needs to be taken into account. Since we are mainly interested in how trade and financial integration act as moderators of each other's relationship with specialization, we therefore compute the conditional marginal effect, following Brambor et al. (2006). This approach sheds more light on the threshold effects demonstrated in the following paragraphs. Ozer-Balli and Sorensen (2010) propose a different treatment and interpretation of linear regression models with interaction terms. They suggest that a model with a demeaned instead of a conventional interaction term is preferable as the former maintains the interpretation of the coefficients to main terms similar to a model without the interaction term, while keeping the coefficient on the interaction term (largely) unchanged. Following their approach, we re-estimate equation (2a), where in place of $T_{it}xF_{it}$, we use a demeaned interaction term $(T_{it} - \bar{T}_{it})x(F_{it} - \bar{F}_{it})$. We find that in a fixed-effect specification, β_1 and β_2 in the case are very similar to those obtained when estimating equation (1) and the coefficient on the demeaned interaction term remains to a large extent constant. However, in our first-difference specification, the demeaned interaction term turns out insignificant.

[45] We check for the sub-sample stability of our results by splitting the sample into high-tech and low-tech countries (See Appendix Table A.2). We first compute the average share of medium and high-tech value added in total manufacturing value added over time for each country, countries whose share is above (below) the medium are classified as high-tech (low-tech). The results are quite similar in both samples. The notable differences lies in the level of threshold. The impact of trade on specialization turns positive when the level of financial integration reaches 100 percent and 29 percent of GDP for high-tech and low-tech countries, respectively. The positive effect of financial integration on specialization occurs when trade openness ratio is above 70 percent and 55 percent of GDP for high-tech and low-tech countries, respectively.

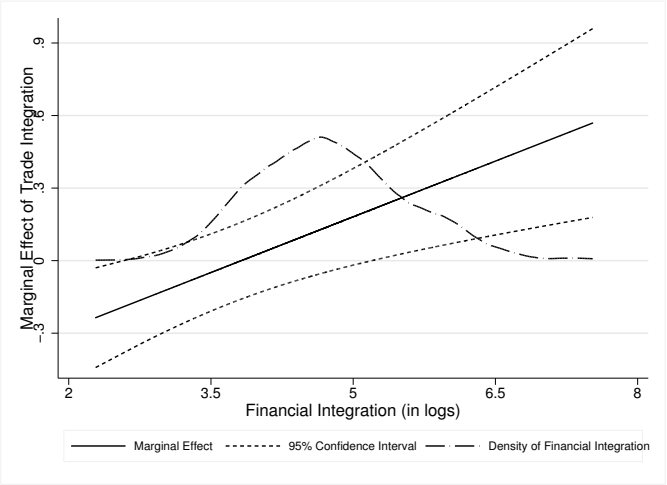
[46] The calculation is as follows: $-0.587 + 0.154 \times 4.15 = 0.052$, $-0.587 + 0.154 \times 2.42 = -0.214$, $-0.587 + 0.154 \times 5.31 = 0.231$, all numbers are expressed as elasticities.

[47] The calculation is as follows: $-0.63 + 0.154 \times 4.75 = 0.1$, $-0.63 + 0.154 \times 2.28 = -0.278$, $-0.63 + 0.154 \times 7.52 = 0.528$.

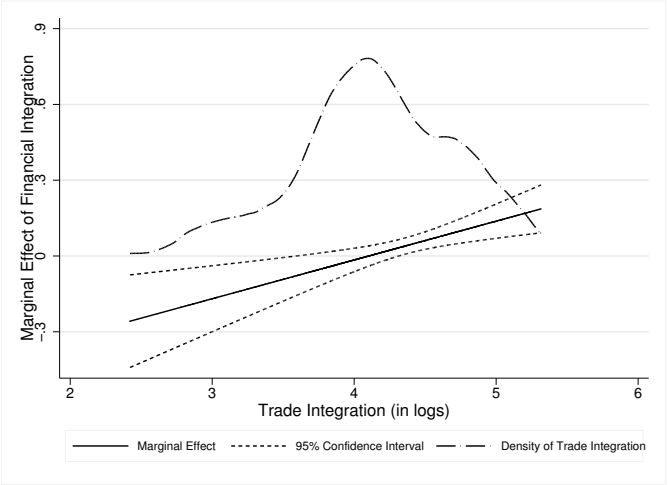
[48] For a comprehensive survey, see Kose et al. (2009b).

Figure 2: The role of trade integration and financial integration as moderators

(a) Financial integration as a moderator



(b) Trade integration as a moderator



allo and Frankel, 2008). Among countries that have experienced these episodes, countries that are more open to trade suffer smaller growth declines than those with a lower degree of trade openness (Guidotti et al., 2004; Edwards, 2004b). Such findings are consistent with the notion that trade integration proceeds financial integration. In other words, (developing) countries should liberalize trade before they liberalize capital flows. Our results also lend support to this notion as finance-induced specialization can only be realized when a threshold level of trade openness is achieved.

