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Macro and Micro Features of Successful Economic Convergence: The Case of Poland

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Abstract

This paper examines the patterns of growth of Poland, and its transition into high-income status over the past two decades from a macro and micro perspective. It benchmarks Polish performance with that observed in established high-income countries, and with that of others that have been trapped in middle--income levels and examines the role that integration into the EU had on growth. The analysis reveals, first, that Poland's growth process has been accompanied by a process of diversification of assets, including institutions, physical and human capital. Second, that the progressive integration into the EU bloc boosted growth and productivity because of three key factors: (i) increased openness to trade, investment and talent, (ii) increased domestic competition, and regulatory harmonization with EU, (iii) increased certainty in reforms, through a commitment to EU-institutions. Third, that for full convergence to high-income levels, Polish firms need to increase their innovative capacities. The paper extracts lessons applicable to other economies trapped in middle-income levels, as well as to Poland itself to consolidate growth looking forward.

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Macro and Micro Features of Successful Economic Convergence: The Case of Poland

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1. Introduction

Since 1991, Poland's economy has grown uninterruptedly. Poland's process of economic growth shows two remarkable characteristics: it has been at relatively high rates, and it has been stable. First, in real terms, the size of the economy as measured by its Gross Domestic Product (GDP) in 2014 was almost twice and a half what it was in 1990, implying an average annual real growth rate of 3.7 percent per year. Also measured in per capita terms, at purchasing power parity prices (PPP), the expansion has happened at a faster rate than elsewhere. For example, in 1990, Polish income per capita at PPP was ranked 61th in the world, while in 2014, it was ranked 46th. Over the last 24 years Poland leapfrogged 15 other countries in terms of income per capita. Second, the volatility of the observed growth rates has been relatively low. Since 1991 there has been no episode of negative growth. Moreover, the coefficient of variation of the rate of real GDP growth at 0.81 is lower than the average for established high-income countries (at 1.17), for new high-income countries (at 1.32) and for trapped middle-income countries (at 1.5). What can we learn from this experience?

Understanding how countries transition to high-income status continues to be a challenge. It has been observed that some countries are able to achieve middle-income status but struggle to make the leap to high-income. In fact, much has been written about the 'middle-income trap'. With policy challenges varying at different levels of development, as countries reach middle-income status, new challenges appear, and countries may need to redefine their economic and social models to sustain growth.

This paper focuses on Poland's growth process and its transition into high-income status. It benchmarks Polish performance with that observed in established high-income countries, with that of other countries that have also recently transitioned into high-income, and with that of countries that have been trapped in middle-income levels. It extracts lessons from this process that may be applicable to other economies trapped in middle-income levels. But it also identifies lessons from the international experience, which may help Poland consolidate growth, and converge to the welfare levels of established high-income countries.

To better understand the process of economic growth it is necessary to understand the productivity dynamics underlying the economy. This note starts with a well-accepted premise: that differences in income per capita across countries are mainly associated with differences in total factor productivity across countries. Thus, for a country to sustainably narrow the gap in the former, it needs to narrow it in the latter.[1] Like in many other successful growth experiences, Poland's growth was backed by sustained productivity growth associated both with an increasingly better allocation of resources

[1] See for example Caselli, 2005.

to most productive uses, and with an improvement of productivity within each Polish firm. Three specific questions are posed: *How was this achieved? Can this experience be replicated by other countries, and if so, how? What needs to be done, after much of the catching-up has already been processed, to continue boosting productivity and growth?*

The note poses three guiding hypotheses:

Poland's growth process has been accompanied by a process of diversification of assets, including institutions, physical and human capital.

The literature points to the importance of diversifying the economy with a solid basis of diversified assets: institutions, physical and human capital. This note explores the extent to which Poland's structural transformation into a more industry and services-based economy was supported by labor market and education reforms that facilitated the building up of skills matching market demands.

Poland started the process of transition with institutions that were unsuited for a market economy, gradually transforming them. As the activities performed by firms in the economy grow in sophistication and complexity, institutions also need to catch up, for example, to set better foundations for conflict resolution and contract enforcement. The strength of these mechanisms has been systematically associated with growth and development in a bidirectional way.

For human capital, evidence reveals stable estimates of returns to education at secondary and tertiary levels, suggesting that supply of graduates and skilled labor has been in line with its demand. Reforms in education and labor markets have facilitated this process by providing of the set of skills the markets needed. The evolution of the importance of occupations show a steady increase of employment in higher skill non-routine cognitive type of activities, matching what is observed in the increasingly sophisticated market structure of the economy. Physical capital accumulation, in turn, benefited from increased sources through increased financial integration.

Integration into the EU bloc, initially through an association agreement, and later through full accession, boosted growth and productivity because of three key factors: (i) increased openness to trade, investment and talent, (ii) increased domestic competition, and regulatory harmonization with EU, (iii) increased certainty in reforms, through a commitment to EU-institutions.

Poland's transition from a planned-economy into a market economy in the context of a process of integration into the EU has certainly affected positively its growth prospects. At first sight, however, it may seem that there is little that is replicable from this experience. After all, not all countries can be part of the EU. However, membership of the EU can be largely dissected into elements that could be replicable outside the EU context: more integration to trade, investment and labor mobility, more competition at home, and low uncertainty with respect to the new rules of the game. Evidence suggests that integration boosted growth and productivity of firms. Firms learned by exporting and by importing. Spillovers due to increased FDI were sizable, and Polish manufacturing firms operating in sectors characterized by strong German capabilities experienced higher growth rates and higher productivity growth. Reforms at home

leading to increased competition were also associated with improved resource allocation, and hence higher productivity growth. Finally, the relevance of the EU accession acting as a commitment device for policy makers and hence reducing policy uncertainty cannot be understated in its implications for investment, innovation and productivity growth. Benchmarking here is useful. Take Argentina, for example, a trapped middle-income country that has exhibited substantial trade and investment policy volatility for the last 40 years.

There is still scope for catching up through technology adoption. Still, to consolidate growth once the scope for catching up is exhausted, firms in Poland need to increase their innovative capacity.

Most of Polish manufacturing and services firms are still facing gaps in technology adoption, suggesting that there is more space for gains from catching up, on average, and from narrowing the differences across Polish firms in making use of the available technologies developed elsewhere. Still, the low-hanging fruit gains of catching up will eventually be exhausted. By then, the innovation ecosystem needs to be strong enough to facilitate frontier-pushing productive activities among Polish firms.

The remaining of the document is structured as follows. The next section takes a macro approach and presents three features of growth that characterize Poland's experience and other new and established HICs experiences: growth being fast and stable, grounded in efficiency gains, and in a diversifying set of assets. The third section zooms into the growth process, focusing on the efficiency gains. For these purposes it decomposes these gains into those achieved through a process of structural change (i.e., movement of resources away from agriculture and into manufacturing or services sectors, i.e.: between sector efficiency gains). Then, it looks, within narrowly defined sectors, at the gains associated with reallocation of resources away from low productivity firms and into high productivity ones (between firm efficiency gains). Finally, it looks at patterns of productivity growth at the level of the firm (within firm efficiency gains). The fourth section addresses the 'how' of the growth process. It looks at the role that: integration into the global marketplace, domestic reforms, and low policy uncertainty had in shaping productivity gains. Finally, the fifth section looks at the next steps for continued growth, and in particular to patterns of technology adoption and diffusion, and at the potential for sustained growth both through more catching up and through moving the technological frontier. Section six concludes.

2. Features of Growth

In 2014, Poland produced 2.4 times more goods and services than it did in 1990. In real terms, this implied an average growth rate of 3.7 percent per annum. This section describes the main features of this growth process and compares it with those observed in established high-income countries (HICs), in new HICs and in trapped middle-income countries (MICs).

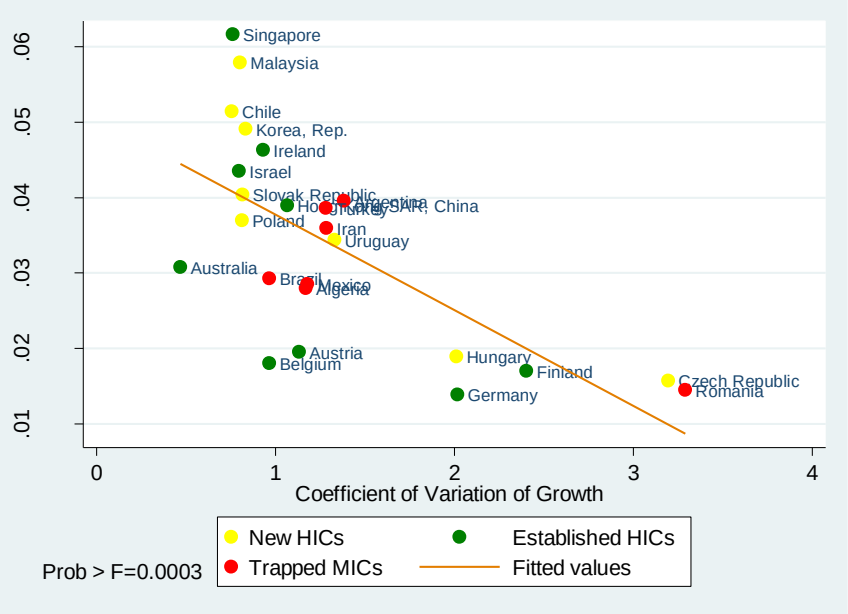
Growth in Poland was fast and stable, grounded in efficiency gains, diversified, and based on a diversifying set of underlying assets. As it will be discussed in this section, these three features of Poland's growth experience are to some extent common to other

HICs –established or new, while different to those underlying the growth process of trapped middle-income countries.

Feature 1: Growth Was Fast and Stable

Since the transition to a market economy, Poland's economic growth has been fast. In real terms, the size of the economy as measured by its Gross Domestic Product (GDP) in 2014 was 2.4 times what it was in 1990, implying a cumulative rate of growth of 3.7 percent per year. This rate of growth is greater than observed by other new HICs (on average 2.54 percent per annum during the same period, and the highest among the three country categories, evidencing the catching up process), established HICs (on average 2.28 percent), or trapped MICs (on average 2.09 percent, the lowest among the three categories evidencing the divergence for this group of countries) (Figure 1). When measured in per capita terms, at purchasing power parity prices (PPP), the expansion has been remarkable, and also at a faster rate than average, allowing the country to climb up the per capita income ranking. For example, in 1990, Polish income per capita at PPP was ranked 61th in the world, while in 2014, it was ranked 46th.

Figure 1: Growth Has Been Fast and Stable



Source: Authors' calculations based on WDI

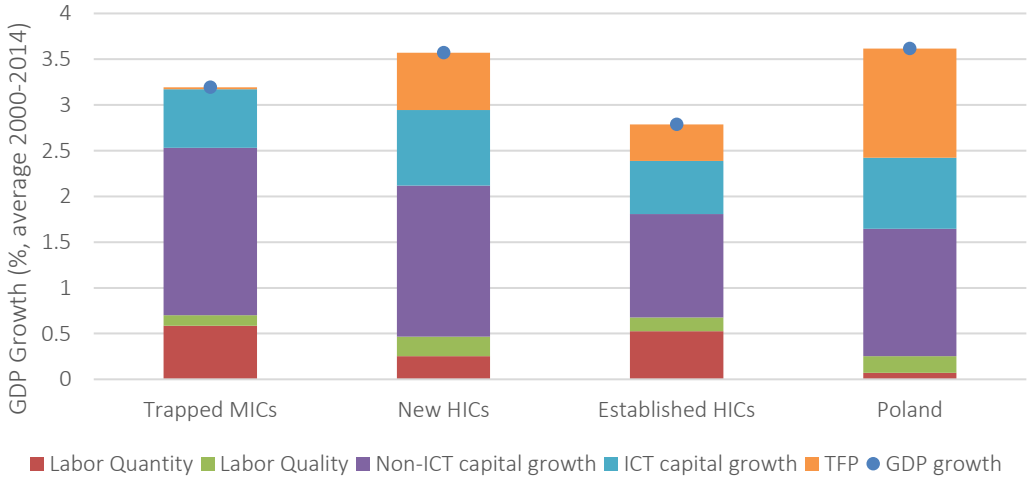
Growth has also been practically uninterrupted. The volatility of the observed growth rates has been low. Growth has been stable, which is key for reduced uncertainty, positively affecting investment and innovation. Since 1991 there has been no episode of economic contraction. Moreover, the coefficient of variation of the rate of real GDP growth at 0.81 is lower than the average for established HICs (at 1.17), new HICs (at 1.32), and trapped MICs (at 1.5) (Figure 1).

Feature 2: Growth Was a Combination of Inspiration and Perspiration

What have been the proximate causes of growth in Poland and how do they compare with those observed for established or new HICs and for trapped MICs? How important was 'perspiration' for growth, that is, work 'harder' by accumulating physical or human capital, relative to inspiration, that is, worker 'smarter' and gaining efficiency? Does it matter if growth is led by perspiration or inspiration?[2]

This note presents the results of decomposing GDP growth rates into contributions of labor accumulation (quantity and quality), capital accumulations (ICT and non-ICT related) and TFP growth, following standard growth accounting methods, and focusing on the period 2000-14.[3]

Figure 2: Total Factor Productivity Growth Has Contributed Substantially to Growth in Poland, as in Other New HICs



Source: Authors' calculations based on Conference Board. Note: Period analyzed: 2000-14.