When it comes to the control variables, the size of manufacturing industries still exhibits a significant positive coefficient, although its magnitude is smaller. The U-shaped pattern between GDP per capita and specialization is (statistically) preserved. However, the threshold level of GDP per capital, where countries begin to re-specialize, is beyond the range of our sample, which only supports the relevance of the diversification effect of economic development.

Overall, these results suggest that financial integration has a stronger relationship with specialization than trade integration, as the marginal effect of financial integration (at the sample mean) is almost twice as large as that of trade integration (0.1 vs. 0.052) and statistically more significant. We find that an increase in trade integration leads to more specialization for most levels of financial integration, although the effect is not always statistically significant. In contrast, financial integration drives specialization only if countries are sufficiently open to trade (above the median in our sample). Taken together, our findings indicate that countries are likely to become more specialized with further deepening of either trade and financial integration. The simultaneous deepening along both dimensions has a larger impact on specialization, confirming the complementarity between trade and financial integration.

Before moving on to our third question, we wish to examine whether there is a regional dimension in the integration-specialization nexus. We therefore focus on a narrower group of countries that is highly integrated, the Eurozone. We examine whether there is a regional dimension in the integration-specialization nexus. In particular, we want to find out to what extent regional integration, specifically trade integration, affects the production specialization in this group. For this purpose, we make use of a narrower measure of trade openness, defined as the share of intra-Eurozone trade scaled by GDP (INT). We estimate equation ($2a'$) and results are shown in column (III) in Table 2.

As the results show, both trade and financial integration have a negative sign and are statistically significant. The interaction term enters with a positive sign and is significant at 1 percent, once again confirming the complementary relationship between (regional) trade integration and financial integration. We find that the impact of regional trade integration, at the mean level of financial integration, is -0.163. Interestingly, when we compute the impact of global trade integration on specialization based on point estimates in (II), we obtain 0.142.[49] Our results suggest that openness to trade within the Eurozone corresponds to increased diversification, which manifests the dominant role of intra-industry trade in contributing to the similarity of production structures. In contrast, overall openness seems to result in more specialization. This discrepancy could be attributed to the fact that the increasing trade linkages between Eurozone countries with emerging trade partners, including China, are likely to be of the inter-industry type.

[49]The calculation is as follows: $-0.705 + 0.122 \times 4.812 = -0.163$, $-0.58 + 0.15 \times 4.812 = 0.142$

Turning to the effect of financial integration, we find that, on average, the marginal effect of financial integration on specialization is calculated to be 0.038. This effect is marginally larger than that calculated using point estimates in (II), which yields a number close to zero.[50] This finding confirms again that financial integration leads to increased specialization only if countries are sufficiently open. With respect to control variables, the size of the manufacturing industry has a significant positive effect on specialization. The U-shaped pattern between GDP per capita and specialization disappears.

In terms of the diagnostic tests, the DHW statistic confirms that trade (intra-Eurozone trade), together with its interaction with financial integration are indeed endogenous variables in column (II) and (III). Therefore, we use lagged levels of trade (intra-Eurozone trade) from $t-2$, $t-3$ and lagged interaction term from $t-2$, $t-3$ as instruments. The validity of instruments is guaranteed by rejecting the absence of first-order serial correlation and not rejecting the absence of second-order serial correlation, although the validity is weaker in (III), possibly owing to a relative small sample. The Hansen J test does not reject the over-identifying restrictions at a reasonable significance level. Finally, the Kleibergen-Paap *rk* test and the Anderson-Rubin test show that specification (2a) is properly identified and specification ($2a'$) may suffer some under-identification problems.

Robustness analyses

To check the robustness of our results, we first consider alternative measures of trade openness. All robustness checks are based on equation (2a). Columns (i), (ii) and (iii) in Table A.3 employ the imports share to GDP (IMP), exports share to GDP (EXP) and manufacturing trade openness ($MANT$), respectively. Results are in general very similar to those reported in (II). Only in column (iii), we find that the impact of manufacturing trade on specialization becomes smaller in magnitude and in significance.[51] One possible explanation that could account for this discrepancy is that trade in services (e.g. financial services) constitutes an important force to the convergence of industrial structures across countries. We have re-estimated (1) using the average of neighboring countries' trade openness (AT) as the instrument for trade openness. The results, displayed in column (iv), are very similar, further confirming the validity of lagged trade openness as instruments we use throughout the estimation. Overall, our results do not seem to be driven by the choice of a particular trade openness measure, nor by the use of an alternative instrument.

We then use different measures of financial integration. Columns (v) and (vi) in Table A.3 employ two narrower measures of financial openness, namely total liabilities (i.e. accumulation of capital inflows) and assets plus liabilities on FDI and portfolio investments divided by GDP (LIB and $FDIEQU$). We find no significant changes to our main findings. However, we obtain relatively weaker results in column (vii) when using the *de jure* index ($Fjure$) compiled by Chinn and Ito (2008). Trade integration bears a positive sign - a finding consistent with recent studies (Bonfiglioli, 2008; Baltagi et al., 2009) that highlight the problems of using *de jure* measures to examine the effects of financial integration.

Furthermore, we use two other measures of industrial specialization, namely the Herfindahl-Hirschman index (HRI) and the coefficient of variation (VSI), calculated using value added data. Results are reported in columns (viii) and (ix) in Table A.3. Again, results are qualitatively similar. In addition, we consider specialization measures ($GINIEMP$, $HRIEMP$ and $VSIEMP$) computed from employment data and report results in columns (x), (xi) and (xii). We note that trade integration carries the same sign but now becomes insignificant. We conclude that trade integration leads to less specialization in terms of value added, but not in terms of employment. This finding is in line with Wacziarg and Wallack (2004), who also find that trade liberalization episodes do not have any significant consequences on inter-sector labor reallocation, even at higher levels of disaggregation.

Finally, we also check whether the estimation results are driven by outliers. One or more very open countries could potentially drive the results. We drop Ireland, where the financial openness is the highest in our sample, re-run the estimation and find quantitatively similar results in column (xiii) in Table A.3.

In summary, two important findings emerge from our analysis. First, we demonstrate that trade (financial) integration has pronounced effects on specialization when the level of financial (trade) integration is high, in support of a complementary relationship. Second, while global trade integration corresponds to more industrial specialization, regional trade integration coincides with increased diversification in the Eurozone. Findings are robust to a wide range of alternative measurement strategies.

4.3. Are intra-industry trade and financial development important mediators for the impact of trade and financial integration on specialization?

Having established that trade and financial integration have a significant relationship with specialization, the last step consists of investigating whether the strength of this relationship is determined by intra-industry trade (IIT) and financial development (FD), respectively.

Column (IV) in Table 2 presents the results based on specification (3a), where IIT and its interaction term with

[50] $-0.345 + 0.122 \times 3.144 = 0.038$.

[51] As a further check, we make use of a slightly different measure and take total manufacturing trade scaled by GDP rather than total manufacturing output. Again, we find a somewhat smaller and insignificant effect of trade integration on specialization compared with the specification (II).

trade integration are included in the specification.[52] Both terms are individually significant at 1 percent and 10 percent (respectively) and jointly significant at 1 percent. Figure (3a) shows the marginal effect of trade integration on specialization, *conditional* on the intra-industry trade intensity. Consistent with column (I), trade integration always leads to a negative impact on specialization, independent of the level of intra-industry trade. We find that countries with high levels of intra-industry trade experience more specialization in response to further integration than countries with low levels of intra-industry trade. Contrary to our expectation, intra-industry trade seems to dilute the diversification effect of trade rather than promoting it. One possible explanation is that further exposure to trade encourages inter-industry trade proportionally more than intra-industry trade for countries that are already heavily engaged in intra-industry trade, consequently resulting in less diversification. Financial integration enters with a positive and statistically significant coefficient at 1 percent. The magnitude is comparable to that found in column (I), confirming the important role of financial integration in driving specialization.

To gauge the role of financial development in mediating the effect of financial integration on specialization, column (V) in Table 2 shows the results based on specification (3b), where financial development and its interaction term with financial integration are added in the specification. We first note that trade integration still exhibits a significant, negative relationship with specialization. Financial integration remains a significant, driving force in promoting specialization.

Figure (3b) shows that the marginal effect of financial integration on specialization is negatively associated with the degree of financial development, implying that the effect of financial integration in promoting specialization is larger in countries with less developed financial systems and smaller in those with well developed financial system.

The apparent substitution between financial integration and financial development in Figure (3b) suggests that both represent alternative channels for countries to share idiosyncratic production risks and thereby smooth consumption and income, which, in turn, induces more specialization. On the one hand, a country with a well-developed financial system can more easily diversify sector-specific risks, and consequently has greater incentives to specialize. In this case, there is less scope for further risk-sharing through financial integration, which in turn has less of an effect on specialization. The ability of reallocating and diversifying risk is considered as one of the major functions of domestic financial systems in shaping production structure and fostering economic development. This argument has been strongly emphasized by a vast body of finance-growth literature (King and Levine, 1993; Levine, 1997; Beck et al., 2000). On the other hand, countries with underdeveloped financial systems may lack appropriate instruments to pool risk. They can benefit more from the openness of financial markets, which brings domestic residents a wider range of ex-ante and ex-post insurance instruments to enhance portfolio diversification and lower aggregate production risk. Consequently, for these countries financial openness surpasses financial development to become the main driver in facilitating risk sharing, consequently promoting specialized production structures. Our results provide some evidence to support this view.