[2] The terms 'inspiration' and 'perspiration' associated with growth through efficiency gains and through factor accumulation respectively, was first coined by Krugman in an article in Foreign Affairs magazine in 1994, referring to the so-called 'Asian Miracle'. The author claimed that there had been no miracle in East Asia, with rapid growth having been simply the result of heavy investment and a big increase in employment, rather than productivity gains – that is, through perspiration.

[3] The growth accounting framework underlying the data reported here is not without criticism. Three lines of criticism are worth of mention. First, TFP is measured as a residual, providing an imperfect measure of shifts in the production function, which can reflect many determinants (e.g.: technical change, but also sustained political turmoil, external shocks, institutional changes, or measurement errors). Second, they assume a sufficient degree of competition in factor markets so that factor earnings are proportional to factor productivities. Third, growth accounting is not intended to determine the fundamental causes of growth, but rather the proximate ones. Acknowledging its limitations, the framework provides a simple and internally consistent way to organize data and it proves helpful to gain insights into the process of economic growth.

Poland's growth since the turn of the century was strongly grounded in efficiency gains. Focusing on the period 2000-14, it is possible to see that efficiency gains (measured by the contribution to growth accounted for by total factor productivity (TFP) gains explained one third of GDP growth. When comparing the contributions of different factors to growth by type of country, what emerges is that TFP growth is a far more relevant contributor in new HICs (17.5%) and established HICs (14.3%), than in trapped MICs (0.6%).

Capital accumulation also mattered in explaining growth in Poland, but patterns are more balanced than observed in other new HICs or in trapped MICs. In fact, ICT and non-ICT capital accumulation accounted for 21 and 38 percent of growth. In trapped MICs, instead, total capital accumulation contributed to over three quarters of growth, while the rest was mainly explained by increases in labor quantities (increased in labor participation, mainly). New and established HICs instead exhibit somewhat more balanced contributions, with capital accumulation explaining 60 to 69 percent of growth, and human capital improvements (because of increased quality or quantity) explain 24 and 13 percent of growth.

The human capital contribution to growth in Poland was mostly driven by improvements in quality of labor. Improvements in labor quality accounted for 5 percent of it and increased labor quantities for 2 percent. This contrasts with all country groups, where the contribution of the growth in quantity of employment was greater than that of quality of employment. This is likely driven by an education boom that started in the mid-1990s. While in the early 1990s only 10 percent of young Poles continued education at university level, twenty-five years later this reached 50 percent of them (see a discussion on this in the next subsection below, and in Lewandowski and Baran, 2016 for more details).

The strong gains in capital accumulation and efficiency in Poland and in other new HICs are likely linked. The aggregate efficiency gains raised the quality of and returns to investments in these countries, contributing to faster (ICT) capital accumulation. At the same time, the relatively small contribution of human capital accumulation to growth might be interpreted with some caution given difficulty to measure its quality and the potential externalities of (higher) education for innovation.[4]

The country group averages mask substantial heterogeneity. There are variations in the importance of specific factor inputs for growth story of individual countries that made successful transition from middle to high-income. For example, TFP growth was a key driver of growth in Poland, Korea, and Uruguay. Capital accumulation was more important for Chile, Malaysia and Czech Republic. For both Chile and Malaysia, it was strong investment in non-ICT capital in the form of non-residential construction, machinery and transport equipment; ICT capital was an important growth factor for Slovakia and Hungary, the two EU countries which have received substantial FDI inflows in the post-transition period, which facilitated adoption of new technologies.

[4] The effect of such externalities on aggregate growth would be captured, by construction, in the residual aggregate efficiency (TFP) measure. For a more detailed discussion and the links between TFP and returns to factor accumulation see, for example, Caselli, 2005.

Labor, especially improvements in labor quality, were important drivers of growth in Chile, Malaysia and South Korea.

Growing through 'inspiration' may be more sustainable than growing through 'perspiration'. Clearly, it is possible to spur growth by increasing labor force participation, better educating the labor force and increasing the investment share of GDP, but these tend to be one-off changes. Once spare labor is all used and capital per worker reaches rich country levels, diminishing returns tend to set in, and growth processes tend to slow down. Instead, working in a 'smarter' way, and better allocating resources to most efficient uses is associated with permanently higher growth rates by raising the returns to physical and human capital accumulation (Section 2 will discuss the relative importance of these mechanisms in the productivity dynamics observed in Poland).

Feature 3: Growth was diversified and facilitated by diversifying assets

As Poland grew and diversified its production structure, its underlying assets – both tangible and intangible – gradually diversified, facilitating the growth process. At the beginning of the 1990s, Poland set off the process of transition with institutions that were unsuited for a market economy, labor that was ample in quantity but not necessarily with the skills to fit its new role in the global marketplace, and with infrastructure in poor quality (see Table 2 for an outline of the major reforms at the time). Gradually, the supply responses allowed upgrading in terms of human capital, hard infrastructure and institutions that to some extent matched increased demand, reducing scope for growth-impeding bottlenecks. The importance of diversifying assets cannot be overstated for growth.

Poland's process of diversification of assets resembles that of the alleged 'economic miracle' experience of Taiwan and the Republic of Korea. The diversified growth process of these two countries, an established HIC and a new HIC, happened on the back of over two decades of massive investments in human and physical capital, at rates rarely seen in history, improvements in infrastructure, and enforced rules of the game that rewarded investment and innovation.[5]

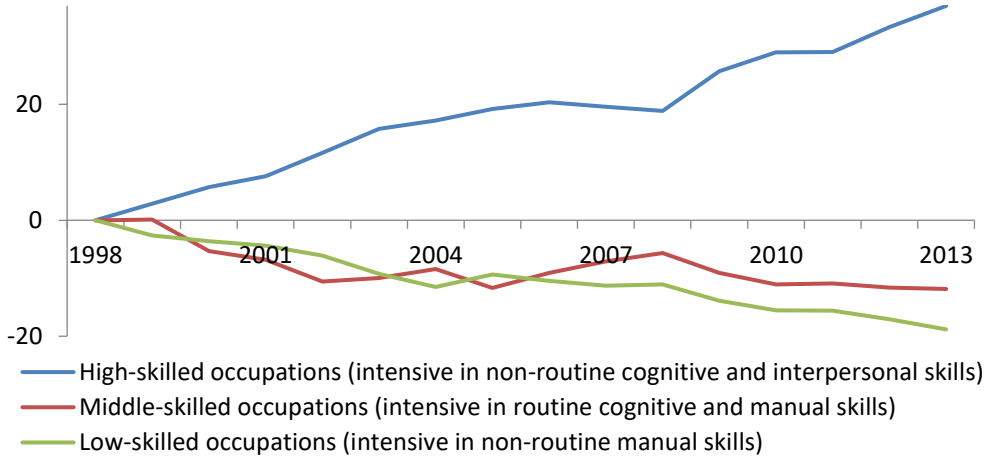
Human Capital

As production increased and became more sophisticated, more skills were needed, which was matched by strong investments in education. An indicator of the increased sophistication in production is given by the quality of Polish exports that has been converging to that displayed by established HICs (Albinowski et al, 2015). Field interviews provide some anecdotal backup to what the evolution of quality indices suggest. A manager in an automotive industry operating in Poland for over 20 years reported that while in the early 1990s most of complex and design activities required the participation of German engineers, these tasks are now performed by Polish ones (Albinowski et al, 2015). This anecdote is revealing of a widespread trend.

[5] For a more detailed account of the underlying drivers of the diversified growth in the Republic of Korea and Taiwan, see Noland and Pack, 2003, Pack and Saggi, 2006.

Employment in high skilled occupations has surged in Poland. These occupations are intensive in non-routine cognitive and interpersonal skills. In contrast, employment in middle- and low-skilled occupations, which are intensive in routine cognitive or manual skills, declined over the same period (Figure 3). The trend was similar in other new high-income countries in Europe, even though the increase in high-skill occupations was the strongest in Poland. Employment shares of high-skilled, high-paying occupations (managers, professionals, technicians) increased on average by 0.5 percentage points a year in Poland over the last decade or about 10 percentage points for the whole period.

Figure 3: Tasks Performed in Polish Labor Markets Have Become More Intensive in Non-Routine Cognitive and Interpersonal Skills



Source: Authors calculations based on Hardy et al. (2016).

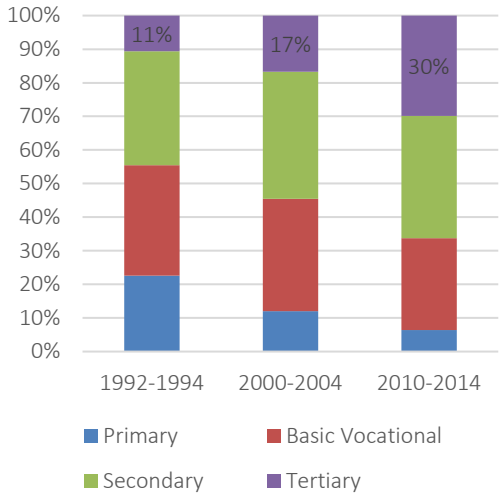
At the same time, the skills of the Polish workforce have been increasing steadily. As argued by Lewandowski and Baran (2016), the share of workers with tertiary education rose from 10.2 percent in 1992 to 32.4 in 2014, with the share of workers with only primary education fell from 24.3 to 5.7 percent (Figure 4).

In Poland, the supply of employees with tertiary education kept up with the strong demand for high-skilled occupations. An indicator of this is given by the stability of returns to education. The returns to tertiary education in Poland have been high and stable over the past decade indicating that the supply of tertiary educated graduates is keeping up with the country's strong demand for skilled labor (Figure 5). They varied very little in Poland between 2005 and 2012 (last year of data) suggesting that the strong increase in the supply of tertiary labor, with the entry of new cohorts of graduates, was met by strong labor demand for these high skilled workers.[6] The international comparison is informative. The returns to tertiary education are typically lower in

[6] Kwiek (2016) argues that there was a radical growth of the Polish higher education system, starting after 1989. There was a large expansion, for example, in the number of private institutions since the early 1990s. The enlargement of tertiary education options was accompanied by an integration of Polish institutions with their Western European counterparts. Indeed, Poland was among the initial signatory countries of the Bologna Declaration in 1999.

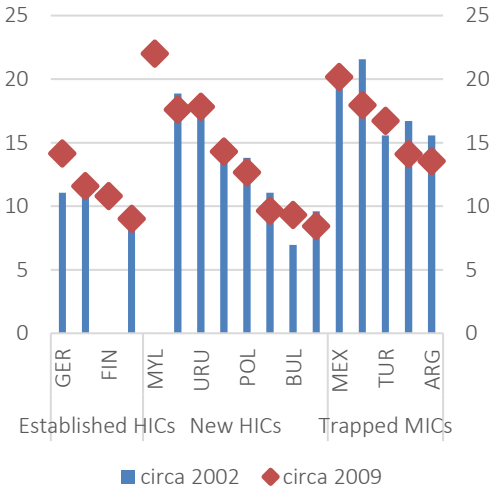
established HICs, signaling that the supply of tertiary educated labor is keeping up with the demand for these workers, without creating significant shortages. In contrast, several trapped MICs have higher and often increasing returns to tertiary education, suggesting that the demand for these high-skilled workers outpaced the supply. There is substantial variation among new HICs, varying from rate of returns at similar levels as in trapped MICs to levels as in established HICs (Figure 5).

Figure 4: **The Educational Structure of Polish Workers Shifted Towards Tertiary Education (1992-2014)**



Source: Baran and Lewandowski, 2016 (based on Polish Labor force survey)

Figure 5: **…With Returns to Education Remaining Stable… (2002 versus 2009)**



Source: Authors' calculations based on Montenegro and Patrinos (2014). Note: returns to tertiary education from 2000-12, salaried workers ages 25−64. Note: Returns to tertiary education are plotted for 2002 and 2009.

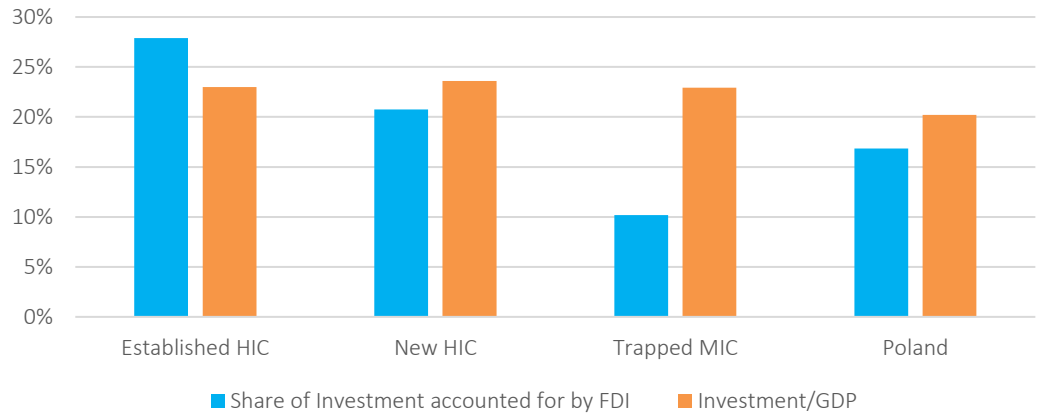
Physical Capital

Integration facilitated a diversification of sources of capital to fund increasing production and infrastructure. Increased demand for investments associated with the process of growth as well as with necessary hard infrastructure upgrading were matched by domestic saving, combined with more financial integration with the rest of the world. For infrastructure, structural funds from the EU played a key role.