An alternative interpretation relies critically on the financial dependence of sectors. Seminal work by Rajan and Zingales (1998) develops a methodology to rank industries according to their external dependence on financing. They find that industries that are highly dependent on external financing grow faster in countries with relatively developed financial systems. Subsequent studies confirm that financial development, as a source of comparative advantage can directly influence the degree of specialization precisely by promoting financially dependent sectors (Beck, 2002, 2003; Svaleryd and Vlachos, 2005; Hur et al., 2006). In the same vein, other studies find industries that are heavily dependent on finance grow faster in countries with liberalized financial markets (Vanassche, 2004).[53] Taken together, the substitution hypothesis holds if financial development and financial integration are alternative channels through which industries/firms are able to raise funds to alleviate their financing constrains, allowing them to grow faster.[54] However, given the data at our disposal, we can not perform a di-

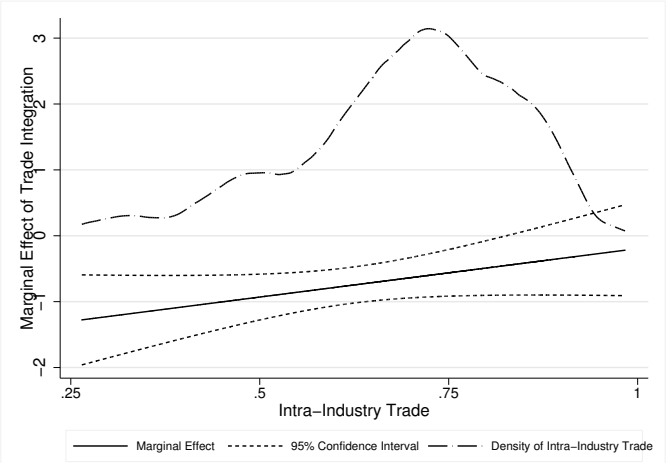
[52] Including both intra-industry trade and our traditional trade integration measure, as well as an interaction term, may raise concerns regarding multicollinearity. However, in light of our analysis of the conditional marginal effects in Figures (3a) and (3b), two aspects of columns (IV) and (V) are worth mentioning (Brambor et al., 2006). First, given the inclusion of interaction terms, we never intend to measure the average effect of a variable in the same way as we would in an additive model, as in column (I). As a result, a change in coefficients as a result of including the interaction terms, should not be interpreted as a sign of multicollinearity. Second, the main 'problem' with multicollinearity would be large standard errors, something that would be accurately captured by Figures (3a) and (3b) and would thereby not lead us to overstate the significance of our results.

[53] Vlachos and Waldenström (2005) do not find support to this view. Eichengreen et al. (2009) provide a comprehensive survey and find reasonably strong evidence that financial openness has positive effects on the growth of industries that are dependent on external finance, although these growth-enhancing effects evaporate during financial crises.

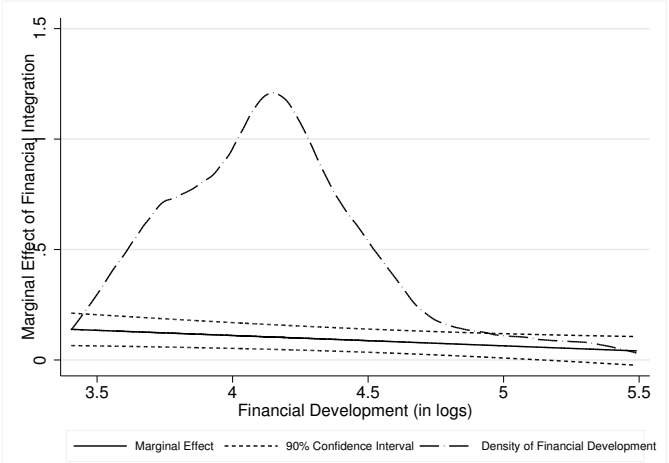
[54] To shed more light on this argument, we refine our specialization measure by computing the share of manufacturing value added in high financial dependent sector($SHIGH$) and low financial dependent sector($SLOW$) as independent variables (See Appendix Table A.2) and re-estimate equation (3b). Columns (xiv) and (xv) in Table (A.3) show that increases in financial integration and financial development lead to increases in the importance of financial dependent sectors. That is, countries with higher levels of financial integration and development experience a shift in production towards industries with high dependence on external finance.

Figure 3: The role of intra-industry trade intensity and financial development as mediators

(a) Intra-industry trade intensity as a mediator



(b) Financial development as a mediator



rect test to discriminate between these two competing interpretations.[55]

In terms of control variables, the size of the manufacturing industry continues to have a significant and positive effect on specialization in both specifications (3a) and (3b). However, GDP per capita and its squared term carry the correct sign, both are no longer significant, possibly due to the inclusion of the intra-industry trade measure or the financial development measure.[56] The threshold level of GDP per capita that countries need to reach before moving to the specialization stage is 30,121 US dollars (23,896 constant 1995 US dollars), which is above the 95th percentile of the whole distribution in specification (3a) and 15,592 US dollars (12,670 constant 1995 US dollars), which is approximately the sample mean level of GDP per capita in specification (3b).