Like established and new HICs, Poland relied substantially on foreign sources of funding for capital accumulation. While the investment rates do not differ substantially across country categories (established and new HICs and trapped MICs), the share of gross capital formation that is accounted for by foreign direct investment (FDI) is substantially higher in established HICs than in new HICs, and in turn higher in new HICs than in trapped MICs. In Poland, this reaches one out of every six dollars invested, slightly below the average for new HICs. This difference in relevance of FDI in

financing investment rates remains when the comparison is made for countries of similar size (Figure 6).[7]

Figure 6: The Contribution of Foreign in Total Investment Rates is Relatively Higher in Established and New HICs (2000-2014)



Source: Authors' calculations based on WDI

Institutions

Broadly defined, Poland transitioned to market base institutions that supported its process of growth. Indeed, one of the main messages of this note is that the combination of integration into the global marketplace, domestic reforms conducive to increased competition, and macroeconomic, and more generally, policy stability have been at the core of the growth process the economy experienced and were gradually adopted as the economy transitioned into a market economy. This differentiates Poland from most trapped MICs.

Poland established new and improved existing institutions throughout the transition and EU membership process. In the early phase, institutional reforms focused on guaranteeing basic property rights and market competition (see Table 2). In 1990, all property classifications from socialist times were eliminated, guaranteeing that all types of property are treated equally. An independent competition authority overseeing fair market competition was created in the same year. At later stages, institutional reforms improved the regulatory quality of assets and backbone service markets. In 1996, an independent regulatory authority for energy markets was established to enhance competition in production and transmission. In 1999, far-ranging reforms in education, health, pension systems, and the public administration were introduced. The regulation of backbone service markets was further strengthened in 2001 with the creation of new independent regulatory agencies, as part of the preparation for EU accession, such as the Office of Competition and Consumer Protection, Securities and Exchange Commission, and the Office of Telecommunication Regulation. A new public procurement law was implemented in 2004 to enhance transparency and eliminate

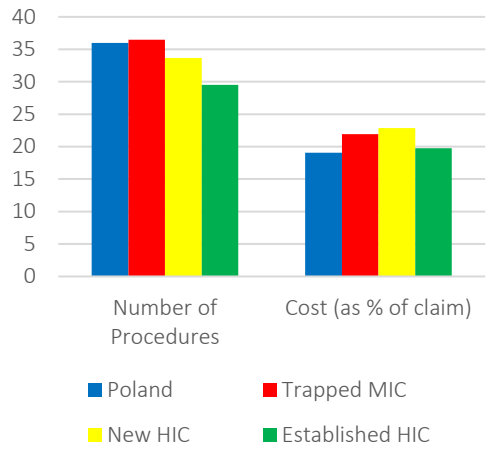
[7] Ireland and Hong Kong are excluded from the sample for this analysis as they are outliers with FDI inflows as a share of GDP above 15 percent.

domestic preference. In 2007, the National Research & Development Centre was established to help financing and commercializing R&D.

To continue this development path, Poland's process of institutional change also needs to keep up. One area in which there is space for improvement relates to conditions around contract enforcement. A good contracting environment is a powerful source of comparative advantage, explaining more of trade patterns than physical capital and skilled labor combined.[8] When investments needed to perform certain tasks or produce certain inputs are relationship-specific, poor contract enforcement may lead to under-investment. More sophisticated tasks or inputs tend to require relationship specific investments (i.e. there is no thick market for them, with many alternative buyers and sellers). This is more relevant for Poland as its firms become more sophisticated players within international production networks. Moreover, there still exist regulatory barriers to entry and competition for selected professional services, even though a recent reform in 2003 started the deregulation of admission into some of them (Table 2).

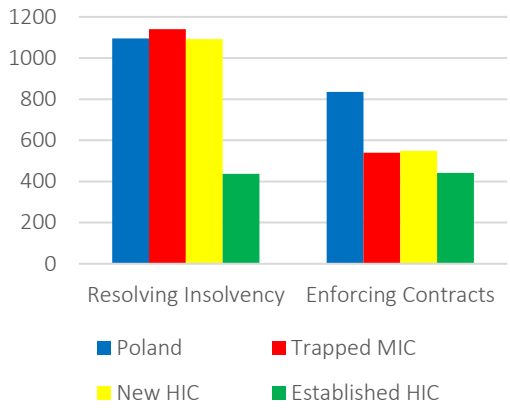
[1] See Nunn, 2007 and Antras, 2014.

Figure 7: Enforcing Contracts Continues Being a Costly Process in Poland



Source: Authors' calculations based on World Bank Doing Business Indicators

Figure 8: …and Lengthy… (Time it Takes [Days])



Source: Authors' calculations based on World Bank Doing Business Indicators

Poland's performance in terms of enforcing contracts and resolving insolvency is more similar to that of trapped MICs than that of established or even new HICs. Doing Business indicators can be helpful to show the complexity and costs associated with enforcing contracts.[9] In Poland, it takes on average 36 procedures to enforce contracts, while it takes less than 30 in new HICs. Also, in Poland it takes on average more than 800 days to enforce a contract, while it takes slightly more than 400 in established HICs or about 500 in new HICs. Similarly, resolving insolvency may take about 1,100 days, while it takes about 400 in established HICs (Figure 7 and Figure 8). In terms of recovery rates, Poland only performs better than trapped MICs, with 40 cents to the dollar versus 30, while it lags both established and new HICs (80 and 45 cents to the dollar respectively). Improving performance in these respects is key to effective protection of rights, which in turn is associated with sustained growth and development.

[9] Similar indicators are used by Nunn, 2007.

3. Zooming in: The Growth Process in Detail

The growth in aggregate efficiency, at the core of Poland's economic growth, was driven by three simultaneous processes: efficiency enhancing structural transformation, within sector reallocation of resources towards more efficient firms, and within firm efficiency gains. Section 1 above described three macro features of Poland's growth process. Among them, the fact that growth was grounded in productivity gains deserves more careful examination. This section zooms into the growth process and looks at sectoral and firm dynamics. It shows that (i) the structural transformation process was efficiency enhancing, as resources moved from relatively lower productivity sectors to higher productivity sectors, (ii) that within sectors, in turn, there has been a strong Darwinian effect taking place, by which resources were reallocated away from low productivity firms into high productivity firms, thereby increasing aggregate productivity, and (iii) within firms there were also substantial efficiency gains achieved as firms reorganized, upgraded management and innovated.

Reallocation of Resources Across Sectors: Structural Transformation

The sectoral reallocation associated with structural change help explain the higher aggregate productivity growth of the New HICs. Structural change describes the reallocation of resources among different broad activities in an economy. A large share of the labor force in less developed countries works in agriculture, often in low productivity subsistence farming. As countries grow richer the labor share of agriculture typically declines while manufacturing and service activities expand.[10] While productivity levels across sectors can differ substantially in developing countries, market forces should re-allocate resources to the sectors with the highest marginal productivity over time. But market failures and distortions, for instance imposed by rigid product or labor market regulations, can prevent this convergence process.[11] Empirical studies reveal stark differences in productivity levels across sectors in developing countries while productivity levels across sectors in high-income countries are typically small, reflecting the outcome of past structural change.[12] The

[10] Theories of structural change show that the reallocation of activity across sectors accompanying balanced growth can originate from income effects generated by non-homothetic preferences for different consumption goods (Pasinetti 1981, Kongsamut et al., 2001), changes in relative prices due to technological progress that differs across sectors (Baumol, 1967; Ngai and Pissarides, 2007), or changes in relative prices due to differences in capital intensities or elasticities of substitution in production across sectors (Herrendorf et al., 2013a). In the following, we analyze the patterns of structural change among middle and high income countries, taking their source as given.

[11] We note that structural change does not affect aggregate labor productivity growth in a neoclassical closed economy framework assuming for instance perfect competition in output and factor markets. In this framework, wages and labor flows between sectors fully adjust (e.g., after a sector specific technology shock) equating marginal labor productivities across sectors. In the presence of market failures, distortions, and rigidities wages and labor flows do not fully adjust driving a wedge between marginal productivities across sectors. While the impact of these distortions is difficult to measure, it is likely that they are more severe in developing countries (Herrendorf and Valentinyi, 2012), implying that aggregate productivity is affected by the sectoral composition of the economy (Duarte and Restuccia, 2010; Herrendorf et al., 2013b).

[12] The latter has been interpreted to reflect an equilibrium balanced growth path in high income countries whereby initial productivity differences across sectors have been marginalized over time as labor moved

sectoral reallocation associated with structural change can thus explain cross-country differences in aggregate productivity growth if countries are at different stages of the process of structural change (Echevarria, 1997; Duarte and Restuccia, 2010). In particular, Duarte and Restuccia (2010) reveal that during the process of structural change, the reallocation of labor from agriculture to manufacturing leads to a catch up of aggregate productivity relative to the U.S., and the reallocation from manufacturing to services leads to a falling behind.[13]

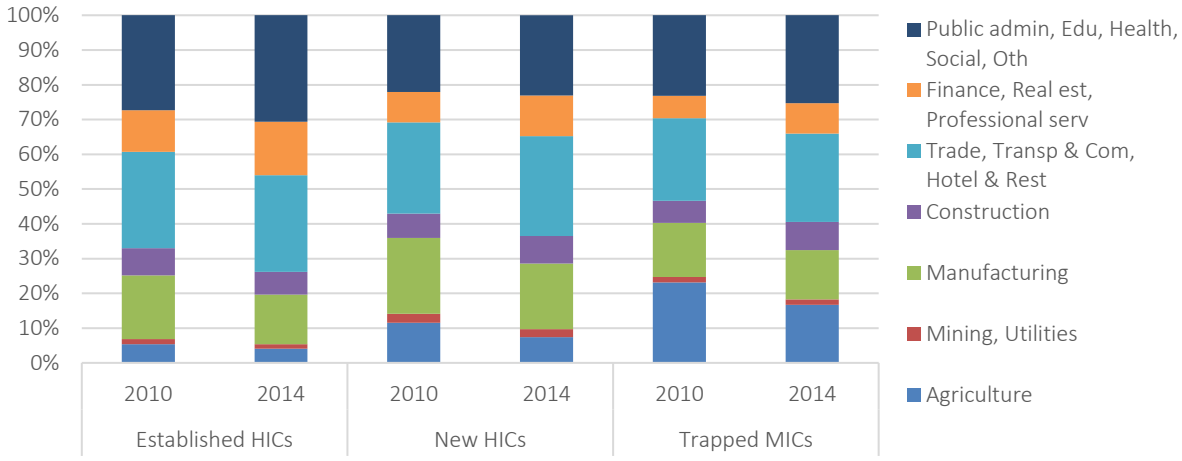
The new HICs are at a more advanced stage of their process of structural change than the Trapped MICs, resembling more the established high-income countries. The new high income countries ("New HICs") have a much lower share of the labor force working in agriculture than the trapped middle income countries ("Trapped MICs")—7 versus 17 percent in 2014—reflecting a more advanced stage of their process of structural change (Figure 8). They also have a higher share of labor in manufacturing and potentially more tradable service sectors such as finance and professional services, similar to established high income countries. The share employment in government dominated sectors such as public administration or social sectors is similar among the New HICs (23%) and Trapped MICs (25%) while established high income countries have a significantly larger public sector (31%).

Manufacturing is still an important employer in the New HICs but structural change has been driven by potentially modern, tradable service sectors. Labor reallocated from agriculture and manufacturing to potentially more modern, tradable service sectors in the New HICs from 2000-14 (Figure 9). While the share of labor in manufacturing was still relatively high in 2014 (19%), it had declined by 3 percentage points since 2000. In contrast, potentially more tradable services such as financial, professional, communication, or transport, expanded during the same period.

to the sectors with the highest marginal productivity equalizing productivity levels. See, among others, McMillian and Rodrik (2011) or Herrendorf and Valentinyi (2012).

[13] The latter finding seems surprising; however, the authors do not distinguish between reallocations to potentially low productivity service sub-sectors (e.g., informal, personal or government services) and higher productivity, tradable services (e.g., finance or professional services).

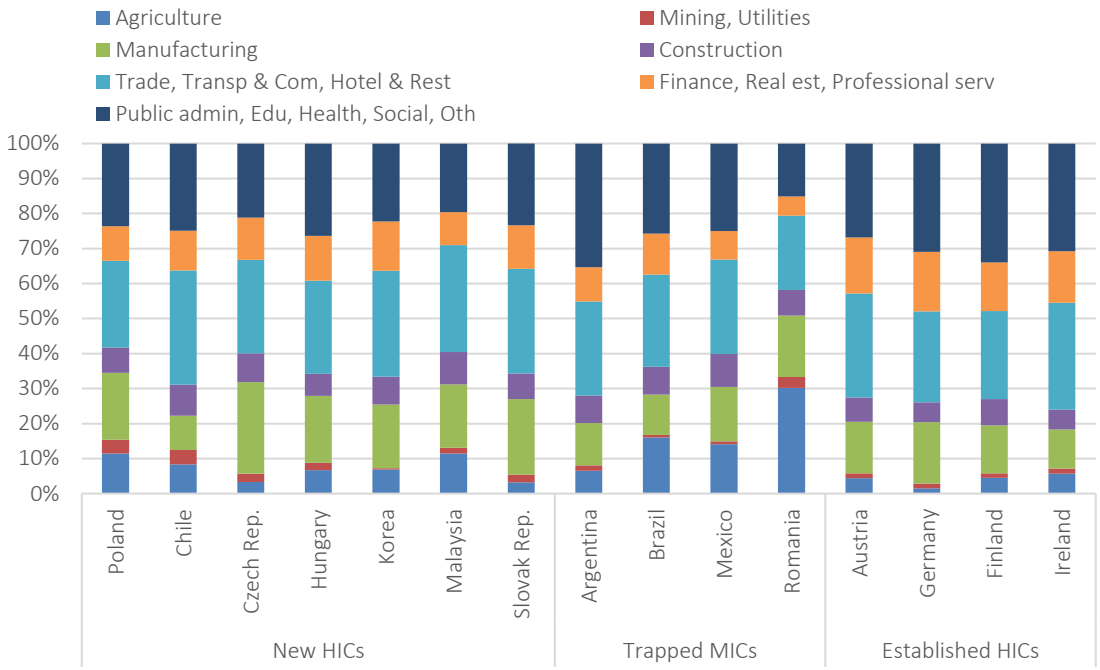
Figure 9: The Share of Labor in Agriculture is Lower in the New HICs While the Labor Shares in Manufacturing and Private Sector Services are Larger



Source: World Bank staff calculations based on Eurostat and the 10-sector Groningen database. Note: Share of labor by economic activities circa 2014. Established HICs data: Austria 2014, Germany 2014, Finland 2014, Ireland 2014; New HICs: Poland 2014, Chile 2012, Czech Republic 2014, Hungary 2014, Korea 2010, Malaysia 2011, Slovak Republic 2014; Trapped MICs: Argentina 2011, Brazil 2011, Mexico 2012, Romania 2013. More detailed sector data are not available for Israel, Turkey, and Uruguay.

Several different paths of structural change can lead to high income. Despite similarities among the countries in the different income groups, the aggregate trends conceal a substantial degree of heterogeneity among them (Figure 10). The Czech and Slovak Republics have especially large manufacturing sectors (26 and 22 percent) while manufacturing only employs 10 percent of the labor force in Chile. The agricultural sector is still relatively large in Malaysia and Poland (11 percent) and accounts only for 3 percent of employment in the Czech Republic. The size of private sector dominated services is relatively large in Chile (44%), Korea (44%), and the Slovak Republic (42%) while these service sectors ranging from trade and transport to financial and professional services only employ 35 percent of the labor force in Poland, less than in Argentina (38%) and Brazil (27%) and similar to Mexico (35%). Finally, government dominated service sectors are smallest in Malaysia (20%) and the Czech Republic (21%), larger in established high-income countries (27-34%), and largest in Argentina (35%) and Finland (34%).

Figure 10: There are Substantial Variations in Economic Structures Across Countries



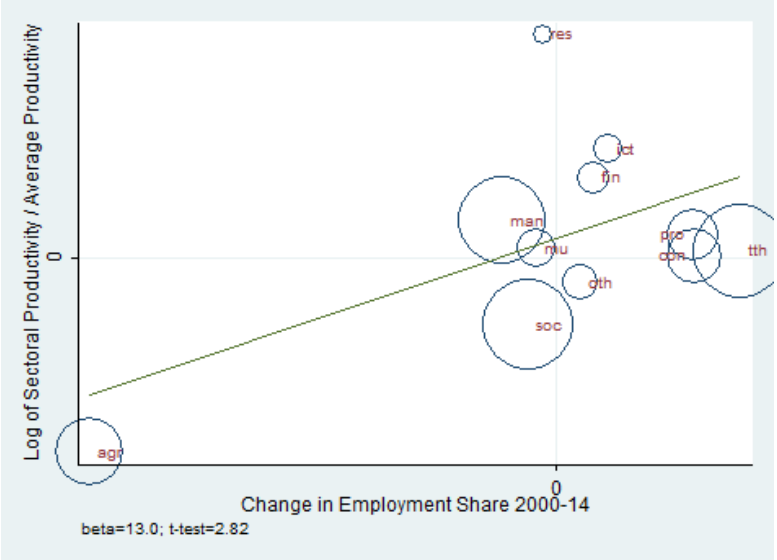
Source: World Bank staff calculations based on Eurostat and the 10-sector Groningen database. Note: Share of labor by economic activities circa 2014.

The reallocation of labor to more productive sectors accounts for about one-fourth of aggregate productivity growth in Poland from 2000-14. Labor reallocations across 11 broad sectors accounted for 23 percent (0.7 percentage points) of the average annual aggregate labor productivity growth of 3.1 percent in Poland from 2000-14. The growth of labor productivity within these sectors contributed the remaining 77 percent (2.4 percentage points). The growth-enhancing labor reallocation was primarily driven by the decline in the labor share of the least productive agricultural sector and the contemporaneous increase of the labor shares of more productive service sectors such as trade, transport, hotels & restaurants, professional services, and construction (Figure 11).[14] The contribution of the reallocation of labor to aggregate productivity growth in

[14] Aggregate labor productivity can be decomposed into a *within* component (first term) measuring changes in sector level productivity and a *structural change component* (second term) measuring changes arising from a re-allocation of labor between sectors as follows: $\Delta Y_t = \sum_{i=n} s_{i,t-k}\, \Delta y_{it} + \sum_{i=n} y_{i,t}\, \Delta s_{it}$; where ΔY_t is the change in aggregate labor productivity between *t* and *t-k*, s_{it} is the employment share in sector *i* at time *t* and y_{it} is the productivity level in sector *i* at time *t*. Data limitations require us to approximate the marginal rate of labor productivity with the average productivity levels (as, among others, in McMillian and Rodrik, 2011). Under perfect competition in both, input and output markets, however, the marginal rates would equalize across sectors over time. In fact, under a Cobb-Douglas production function specification, the marginal productivity of labor is the average productivity multiplied by the share of labor in GDP. Thus, large differences in labor shares across sectors, i.e. due to different capital intensities, drive a wedge between the marginal and average productivity. Apart from mining & public utilities, however, several authors argue that labor shares do not differ much across other sectors (Hsieh and Olken, 2014; Mundlak et al.,2008). Moreover, robustness test for Chile, Mexico, and Peru—approximating marginal rates by calculating the income share of labor using wage data from the World Bank I2D2 data—show that the marginal and average productivity differences across sectors are very closely correlated (see World Bank, 2015).

Poland from 2000-14 was large compared to other countries—only seven countries (including Turkey) of the 40 countries included in the Groningen database had a higher percentage point contribution; 17 countries (including Korea, Malaysia, and Argentina) had a higher within sector productivity growth contribution.

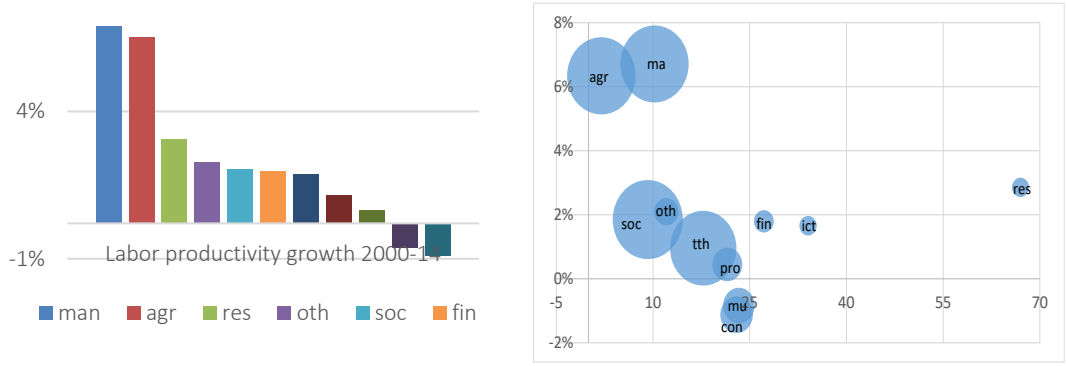
Figure 11: The Reallocation of Labor Across Sectors Associated with Structural Change Contributed to Aggregate Productivity Growth in Poland from 2000-14



Source: Staff calculation based on Eurostat. Note: The figure plots logarithm of sectoral value added per worker (relative to the average across all sectors) and the change in the employment share for 11 economic sectors between 2000 and 2014. The size of the circle reflects the employment share in 2000. On the vertical axis, sectors above zero are relatively more productive compared to an average sector in an economy. On the x-axis, sectors to the right from zero have had increases in their employment shares. agr: agriculture; con: construction; fin: finance; ict: communications; man: manufacturing; mu: mining & utilities; oth: other services; pro: professional services; res: real estate; soc: health, education, and social services; tth: trade, transport, hotels & restaurants.

The strong within-sector productivity growth was primarily driven by a surge in agriculture and manufacturing labor productivity which increased by 6.3 and 6.7 percent annually from 2000-14 (Figure 12, left). Labor productivity also increased among service sectors, albeit at a slower pace; it declined in mining & utilities and construction. And labor productivity converged across sectors in Poland—the two sectors with among the lowest productivity levels in 2000, agriculture and manufacturing, had the fastest productivity growth (Figure 12, right). Both sectors are also large employers in Poland, accounting together for 40 percent of all jobs in 200 and 30 percent in 2014.

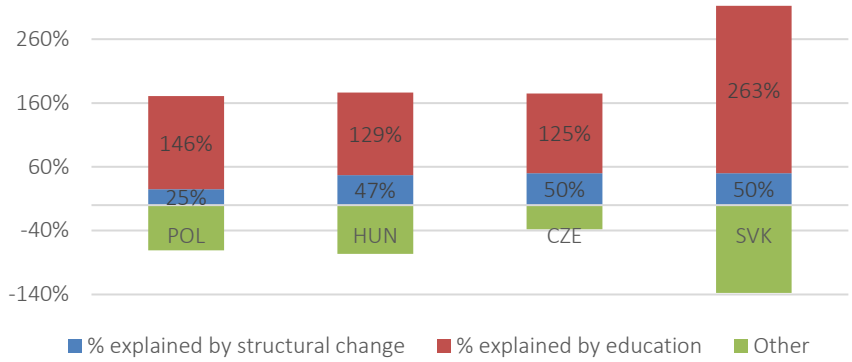
Figure 12: Within Sector Productivity Growth was Driven by a Surge in Agriculture and Manufacturing Productivity, Together Employing 30% of the Labor Force in 2014



Source: Staff calculation based on Eurostat. Note: The right graph shows the average annual labor productivity growth rates by sector from 2000-14. The right graph plots these growth rates against the labor productivity level in 2000; the size of the circle reflects the labor share of the corresponding sectors in 2000. agr: agriculture; con: construction; fin: finance; ict: communications; man: manufacturing; mu: mining & utilities; oth: other services; pro: professional services; res: real estate; soc: health, education, and social services; tth: trade, transport, hotels & restaurants.

Structural change also smoothed the transition to employment in high-skill occupations in Poland and other European new HICs. As indicated earlier, employment in high skilled occupations increased substantially in Poland and other new European high-income countries between 1998 and 2013 (Figure 13). The surge in employment in high skill occupations was supported by structural change with labor moving from low- or medium-skill employment in the agricultural sector to higher skilled services jobs such as such as real estate and business activities. For the period between 1998-2000 and 2011-13, structural change explained 25 percent of the total increase in high skill employment. The share was even larger in Hungary, the Czech Republic, and the Slovak Republic. Still, the most important determinant of the increase of employment in high skill occupations was the increase in higher education in Poland as well as in the other new high income European countries.

Figure 13 Structural Change and Education Account for the Surge in High-Skilled Occupations (Intensive in Non-Routine Cognitive & Personal Skills, 1998-2000 and 2011-13)



Source: Authors calculations based on Keister, Lewandowski (2016).