Overall, the diagnostic tests are satisfactory in both specifications. The DHW statistic confirms that trade integration is an endogenous variable in column (IV), and trade integration and it interaction with IIT are endogenous variables in column (V). In column (V), we instrument them using the lagged trade integration from $t-3$, $t-4$ and the lagged interaction term from $t-3$, $t-4$, whereas in column (IV) we instrument trade integration with lagged trade from $t-3$, $t-4$ and $t-5$. The absence of first-order serial correlation is rejected and the absence of second-order correlation is not rejected at the reasonable level of significance. The Hansen *J* test does not reject over-identifying restrictions in both specifications. The Kleibergen-Paap *rk* test and the Anderson-Rubin test reject the null-hypothesis of under-identification and weak-identification. All these tests indicate both specifications are well-specified.

Robustness analysis

To ensure the robustness of our results, we employ two other measures of financial development: the amount of credit provided to private agents scaled by GDP, and the bank concentration index. Results are shown in columns (xvi) and (xvii), respectively, of Table A.3 in the Appendix. It appears that the size of the banking sector does not have a significant direct impact on specialization, nor an indirect impact via financial integration. When looking at the structure of the banking sector, we find some evidence that the relationship between financial integration and specialization is larger in countries with a less concentrated banking sector, although statistically not significant. This may imply a potentially important mediating mechanism through which financial integration affects specialization, namely by improving efficiency in the banking sector via increasing competition and facilitating risk sharing in a more efficient way. This finding is in line with Leibrecht and Scharler (2009) who demonstrate that the development of the banking sector contributes little to the international diversification of consumption risk among the OECD countries. Moreover, they postulate that the extent of risk sharing achieved is not dependent on the overall size of the financial sector

[55] To further gauge the potential linkages between moderation and mediation effects, we perform an additional exercise by re-estimating equation (2a) in two ways, following Brambor et al. (2006). First, we add $T_{it}xF_{it}xIIT_{it}$ and all combinations between T_{it}, F_{it} and IIT_{it}. In a similar vein, we also add $T_{it}xF_{it}xFD_{it}$ and all combinations between T_{it}, F_{it} and FD_{it} instead. Our aim is to examine whether the moderation effect between trade and financial integration on specialization depends on the levels of mediators intra-industry trade and financial development. More specifically, we calculate the marginal effect of $T_{it}xF_{it}$ on S_{it}, conditional on IIT_{it} and FD_{it}. As shown in Appendix Figure (A.1), the conditional marginal effects do not seem to vary with the level of IIT_{it} and FD_{it}, suggesting that the moderation and mediation effects are likely to be independent from each other. Therefore, we prefer to discuss them in separate sections.

[56] They are also not jointly significant. The p-value of a standard *F* test is 0.105 and 0.175 in (3a) and (3b, respectively).

per se, but rather on its structure, i.e. how the financial system is organized. Our tentative evidence seems to be pointing in this direction. Future research on structural aspects of the financial system in facilitating the effect of financial integration on specialization is warranted.

Summing up, we find that (i) trade integration has a stronger relationship with industrial specialization in countries with a high degree of intra-industry trade; (ii) financial integration has a stronger relationship with specialization in countries with relatively less developed financial systems, a finding in line with the substitution hypothesis; however, the substitution effect does not appear to be very strong; (iii) although we find a U-shaped pattern between GDP per capita and specialization in most of the specifications, the threshold point of GDP per capita, where countries re-specialize, varies significantly across specifications, casting some doubts on the implications of such a finding.

5. Conclusion

This paper investigates the economic integration - industrial specialization nexus and empirically establishes the direct linkages between trade, financial integration and industrial specialization for a panel of 31 countries over the period 1970-2005.

We contribute to the existing literature by answering three questions. First, we document the relationship between economic integration and specialization via two separate channels, trade and financial openness. We find a statistically significant negative relationship between trade integration and specialization, suggesting that further openness to foreign trade induces a more diversified industrial structure, and a statistically significant positive effect of financial integration on specialization, in line with the risk-sharing rationale put forward by Kalemli-Ozcan et al. (2003), and subsequently confirmed by Basile and Girardi (2010) and Imbs (2004). In terms of magnitude, the negative relationship of trade openness with specialization dominates the positive relationship of financial openness.