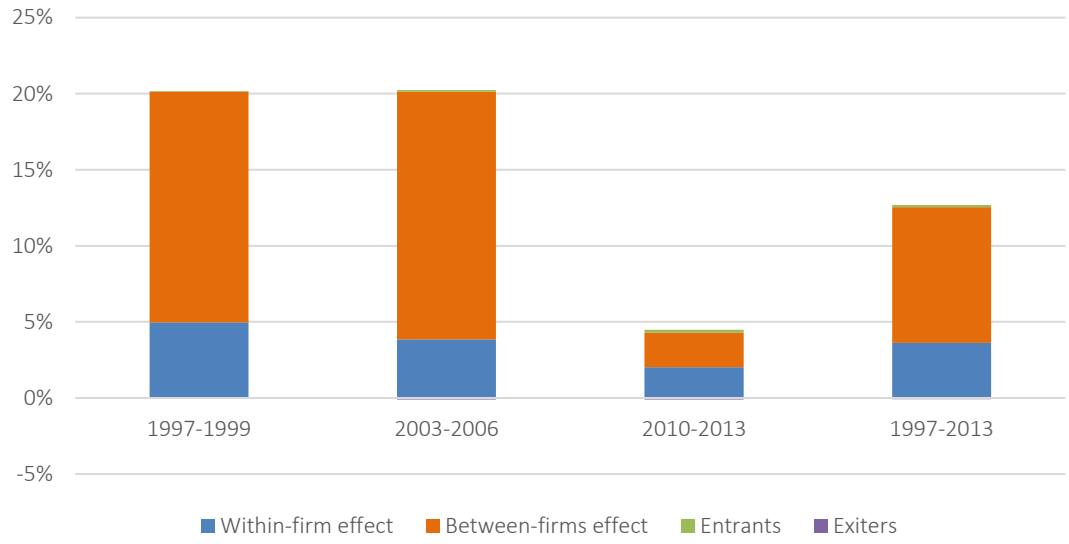
Micro-Level Sources of Productivity Growth: Allocative and Within Firm Efficiency Gains

The productivity growth of Polish firms had three characteristics: it was fast, it was widespread among firms, and it was associated with reallocation of resources towards the most efficient producers. This subsection further zooms into firm-level dynamics to take better stock of the productivity growth process underlying the growth experience of Poland. It looks at manufacturing firms, and examines the patterns associated with their productivity growth.[15] Three main messages emerge: (i) in the aggregate, productivity growth was impressively fast, with double digit growth rates during the 1997-2004 period; (ii) about three quarters of that aggregate productivity growth was due to a Darwinian effect with more efficient firms thriving and gaining market shares, and less efficient ones shrinking; and (ii) within-firms, productivity gains were widespread, accruing both to domestic and foreign units.

The early transition period was characterized by fast productivity growth. Aggregate total factor productivity (TFP) in manufacturing grew at an average of 22 percent per year during the period 1997-2005. These rates are in line with those reported for other successful transition economies. For example, for Slovenia, Melitz and Polanec (2015) report aggregate productivity growth at 26.2 percent per year for the period 1996-2000. TFP growth decelerated in the years that followed, but remained at relatively high levels by international standards, averaging 4.75 percent per year for 2006-2013.[16]

[15] The focus on manufacturing firms is given by data availability, and so is the choice of the period.
[16] This compares with growth at about 1 percent per year among Portuguese manufacturing firms during 1997-2000 as reported by Carreira and Texeira (2011), or 2.3 percent per year among French firms during 1991-2006 (Osotimehin, 2013), 1.04 percent per year among Belgian firms during 1996-2003 (Van Beveren, 2010), or 1.5 percent per year for Colombian firms during 1982-1998 (Eslava et al, 2006).

Figure 14: Aggregate TFP Growth in Poland was Fast, and Driven Largely by Reallocation of Resources Away from Less Productive Firms, and into More Productive Firms (Total Factor Productivity Growth in Manufacturing – Evolution and Sources: 1997-2013)



Source: Authors' calculations based on GUS data.

Allocative efficiency gains played a crucial role in aggregate productivity growth. Aggregate productivity growth is the product of three forces at place: existing firms becoming more productive, more productive firms entering or gaining market shares, and less productive firms shrinking or exiting the market. In Poland, the three forces help explain the growth observed, but in particular, the fact that more productive firms gained market share at the expense of less productive shrinking (the 'between-firms effect' or allocative efficiency channel) accounted for three-fourths of productivity growth (Figure 14).[17]

The strength of the allocative efficiency channel in Poland is indicative of markets working efficiently. There is a vast theoretical and empirical literature devoted to identify sources of large and persistent differences in productivity across countries, and in understanding persistent heterogeneity in firm-level productivity even in narrowly defined industries.[18] In fact, these persistent differences may indicate misallocation of resources across firms with negative effects at the aggregate level.[19] Instead, the fact that, as it is the case in Poland, more efficient firms grow, and less efficient ones shrink, is indicative of these misallocations narrowing through market mechanisms that enable

[17] The net effect of entrants and exiters is positive with entrants being more productive, on average, then exiters. Their contribution to overall growth is, however, very small, accounting for less than 1 percent of the productivity growth observed during the period 1997-2013.

[18] For example, Haskel and Martin (2001) report that in year 2000 the spread between the 90th and 10th percentile of productivity distribution in the United Kingdom was on average 150 percent. More strikingly, Hsieh and Klenow (2009) find a TFP spread of 5 to 1 between top and bottom 10 percent of firms in India.

[19] See Bartelsman, Haltiwanger and Scarpetta (2013) for an analysis of the effects of policy distortions on aggregate productivity outcomes.

resources to be shifted towards more efficient uses (see box on reallocation consequences on firms' dynamics).

In only three instances, in 2005, 2007 and 2012, the growth-enhancing 'Darwinian' selection mechanism was interrupted. Looking at annual growth rates, we observe that the between-firm effect, due to more productive firms gaining market shares, has been sometimes positive and sometimes negative. It was particularly negative in 2012, driving down overall TFP growth. In particular, it was mainly in the computing, electronic, basic metals and beverages sectors that more productive firms were losing market shares (see Appendix for a year-by-year decomposition of TFP growth).

Box 1: How Did Allocative Efficiency Transform into Jobs?

The improvements in allocative efficiency are reflected in the private sector firm dynamics whereby many small firms were either forced to exit or lay off workers or grew fast and created many new jobs. This finding is illustrated in Table 1 that summarizes the probabilities that firms transitioned among different size categories (or exited them) in 1999-2004 and 2004-10. In fact, 16 percent of the firms that were small (10-49 employees) in 2004 were forced to exit the market by 2010 while 18 percent grew and transitioned to medium or large firms, creating many new jobs. Likewise, 29 percent of the medium size firms (50-99 employees) in 2004 were forced to exit or laid off workers by 2010 while 23 percent grew and became large firms hiring more than 100 employees in the same period.

The firm dynamics were even stronger in the beginning of the 2000s when the economy was to some extent still adjusting to the market forces unleashed by the economic liberalizations. Only less than half of all small firms in 1999 remained small 5 years later—30 percent of the small firms were forced to exit the market by 2004 while 15 percent grew and employed more than 50 workers and 8 percent more than doubled their number of employees to become large firms by 2004. Likewise, 22 percent of the medium size firms in 1999 were forced to exit by 2004 and another 17 percent had to lay off workers and became small firms. At the same time, however, 19 percent experienced strong growth and transitioned to large firms creating many new jobs. The stronger firm size dynamics in the early 2000s mirror the stronger contribution of improvements in allocative efficiency to aggregate productivity growth in the same period.

The probability that small or medium-size firms grew to become large was higher in the manufacturing than in the service sector in the early 2000s, but probabilities converged towards the end of the decade. The share of firms that grew and became large was especially high in the manufacturing sector in the early 2000s. Almost one out of four manufacturing firms (24 percent) with less than 100 but at least 10 employees in 1999 grew and became large firms by 2004 compared to only 11 percent of all services firms of the same size category. But many smaller services firms also grew more strongly towards the end of the decade when one out of five small or medium size services firms in 2004 grew and became large firms by 2010.

Table 1: Employment Transition Matrices

Transitions 1999-2004					Transitions 2004-10				
	Status in 2004					*Status in 2010*			
Status in 1999	**Exited**	**Small**	**Medium**	**Large**	*Status in 2004*	**Exited**	**Small**	**Medium**	**Large**
Small	30%	**47%**	15%	8%	**Small**	16%	**67%**	15%	3%
Medium	22%	17%	**43%**	19%	**Medium**	13%	16%	**48%**	23%
Large	20%	1%	10%	**69%**	**Large**	13%	1%	9%	**77%**

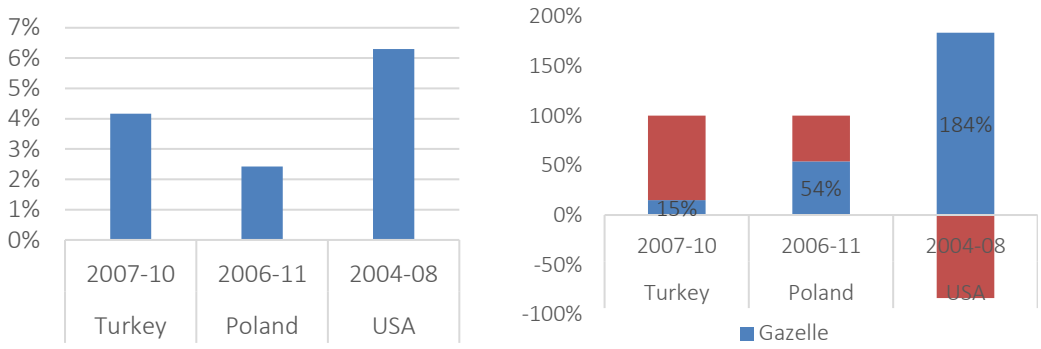
Source: Authors calculation based on census data. Note: Small: 10-49 employees, Medium: 50-99, Large: >=100.

A few fast-growing firms (the "*Gazelles*") accounted for more than half of all net job creation in Poland and more than compensated for the job-losses incurred by less productive firms. Gazelles are defined as firms that double their employment over a four-year period.[20] Poland had relatively few fast-growing firms between 2006 and 2011—only 2.4 percent of all firms were Gazelles compared to 4.2 percent in Turkey and 6.3 percent in the United States. While firms are less likely to be Gazelles in Poland, the handful of fast-growing firms accounted for 54 percent of all net job creation during this period. In contrast, more firms in Turkey can be characterized as Gazelles but these firms account for a smaller share of job creation than in Poland. In the United States, the few fast-growing firms accounted for all job creation—they created 184 percent of all net jobs, compensating for the net job destruction (84 percent) of all other firms.

Gazelles emerged in most sectors and are more often services firms. Fast-growing firms are not a sector specific or high-tech sector phenomenon. They emerge in all sectors of the economy. For instance, food or printing and publishing companies are as likely to become Gazelles as transport and communication companies. And manufacturers of plastic or machinery and electronics are as likely to become fast-growing firms as retail service providers. Overall, transport equipment companies had the highest probability (15 percent) of becoming fast-growing firms followed by construction companies. In turn, real estate, hotels and restaurants, and textile firms had the lowest probability (see Figure 30 in the Appendix).

[20] The analysis is restricted to firms with more than 10 employees. Apart from sampling restrictions, this also avoids considering micro businesses as gazelles that increased employment, for instance, from two to four over a four-year period by hiring two more family members. In Turkey, only firms with at least 20 employees are included while no size restrictions were applied for the United States. The US gazelles are based on a somewhat stricter definition: firms whose sales and employment have at least doubled over the same four-year period (Spencer, 2011).

Figure 15: A Few Fast-Growing Firms (Gazelles) Accounted for Almost Half of all Net Job Creation in Poland



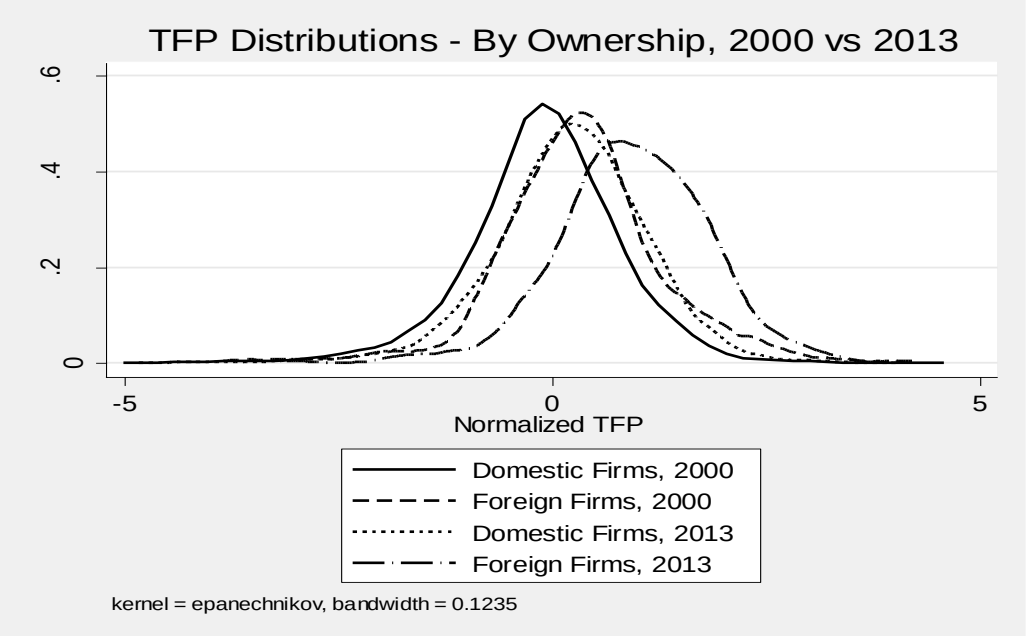
Source: Authors' calculations from F01 dataset. Firms > 10 employees. Note: the graph excludes the years 2000 to 2002 because of lack of data on firms with less than 50 employees; left: percentage of firms that are Gazelles; right: percentage of net jobs created by Gazelles versus all other firms.

Source: Authors' elaboration based on firm level data from GUS.

The within-firm channel has also been an important driver of productivity growth, due to both growth in the increased efficiency of domestic and foreign firms. This channel accounts for one quarter of TFP gains observed during the period, and is associated with improvements in firms' internal organization, improved management and innovation. When looking at TFP by ownership type, similar to what is found internationally, foreign owned firms are more productive than domestic firms, but domestic firms have shown greater TFP improvements. Furthermore, improvements have been experienced at all levels of productivity shifting the entire distribution towards the more productive foreign firms. Foreign firms have also, on average, increased their productivity but improvements have mainly been experienced by less productive firms (Figure 16).

Figure 16: Both Foreign and Domestic Firms Became Substantially More Productive Over the Last 15 years

(Productivity Distribution by Type of Ownership – 2000 versus 2013)



Source: Authors' calculations based on GUS

As important as understanding the intensity with which productivity gains materialized through structural transformation, and increased allocative efficiency, is to understand the main policy determinants underlying this growth experience. This allows us to extract lessons for other countries in the process of development, and it is the objective of next section.

4. The How: Policies That Supported Growth

The combination of policies implemented in Poland since the transition made firms' investments and innovation *fertile* and their returns *appropriable* to Polish firms. Three policy elements are highlighted as critical: integration into the global economy, domestic reforms conducive to market-based institutions and increased competition at home, and a binding commitment to reforms conducive to little policy uncertainty.

Why? Integration increased returns to investment and innovation because it allowed firms to exploit economies of scale, to relax technological constraints through access to imported inputs and capital goods, and to partake in the powerful growth platform that international production networks provide. Policy continuity reduces firms' uncertainty, thus making investment and innovation less costly. Domestic competition enhancing reforms facilitated the reallocation of resources towards comparative advantage activities, while, in general, the transition to market-based institutions enabled firms to appropriate the gains generated by their activities.

This section discusses the role that integration, domestic reforms and reduced policy uncertainty had in enabling growth in Poland.

Integration into World Markets

How did Polish firms gain from integration into the global economy? Several intuitive theoretical mechanisms suggest that deeper economic integration with higher-income nations has the potential to lead to improvements in firm performance. In particular, by enhancing trade and investment flows between the two countries, deeper economic integration would be expected to stimulate technology transfer, product quality upgrading and the adoption of better managerial and organizational practices among Polish manufacturing firms.[21]

For the case of Poland, it is likely that the scope for technological and organizational upgrading would be most important in industries in which Germany had stronger industrial capability and outsourcing potential. Here we examine whether the evolution of several indicators of firm performance in Poland (notably total factor productivity and employment) following EU accession differed systematically across sectors characterized by different levels of German industrial performance in the pre-accession period.[22] To assess the role of trade and investment linkages in shaping these effects, we also examine effects of EU accession on export participation and foreign ownership status.[23]

Deeper economic integration with Germany following EU accession was an important driver of the recent firm dynamics observed in Poland. Two results back up this assertion.

Result 1: Following EU accession, total factor productivity and employment grew relatively faster among firms operating in sectors in which Germany had a stronger industrial capacity and outsourcing potential.

Polish manufacturing firms operating in sectors characterized by stronger German industrial capability and outsourcing potential experienced higher growth rates in total factor productivity and employment in the post-accession period. [24] The trends on TFP and employment appear to reflect some anticipation effects of EU accession, as might be expected since the legislation defining the reform steps of the government's roadmap to EU accession had been published in 1996. Nonetheless, the confidence intervals only make it possible to reject the null of no effects in the post-accession period (Figure 17).

[21] See, for example Verhoogen, 2008; Bastos and Silva, 2010; Bastos, Silva and Verhoogen, 2014; Bloom, Sadun and Van Reenen, 2012; Arnold and Javorcik, 2009; Javorcik and Harding, 2012

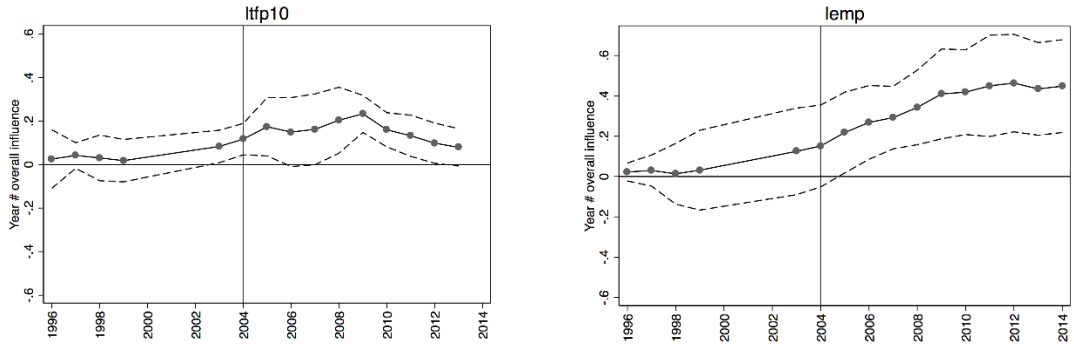
[22] "Pre-accession" refers to the period prior to accession to the European Union.

[23] Both pieces of analyses rely on a difference-in-differences strategy, whose details are described in the appendix.

[24] See Appendix for a description of how stronger German industrial capabilities and outsourcing potential are measured. Results reported in this section are robust to alternative specifications. Reassuringly, placebo tests using similar measures of industrial capability for Russia and other neighbor countries—notably Ukraine and Lithuania—fail to identify systematic links with the evolution of firm performance following EU accession.

Figure 17: Productivity and Employment Increased as Poland Increased its Linkages with Germany, Following Accession to the EU

(Effects of Integration with Germany on TFP and Employment)

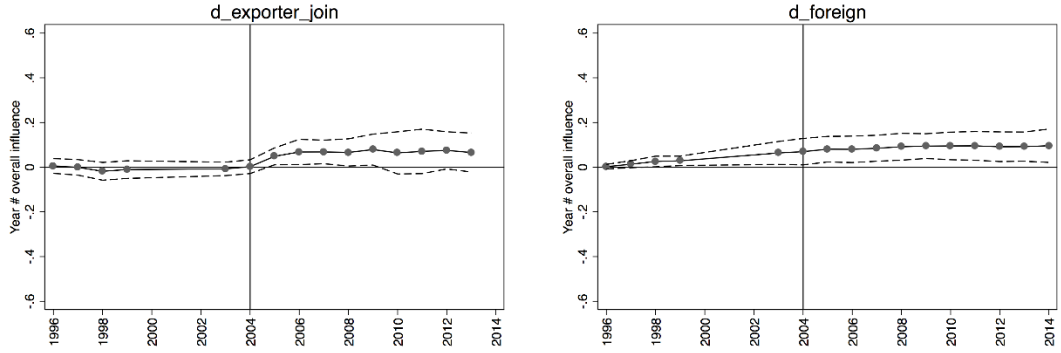


Source: Author's elaboration based on firm level data from GUS, OECD, EuroStat, and UNIDO. Notes: The diagrams are created by regressing the dependent variable (TFP and employment respectively) on a full set of event time indicators interacted with a dummy indicating whether Germany has above-median level of industrial capability or outsourcing potential in the sector and controlling for firm fixed effects. The dashed line indicates the 95% confidence interval.

Result 2: Following EU accession, firms operating in industries in which Germany had stronger industrial capacity and outsourcing potential were more likely to become exporters or foreign-owned.

Trade and investment linkages played a role in shaping the productivity and employment impacts mentioned above. The productivity and employment effects described above were matched by increases in export participation and incidence of foreign firms in sectors in which German capabilities and outsourcing potential was greater after accession to the EU (Figure 18). The result stresses the importance that participation in international production networks – in this case led by German firms in the internationalization process of Polish firms, their productivity upgrading and their overall growth.

Figure 18: Polish Firms Increasingly Internationalized Their Activities as Poland Increased its Links with Germany, Following EU Accession (Effects of Integration with Germany on Export Participation & Foreign Ownership)



Source: Author's elaboration based on firm level data from GUS, OECD, EuroStat, and UNIDO. Notes: The diagrams are created by regressing the dependent variable (export participation, foreign ownership) on a full set of event time indicators interacted with a dummy indicating whether Germany has above-median level of industrial capability or outsourcing potential in the sector and controlling for firm fixed effects. The dashed line indicates the 95% confidence interval.

Overall, these results point to the fact that increased integration accelerated Poland's development process. As argued before, it must be born in mind that the positive effects have likely been compounded by other simultaneous reforms in domestic markets, as well as by low policy uncertainty (to be discussed below). In addition, it is important to highlight that Poland's initial industrial base at accession, together with its location next to Germany, a high-income country and an export powerhouse, also played a role. In this way, this evidence provides a more relevant lesson for integration processes with similar characteristics (US and Mexico; or Japan and regional new HICs or MICs).

Box 2: Gaining from Integration Through FDI Spillovers

As argued above, there are many channels through which integration can affect a firm's productivity and growth. One of them is associated with spillovers from operation of multinational companies that connect to domestic firms. Most of the international research that find robust evidence on FDI spillovers focuses on vertical linkages between FDI and domestic firms (by supplying [forward linkages] or demanding inputs [backward linkages] from them).[25] Evidence on spillovers through horizontal linkages (through competition in same sectors) is much more ambiguous.[26] Albinowski et al (2015) look into the anecdotal and quantitative evidence on spillovers from activity of multinationals in Poland, reporting sizable effects.

The large investment that GM Opel carried out in the Special Economic Zone (SEZ) of Gliwice seems to be a good example. It received public support from the Government of Poland in the form of tax holidays, and from the EU in the form of grants for the support of innovation-related investments. In fact, this firm was the first one to set up shop in the SEZ in Gliwice creating a 'chain reaction' in the region, according to anecdotal evidence. The SEZ has now 80 plants, many of them supplying to Opel, but also to other carmakers in Poland and abroad. Once small and medium enterprises become accredited suppliers of GM Opel (which involves some training and supervision by GM Opel), they acquire the intangible asset of reputation or a demonstration effect (a "stamp of quality" as claimed by one of the entrepreneurs we interviewed) that is transferrable and boost firms' business opportunities with other clients. The multinational also interacts substantially with regional universities, from where it sources interns that obtain training and may stay working for the

[25] Blalock and Gertler (2008) found evidence of positive vertical spillovers from increased FDI in downstream activities of the manufacturing sector. They found strong evidence of TFP gains, greater competition and lower prices among local firms in markets that supply foreign entrants. Relatedly, Blalock and Simon (2009) found that the vertical spillovers from increased FDI in Indonesia accrued disproportionately to firms with greater absorptive capacities (i.e.: better trained workers, more investments in R&D). In Lithuania, Javorcik (2004) found positive TFP spillovers from FDI taking place through interactions between foreign affiliates and their local suppliers upstream. Also, Javorcik found evidence of vertical spillovers through backward linkages Czech Republic and Latvia through multiple channels. Evidence through forward linkages has concentrated on how FDI in upstream services sectors affected the productivity of downstream manufacturers. In Czech Republic, Arnold et al (2007) found sizable effects on productivity of increased foreign entry into upstream services. Fernandes and Paunov (2008) used data from Chilean manufacturers combined with FDI stocks in upstream services sector and found that those manufacturing firms furthest from the technology frontier had most to gain in terms of productivity improvements as a result of service sector liberalization. For Indonesia, Duggan et al (2013) found the contrary: it was the better performing manufacturers that benefited the most from upstream FDI in services. These authors found that FDI specific upstream sectors mattered the most for manufacturers. These sectors were telecom and transport (a similar result was found for the case of India by Arnold et al (2010). Davis, Lamla, and Schiffbauer (2015) find positive backward linkages from foreign FDI to domestic services firms in Jordan between 2006 and 2011. The effects were, however, partly reversed after the exit of foreign companies during the 2009 financial crisis, implying that only part of the positive spillovers to domestic suppliers embedded permanent learning effects.

[26] Irzova and Havranek, 2013 find that horizontal spillovers are on average zero, and that the sign and size of these spillovers depend on the characteristics of the foreign investors.

company or may circulate among other firms later. Is this anecdote representative? A systematic quantitative analysis reported in Albinowski et al (2015) suggests that it is.

Polish firms have gained from FDI in upstream sectors. The increase in FDI in upstream sectors has led to increases in productivity in sectors downstream. The effects are robust to controls for the presence of FDI in the same sector of activity (horizontal spillovers).

Vertical spillovers through forward linkages account for a substantial share of productivity gains observed during the period of analysis. These spillovers have had not only a statistically significant effect on firms' productivity, but also an economically significant effect. A back of the envelope calculation based on the estimated coefficients, the evolution of productivity by sector over the period and the evolution of the stock of FDI in upstream sectors shows substantial heterogeneity in the effects. It is, by far, in basic metals where most of the TFP gains can be attributed to positive vertical spillovers through forward linkages (explaining one third of total TFP gains). This is because it is in this sector where FDI stocks increased the most during the period. Gains have also been substantial in fabricated metals, non-metallic minerals and chemicals and chemical products. Instead, for textiles, wood and wood products, and office, accounting and computing machinery, a decrease in FDI stocks during the period implied a TFP loss for firms in that sector.