Second, we show that financial integration acts as a moderator to the relationship between trade integration and specialization, and vice versa. We demonstrate that the role of trade (financial) integration is further enhanced by the degree of financial (trade) integration. Our finding indicates that trade and financial integration do not operate through independent channels. In fact, they complement each other in shaping industrial specialization across countries. Furthermore, trade integration coincides with increased specialization for most levels of financial integration, whereas financial integration coexists with high degrees of specialization only if countries are sufficiently open to trade. These findings extend Imbs (2004) by offering additional insights in understanding trade and financial integration as joint determinants of specialization across countries. Moreover, for a number of highly integrated Eurozone countries, we find that regional trade openness coincides with industrial diversification, while global trade openness coincides with higher degrees of specialization.

Lastly, we assess the impact of two important mediators to the relationship between economic integration and industrial specialization. First, we study to what degree intra-industry trade intensity acts as a mediator to the relationship between trade integration and specialization. Our results reveal that trade integration has a stronger relationship with specialization in countries with high levels of intra-industry trade. Next, we study how financial development mediates the relationship between financial integration and specialization. Our findings suggest that financial integration has a stronger relationship with specialization in countries with less developed financial systems, although this substitution effect does not appear to be very strong. Overall, our results are robust to a wide range of alternative measures and estimation strategies.

A main implication of our results is the importance of simultaneously deepening trade and financial integration. Countries that exploit integration along both lines can be expected to benefit the most from the benefits of integration (economies of scale and enhanced efficiency), while insuring themselves against idiosyncratic shocks. However, both effects depend crucially on the degree to which trade is intra-industry and the level of development of the domestic financial system. On the one hand, countries with little intra-industry trade and a high level of financial development may not reap great benefits from specialization, but will also be less exposed to shocks. On the other hand, countries with large inter-industry trade and a relatively low level of financial development stand to gain the most from increased trade ánd financial integration, as the former will allow them to reap the fruits of comparative advantage, whereas the latter may improve risk-sharing.

Nevertheless, our analysis underlines the fact that in the presence of asymmetric shocks, there is still a need for better risk-sharing mechanisms, in particular in the presence of common policy objectives, such as is the case, for example, in the Eurozone.

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Appendix

Table A.1: Country, Time and Specialization

Eurozone Countries	Specialization	Non-Eurozone Countries	Specialization
Austria (1970-2005)	0.356	Australia (1970-2005)	0.420
Belgium (1970-2005)	0.432	Canada (1979-2003)	0.393
Finland (1970-2005)	0.461	Czech Republic (1995-2005)	0.385
France (1970-2005)	0.52	Cyprus (1995-2005)	0.574
Germany (1970-2005)	0.408	Denmark (1970-2005)	0.500
Greece (1970-2005)	0.499	Estonia (1995-2005)	0.487
Italy (1970-2005)	0.371	Hungary (1995-2005)	0.409
Ireland (1970-2005)	0.591	Japan (1973-2005)	0.388
Luxembourg (1970-2005)	0.485	Korea (1970-2005)	0.455
Netherlands (1970-2005)	0.471	Latvia (1995-2005)	0.613
Portugal (1970-2005)	0.434	Lithuania (1995-2005)	0.527
Spain (1970-2005)	0.383	Malta (1995-2005)	0.522
		Norway (1979-2003)	0.454
		Poland (1995-2005)	0.405
		Slovakia (1995-2005)	0.373
		Slovenia (1995-2005)	0.356
		Sweden (1970-2005)	0.467
		United Kingdom (1970-2005)	0.362
		United States (1970-2005)	0.398

The time span for each country is in parentheses. Austria, Belgium, Finland, France, Germany, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain adopted the Euro on January 1, 1999. Greece was admitted on January 1, 2001. Although Cyprus, Malta entered the Euro-system on January 1, 2008 and Slovakia on January 1, 2009, our data stop at 2005. Therefore we classify these three countries as Non-Eurozone countries in our sample. Specialization is the average Gini coefficient (value added) over time.