Source: Authors' elaboration based on "Supporting Micro Competitiveness to Ensure Convergence and Macro Resilience" by Albinowski, Hagemejer, Lovo and Varela (2015)

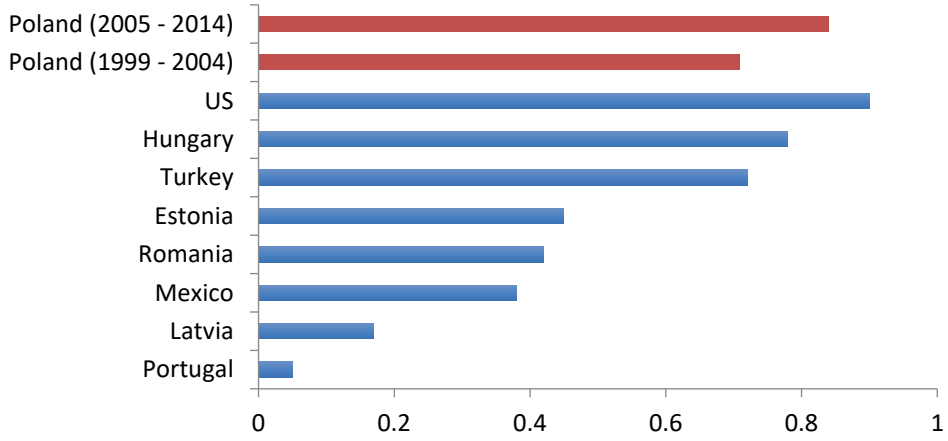
Role of Domestic Reforms

The strong turnover in firm sizes, which was associated with a reallocation of resources towards the most efficient producers, signals a healthy degree of competition in domestic markets. More than half of the medium size firms (50-99 employees) in 2004 were either forced to exit or lay off a large share of their workers becoming small firms (29 percent) or grew substantially to become large firms (23 percent) by 2010. This strong firm turnover, which was associated with higher allocative efficiency (Figure 14), indicates that barriers to competition and firm entry in domestic product and factor markets were sufficiently low to force firms to make profits and grow by competing in their cost effectiveness.[27] The results also provide evidence of creative destruction in domestic markets, in the sense that firms with higher productivity created more jobs.[28]

[27] O'Connell et al. (2016) argue that economic sectors with more liberal product and labor market regulations across European countries experienced higher productivity growth and allocative efficiency.
[28] See Aghion et al. (2001). The authors show in a theoretical framework how fair private sector neck-and-neck competition drives economic growth. In this model, competition increases firms' incentives to grow by adopting more efficient technologies in order to reduce costs and increase profits by escaping competition (at least temporarily). However, if regulatory barriers to competition impose sizeable cost advantages of few incumbent firms, then all firms in the sector have fewer incentives to adopt more efficient technologies to make profits, and sector growth is lower.

Consistently, strong firm entry and exit led to creative destruction within sectors, signaling that domestic reforms removed barriers to firm entry, exposing incumbent firms to competition. Consistent with previous results, firm turnover was driven by creative destruction in that new firms enter domestic markets, forcing less productive incumbent firms in the same sectors to exit. Bartelsman et al. (2004) suggest that firm turnover is driven by structural change (resource reallocations between sectors) if the correlation between entry and exit rates across sectors is negative capturing that most new firms enter other sectors than the ones that incumbent firms exit. In contrast, if the correlation between firm entry and exit rates is positive, firm turnover is driven by creative destruction (incumbent firms are forced to exit from the sectors that new firms enter). Figure 19 reveals that the main force behind firm turnover in Poland was creative destruction in the last 15 years, indicating that the lack of regulatory barriers to firm entry exposed incumbent firms to domestic competition.

Figure 19: Firm Turnover was Driven by Creative Destruction Indicating that Domestic Reforms Cut Back Regulatory Barriers to Entry and Competition



Source: Author's elaboration based on firm census data. Notes: Correlation between (employment weighted) entry and exit rates across 2-digit sectors. A positive correlation indicates that firm turnover is driven by creative destruction (new firms enter forcing incumbent firms in the same sectors to exit) and a negative indicates that structural change dominates (most new firms enter other sectors than incumbent firms exit). The entry/exit rates are weighted by employment; correlation coefficients are significantly different from 0. Poland: entry in /exit out 10+ employees; Turkey: Entry in / exit out 20+ employees. Correlations are measured from 2005-10 in Turkey and in 1990s for all other countries.

Available indicators suggest that domestic barriers to entry declined substantially in New HICs and are lower than in Trapped MICs. The index for barriers to (domestic) entrepreneurship in Poland in 1998 was comparable to the indices in Mexico and Turkey, the only two Trapped MICs with available data for this period. But Poland had the strongest decline in measured entry barriers among all countries between 1998 and 2013—it had the second lowest index among new HICs in 2013. The barriers to entrepreneurship are higher among all Trapped MICs than in the most restrictive New

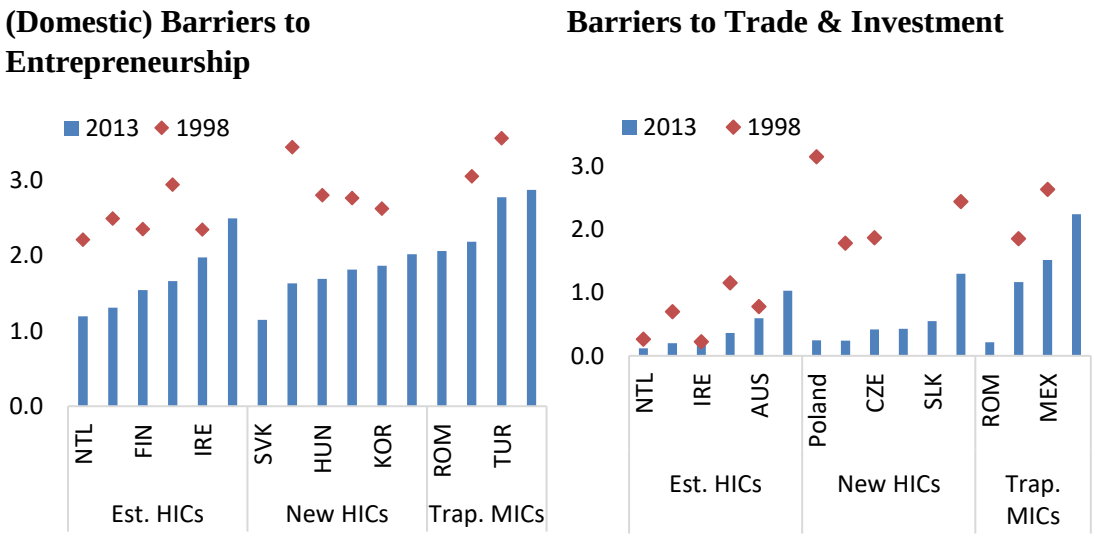
HIC country (Chile). Established HICs have comparable indices for barriers to entrepreneurship (apart from Israel).

Barriers to domestic competition declined less than barriers to foreign competition in all countries. Most barriers to foreign trade and investment have been removed between 1998 and 2013 in all countries, with some the exception of Brazil and to a lesser extent also Mexico, Turkey, Korea, and Israel. Barriers to domestic entrepreneurship are higher in all countries—they were already significantly higher in most countries to start with in 1998. The exception is Poland that had very high and comparable barriers to domestic entry and foreign competition in 1998. While Poland has removed most barriers to foreign trade and investments, some barriers to foreign entry remain.

New HICs have fewer domestic regulatory barriers to entry and protection of incumbents than Trapped MICs. Barriers to (domestic) entry consist of regulatory barriers that protect incumbents, regulatory administrative barriers for startups. The latter can be further decomposed into overall entry barriers and barriers in services sectors. The protection of incumbent firms is stronger in Trapped MICs, especially in Mexico. All Trapped MICs also have high administrative barriers to entry overall.

But regulatory barriers in service sectors are still high in most countries. While entry barriers in services sectors are relatively strong in all countries, Poland has the strongest barriers in services in the sample. A recent reform in 2013 reduced some of the restrictions to competition in services by removing legal barriers for the admission into selected professional services (Table 2).

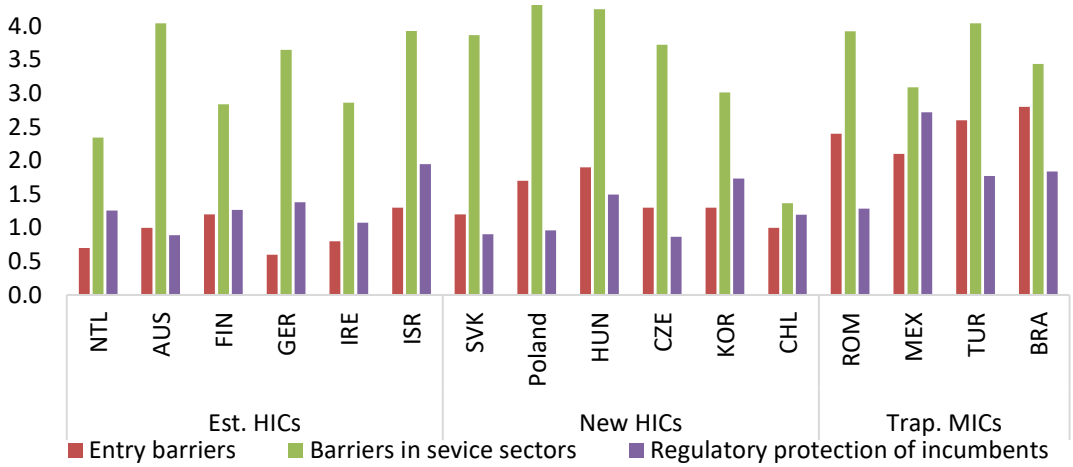
Figure 20: Domestic Barriers to Competition Declined Substantially in New HICs But Less than Barriers to Foreign Competition



Source: Author's elaboration based on OECD. Notes: Product regulation sub-indicators distinguish between (domestic) barriers to entrepreneurship and barriers to trade & investment. The indicators vary from 0 (no restrictions to competition) to 5 (highly restricted). Domestic barriers to entrepreneurship include three sub-indicators: complexity of regulatory procedures, administrative burdens on start-ups, and regulatory protection of incumbents. Barriers to foreign trade and investment include four sub-indicators: barriers to FDI, tariff barriers, differential treatment of foreign suppliers, and barriers to trade facilitation.

Poland's path from a centrally planned to a high-income market economy required an impressive, uninterrupted economic reform program across various policy dimensions in the past 25 years. The major individual economic reforms vary across policy areas in Poland between 1989 and 2013 and are outlined in Table 2. It sketches an impressive, continuous economic liberalization program from a central planned to a market-based economy. The reform momentum was strong in the early 1990s but continued through the 1990s and early 2000 in preparation for the EU accession. The detailed government reform roadmap to a full EU membership started to be implemented as early as 1996. Poland continued the reform momentum also after accession, in part, to comply with new EU directives—for instance, in public procurement or services trade. Recent reform efforts focused on supporting the transformation to a knowledge economy by providing targeted incentives for entrepreneurship, R&D, and higher education.

Figure 21: While New HICs have Fewer Domestic Regulatory Barriers to Entry and Protection of Incumbents than Trapped MICs, Regulatory Barriers in Service Sectors are Still High in Most Countries



Source: Author's elaboration based on OECD. Notes: Product regulation sub-indicators distinguish between domestic barriers to entrepreneurship and barriers to trade & investment. The indicators vary from 0 (no restrictions to competition) to 5 (highly restricted). Domestic barriers to entrepreneurship are expressed as the composite of three sub-indicators measuring the complexity of regulatory procedures, administrative burdens on startups, and regulatory protection of incumbents. Entry barriers are all administrative burdens on startups other than barriers in services.