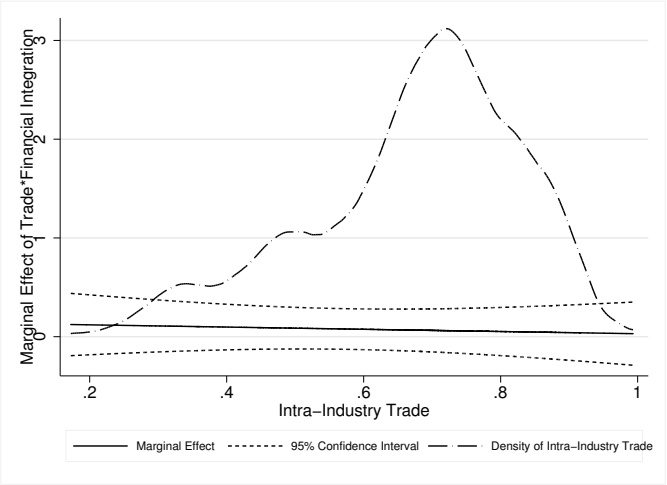
Table A.2: Industries and NACE Codes

Industry	NACE Code	Technology	Financial Dependence
Food, beverages and tobacco products	15-16	Low/Medium-low	Low
Textiles, wearing apparel	17-18	Low/Medium-low	High
Leather products and footwear	19	Low/Medium-low	Low
Wood products and cork	20	Low/Medium-low	High
Pulp, paper products	21	Low/Medium-low	High
Publishing and printing	22	Low/Medium-low	Low
Coke, refined petroleum and nuclear fuel	23	Low/Medium-low	High
Pharmaceuticals	24	High/Medium-high	High
Rubber and plastics products	25	Low/Medium-low	High
Other non-metallic mineral products	26	Low/Medium-low	Low
Basic metals	27	Low/Medium-low	High
Fabricated metal products	28	Low/Medium-low	Low
Machinery, NEC	29	High/Medium-high	High
Office machinery	30	High/Medium-high	High
Other electrical machinery	31	High/Medium-high	Low
Electronic valves and tubes	32	Low/Medium-low	High
Scientific instruments	33	High/Medium-high	Low
Motor vehicles, trailers and semi-trailers	34	High/Medium-high	High
Building repairing aircraft and spacecraft	35	High/Medium-high	High
Manufacturing nec, recycling	36-37	Low/Medium-low	Low

The classification of high-tech vs.low-tech industries is based on OECD (2005). The classification of financial dependent industries is based on Cetorelli and Strahan (2006, p. 447). They define a firm's financial dependence as the proportion of capital expenditures not financed with cash flow from operation, following Rajan and Zingales (1998). Then they take the level of the median firm as external financial dependence of the industry. We classify, therefore, industries as high vs. low financial dependence based on the median across all industries.

Figure A.1: Moderators and Mediators

(a) Intra-industry trade as a mediator



(b) Financial development as a mediator

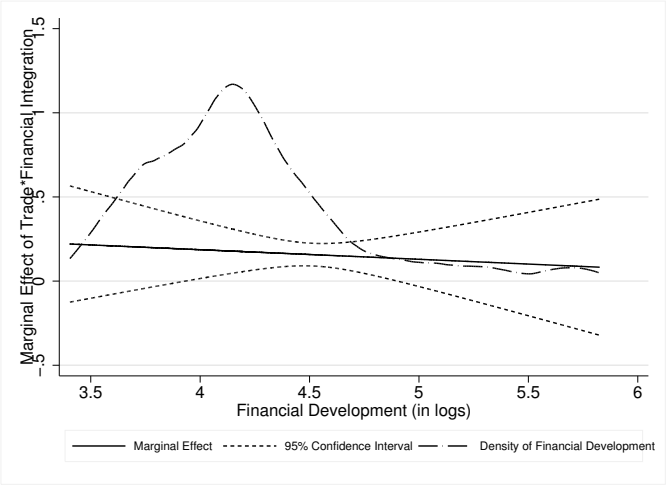


Table A.3: Robustness results

	Trade Integration				Financial Integration			Specialization					Outlier	Finan.Dependence		Finan.Develop.	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)	(xiv)	(xv)	(xvi)	(xvii)
T				-0.536***	-0.518***	-0.388***	0.312**	-0.780***	-0.725**	-0.128	-0.076	-0.129	-0.696***	-0.055	0.035	-0.729***	-1.191**
				(0.187)	(0.159)	(0.144)	(0.149)	(0.368)	(0.346)	(0.185)	(0.179)	(0.229)	(0.230)	(0.071)	(0.101)	(0.241)	(0.512)
IMP	-0.696***																
	(0.201)																
EXP		-0.549***															
		(0.211)															
MANT			-0.286														
			(0.182)														
F	-0.529***	-0.551***	-0.523***	-0.620***				-0.905***	-0.901**	-0.393**	-0.344*	-0.502***	-0.753***	0.137**	-0.221***	0.161	0.248**
	(0.168)	(0.203)	(0.130)	(0.179)				(0.361)	(0.353)	(0.161)	(0.191)	(0.226)	(0.248)	(0.065)	(0.08)	(0.114)	(0.121)
LIB					-0.634***												
					(0.187)												
FDIEQU						-0.613***											
						(0.167)											
Fjure							-0.476										
							(0.732)										
T*F				0.149***				0.217***	0.216***	0.084**	0.071*	0.105**	0.183***				
				(0.041)				(0.084)	(0.081)	(0.035)	(0.039)	(0.048)	(0.057)				
IMP*F	0.156***																
	(0.047)																
EXP*F		0.159***															
		(0.054)															
MANT*F			0.131***														
			(0.032)														
T*LIB					0.154***												
					(0.043)												
T*FDIEQU						0.149***											
						(0.039)											
T*Fjure							0.115										
							(0.173)										
FD														0.137**	-0.245**		
														(0.065)	(0.097)		
PRI																0.024	
																(0.142)	
HHI																	0.369
																	(0.300)
F*FD														-0.028**	0.046***		
														(0.013)	(0.018)		
F*PRI																-0.004	
																(0.024)	
F*HHI																	-0.067
																	(0.056)
Size	0.203**	0.136**	0.268***	0.139***	0.164**	0.168**	0.0924	0.334**	0.267**				0.140*	0.19***	-0.373***	0.554***	0.709***
	(0.08)	(0.066)	(0.064)	(0.071)	(0.069)	(0.0854)	(0.112)	(0.149)	(0.127)				(0.071)	(0.073)	(0.096)	(0.135)	(0.229)
SizeEMP										-0.199**	-0.201*	-0.270***					
										(0.080)	(0.103)	(0.118)					
GDPpc	-0.558***	-0.538***	-0.751***	-0.548***	-0.602***	-0.450***	-0.613***	-1.100***	-1.009***	-0.318**	-0.604***	-0.608***	-0.574***	-0.035	0.265	-0.596***	-0.393
	(0.158)	(0.195)	(0.202)	(0.162)	(0.155)	(0.168)	(0.232)	(0.261)	(0.258)	(0.126)	(0.151)	(0.174)	(0.162)	(0.143)	(0.183)	(0.330)	(0.290)
GDPpc2	0.077**	0.071	0.071*	0.067**	0.081***	0.046	0.055	0.159***	0.132**	0.029	0.074**	0.061*	0.072**	0.035	-0.087***	0.102***	0.116***
	(0.032)	(0.044)	(0.036)	(0.032)	(0.031)	(0.038)	(0.069)	(0.053)	(0.052)	(0.025)	(0.033)	(0.036)	(0.034)	(0.025)	(0.033)	(0.056)	(0.059)
Endogeneity	0.131	0.046	0.006	0.054	0.082	0.044	0.048	0.169	0.184	0.032	0.066	0.031	0.040	0.304	0.704	0.004	0.052
AR(1)	0.036	0.052	0.036	0.038	0.048	0.037	0.065	0.041	0.060	0.503	0.366	0.372	0.040	0.389	0.317	0.039	0.089
AR(2)	0.096	0.146	0.037	0.138	0.116	0.066	0.384	0.176	0.171	0.386	0.366	0.464	0.105	0.216	0.039	0.336	0.235
Overidentification	0.061	0.159	0.879	0.045	0.044	0.036	0.218	0.069	0.030	0.552	0.471	0.630	0.136	0.775	0.2301	0.941	0.283
Underidentification	0.001	0.007	0.001	0.011	0.002	0.008	0.263	0.001	0.001	0.099	0.099	0.099	0.002	0.021	0.021	0.068	0.401
Weak-identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.021	0.005	0.000	0.765	0.276	0.000	0.000
Observations	704	704	681	694	704	689	699	704	704	685	685	685	672	664	664	656	374

All models are estimated in first difference using the two-step GMM estimator. Variables are expressed in log, except *HHI*. Variables are defined as follows: *T* is trade openness, defined as total imports plus exports/GDP; *IMP* is the share of imports/GDP; *EXP* is the share of exports/GDP; *F* is Financial openness, defined as total financial assets plus liabilities/GDP; *LIB* is total liabilities/GDP; *FDIEQU* is the assets and liabilities of FDI and portfolio assets/GDP, *MANT* is manufacturing trade/total manufacturing output; *Fjure* is a *de jure* financial openness index, retrieved from Chinn and Itó (2008); *Size* is the share of total manufacturing value added in the economy; *SizeEMP* is the manufacturing employment/total employment in the economy; *GDPpc* is per capita real GDP (Constant 2000 U.S. dollars); *GDPpc*2 is per capita GDP squared. *FD* is liquid liabilities divided by GDP; *PRI* is private credits divided by GDP; *HHI* is the Herfindahl-Hirschman banking market concentration index; The dependent variable is *S*, the Gini specialization index in all specifications, except in (viii) to (xii) where the dependent variable is *HRI*, *VSI*, *GINIEMP*, *HRIEMP*, *VSIEMP* and in (xiv) to (xv) where the dependent variable is *SHIGH* and *SLOW*; *HRI* and *VSI* are Herfindahl-Hirschman index and coefficient of variation, calculated using value added data. *GINIEMP*, *HRIEMP* and *VSIEMP* are Gini coefficient, Herfindahl-Hirschman index and coefficient of variation calculated using employment data; *SHIGH* and *SLOW* are the share of high (low) financial dependent industries, respectively; Endogeneity is the Durbin-Wu-Hausman test; AR(1), AR(2) are the Arellano-Bond serial correlation tests; Over-identification is the Hansen *J* statistic; Under-identification is the Kleibergen-Paap *rk* test; Weak-identification is the Anderson-Rubin test. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1