Table 2: Poland's Reform Path from a Centrally Planned to a High-Income Market Economy: Major Economic Reforms Between 1989 and 2013

Year	Reform	Policy area	Sectors
1989	**European Community** and Poland had concluded a co-operation agreement on trade, commercial and economic matters; EC removed gradually all quantitative restrictions not in conformity with Article XIII of GATT (specific trade restrictions) until 1995.	trade	tradable
1989	**Corporate income tax** was introduced	taxation	all
1989	**Introducing unemployment benefit**, job search, start-up loans, re-training	labor	all
1990	**Economic Transformation Programme** including price liberalizations; abolishing all domestic and foreign trade monopolies and quantitative trade restrictions; introduction of import tariffs (averaging about 20%); immediate stabilization package; creation of market institutions, multiple year privatization program	trade, price control, privatization, institutions	all
1990	**Reduction in subsidies** (from 10.5-7% of GDP); elimination distortions in tax system private vs state firms; revision of the excess wages tax (Popiwek) and the capital tax (dividenda)	taxation	all
1990	**Property of all type treated equally**; socialist classifications eliminated	property rights	all
1990	Antimonopoly Act established an independent **Competition Authority**	competition	all
1991	**Foreign Investment Law** addressed most major FDI restrictions introducing guarantees from expropriation, repatriation of profits, no minimum capital requirements, simplified regulation	FDI	all
1991	**EC Association Agreement** signed including movement of workers & capital, timetable free trade zone, possible member	trade, FDI, competition	tradable
1992	**Personal income tax** was introduced	taxation	all
1993	**VAT** was introduced	taxation	all
1993	National **Investment** Fund Law	privatization	all
1993	**Investment tax relief** for firms with high profits and exporters, free of arrears on corporate taxes and social contributions	industrial policy	all
1994	**Collective bargaining** central with Tripartite Commission	labor	all
1994	**Special economic zone** program granting investors total income tax relief for 10 years and 50 per cent relief for following 10 years on case by case basis, no real estate tax, fast depreciation	SEZs	all
1995	**WTO member**	trade	tradable

1996	**OECD member**	foreign relation	all
1996	**Energy Law** for competition in production and transmission, privatization, independent Energy Regulatory Authority	competition, privatization	energy
1996	Government **roadmap to EU accession**	trade	tradable
1997	**Liberalization of financial services** through WTO agreement	competition	finance
1998	New **bankruptcy law**	competition	all
1999	Imports industrial goods from EU duty free, **tariffs cuts** for CEFTA countries	trade	tradable
1999	**Education reform** with new structure of primary and secondary	education	education
1999	**Public administration reform, new health care system, new pension system**	health, pension	health
1999	Personal and corporate income **tax cuts**	taxation	all
1999	Business Activity Law **new legal framework for firm entry**, transparency permits and licenses, sectors with licenses reduced from 28 to 8	competition, regulation	all
2001	**Creation of new regulatory agencies** as part of preparation for EU accession such as Office of Competition and Consumer Protection, Securities and Exchange Commission, Energy Regulatory Authority, Office of Telecommunication Regulation	institutions, regulation	all
2002	Amended Labor Code **increases hiring flexibility** and reduces administrative burdens on firms	labor, competition	all
2004	**Tax reform**: reduction of CIT and increase in VAT and indirect taxes	taxation	all
2004	Poland **joins the European Union** on 1 May	trade, FDI	all
2004	Law freedom of economic activity **reducing firms' bureaucratic burden**, electronic registration, reducing concessions, licenses & inspections, **EU firms legally on par with domestic firms**	competition, regulation, FDI	all
2004	**Public procurement law** implemented as part of EU accession including electronization, eliminate domestic preference, enforce obligatory public procurement notices	procurement, competition, FDI	all
2006	**Regulatory Reform Programm** reduces administrative burden and facilitates implementation of EU directives	competition, regulation	all
2006	Introduction of "**fast business courts**"	regulation	all
2007	**National Research & Development Centre established** for R&D financing & commercialization	innovation	all
2008	**Simplification of administrative procedures** to improve absorption of EU structural funds (environmental reg., PPPs)	regulation	all

2008	**Lowering minimum capital requirements** for limited liability and joint stock companies, simplification M&As	regulation	all
2008	Implementation of **'One Stop Shops'** in municipalities	regulation, entry	all
2008	**Tax deductions for technology purchases,** technological credit	innovation	all
2009	**Reduction CIT for startups and SMEs**, subsidized credit	industrial policy	all
2010	**Service trade facilitation** foreign entry	trade, FDI	all
2011	**Partnership for knowledge Programm** for higher education and linkages to business R&D	Education	education
2011	One stop-shop for firm entry, **online registration**, faster inspections	regulation, entry	all
2012	**Research grants** selected firms, 119 projects co-financed for PLN 563 mn	industrial policy	all
2013	**Removal of legal barriers for admission for selected professional services**, three stages: 1st stage de-regulated 50 professions	Competition	professional services

Source: World Bank staff based on Duval, Romain, Davide Furceri, Joao Jalles, and Huy Nguyen. Forthcoming. "A New Narrative Database of Product and Labor Market Reforms in Advanced Economies." IMF Working Paper. International Monetary Fund, Washington; MICREF reform database for Poland.

Role of Low Policy Uncertainty

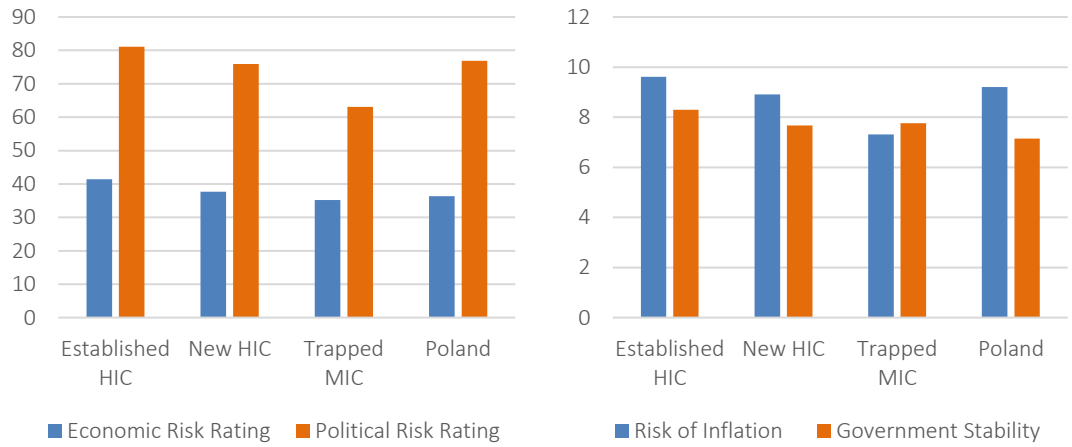
In Poland, policies conducive to increased integration and domestic reforms increasing competition at home were combined with low policy uncertainty. Policy uncertainty can be deterrent for growth as it delays investment and hiring decisions when it is costly to reverse them. In this respect, EU membership acted as a strong commitment device for policy makers in Poland that reduced uncertainty with respect to policy reversals, as many of the most relevant reforms were part of the integration package.

Policy uncertainty matters. Choosing the 'right' set of policies is crucial for countries to growth, but as important as the 'levels' of these policies are, it is also important for uncertainty with respect to how policy reversal is minimized. Theoretical literature linking different dimensions of uncertainty with growth tends to focus on the channel operating through the delay of irreversible investment or hiring decisions (when firing costs exist).[29] Empirically, the links between policy uncertainty and investment and growth points to sizable negative effects. For example, Aizenman and Marion (1993)

[29] The theoretical literature essentially argues that when downward adjustments of the capital stock are costlier for firms than upward adjustments due to irreversibility in the investment process (notice that the same can be argued for hiring personnel with firing costs), then increased uncertainty brings about an asset for the firm – a call option – originated by the chance that the firm has to delay the investment, awaiting for more information. This makes the required expected net present value of the investment that triggers the investment to be greater than zero and depresses investment at a given point in time (see Dixit and Pindyck, 1994).

look 46 developing countries over the 1970-85 period and uncover a negative correlation between macroeconomic policy uncertainty and investment and growth. More recently, Baker et al (2012) look at the US experience and show that policy uncertainty is an important factor in explaining recently depressed US output growth – through both investment and employment channels. They also argue that by slowing the reallocation of jobs, workers and capital, uncertainty also undercuts productivity growth worsening medium and long term economic prospects.

Figure 22: Economic and Political Risks are Systematically Associated with a Country's Level of Development
(Indicators of Economic and Political Uncertainty [average 2000-2015])



Source: ICRG.

Note: Economic and Political risk ratings are composite indices, with the maximum being 100 when risk is the lowest, and the minimum is zero, when risk is the highest. The government stability indicator assesses the government's ability to carry out its declared program and its ability to stay in office. For risk or inflation and government stability, the index ranges from 0 to 12. Analogously to the composite indices, for these two specific indicators, the higher the rating the lower the risk.

Policy uncertainty is lowest among established HICs and highest among trapped MICs. Several measures of policy uncertainty point to a `ranking' of countries with it being higher in trapped MICs than in new HICs and in established HICs. For example, relying on the International Country Risk Guide (ICRG) indicators (Figure 22), the composite indices of economic and political risk points to established HICs to show on average significantly lower risk ratings relative to new HICs (with 3.7 and 5.19 lower risk ratings respectively) and to trapped MICs (with 6.19 and 18.03 lower risk ratings respectively). Poland displays lower political risk than new HICs (but higher than established HICs), although slightly higher economics risks than established and new HICs. Similarly, inflation risks, typically indicative of macroeconomic uncertainty being greater in trapped MICs than in new HICs, and in new HICs than in established HICs (with Poland's rating in this respect being closer to established HICs). For Government Stability indicators, while the difference between established HICs with the other two country groupings is significant, the difference between new HICs and

trapped MICs is statistically insignificant (here Poland shows similar risk to trapped MICs and new HICs).[30]

The multiplicative nature of the effects of openness, domestic competition and low policy uncertainty make the consequences of the Polish experience very impactful. One of the exceptional features of the reforms processed in Poland and that distinguish the country from the experiences observed in other trapped MICs and new HICs is the combination of the aforementioned elements whose individual effects on growth are compounded by the effects of the other elements. Having processed these reforms and achieved policy stability, how can Poland continue on the growth path, once a substantive portion of the catching up gains has been already reaped? This is discussed in the section that follows.

[30] Of course, these associations between country risks and level of development are not necessarily showing any causality as, for instance, institutions and policy uncertainty are in interconnected (Acemoglu, et al. 2003, Rodrik, 1999).

Box 3: Policy Uncertainty: The Case of Argentina

Figure 23: Economic Policy Swings in Argentina (1963-2016, Summary of Policy Orientations as Classified by Arza, V. 2006)

"In the Argentinean economy, the long term does not exist" Juan Carlos Pugliese, Argentinean Minister for the Economy for two years during Arturo Illia's government, and just over one month in Raul Alfonsin's government.

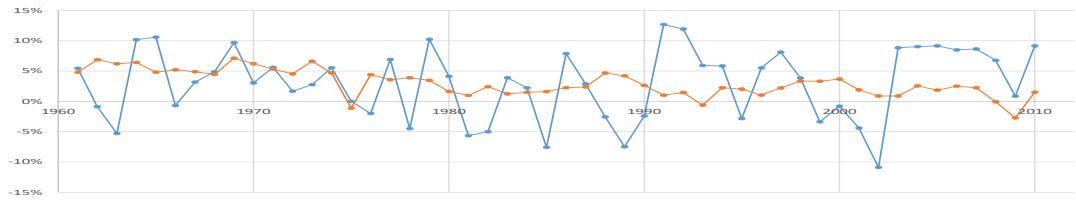
Arza (2006) looked at the effects of macroeconomic policy uncertainty and investment and innovation decisions in Argentina. The author classifies, for the period 1960-2001, different historical periods into orthodox and heterodox economic policy orientations.[31] Orthodox policy orientation periods are those in which the authorities in charge of macroeconomic policies make explicit the following principles in their decisions: macroeconomic discipline, market-oriented reforms, and openness to the world through trade and investment liberal policies (see page 57 in Arza, 2006). "Heterodox" periods are those in which decisions do not agree with those three guiding principles. There are some periods, however that do not allow a classification, either because there was no clear economic program or because the three areas taken into account showed

[31] The figure was updated by the authors until 2016 based on available information.

opposite orientations (see Figure 23).

Associated with the frequent macroeconomic policy swings is the extremely volatile growth rate of real GDP in Argentina, a trapped MIC, when compared with that of an established HIC, over a long period of time (Figure 24).

Figure 24: Growth Rates of Real GDP – Argentina (Blue) versus France (Orange) 1960-2010



Source: Authors' elaboration based on Arza, V. (2006)

5. What's Next?

Innovation-driven productivity gains are critical for sustainable economic growth. Previous sections emphasized the role of productivity gains in driving growth in countries that have been successfully converging to high income. To some extent this is achieved by absorbing innovations that others have developed. In the process of convergence, Poland has greatly benefited from absorbing innovation from more advanced economies through many channels (learning by exporting and importing, FDI spillovers, technological transfers, etc.). Moving forward, more gains are to be reaped both from the adoption and diffusion of existing innovations among firms, and from autochthonous innovations. The scope for these two channels are discussed in this section.

Slow Technology Adoption Points to Forgone Growth Opportunities

A significant share of cross-country income differences can be explained by the lack of adoption of the latest available, more productive technologies of many firms within a country. Policymakers often focus on supporting new, cutting-edge innovations at the technology frontier of a few individual firms. While innovations at the technology frontier are an important to boost productivity growth in advanced countries, the extent to which the latest available existing technologies developed elsewhere diffuse to most firms in the country is often overlooked as a source to boost productivity growth. But recent evidence suggest that it took on average 45 years for new technologies developed elsewhere to be adopted in other countries and this cross-country variation in the adoption of technologies has been found to account for at least 25 percent of per capita income differences.[32] While the speed of diffusion of technologies reaching new countries has increased for recent technologies such as the internet, the penetration of these new technologies across all firms within a country has been slower than for past technologies. [33] This divergence in penetration rates of existing technologies across most firms within countries constrains aggregate productivity growth, rationalizing the slow cross-country convergence in incomes.[34]

Firms in Poland have been slow to adopt the latest available digital technologies, pointing to forgone opportunities for higher productivity growth.[35] Despite the significant growth opportunities of the digital revolution, firms' use of digital technologies differs substantially across sectors and countries. In fact, more advanced digital technologies have not yet diffused widely even within high-income European countries (Figure 25). As in all other European income countries, almost all formal sector firms in Poland with at least 10 employees use a PC (94 percent) or have broadband internet (90 percent). But only 65 percent of formal firms in Poland have a

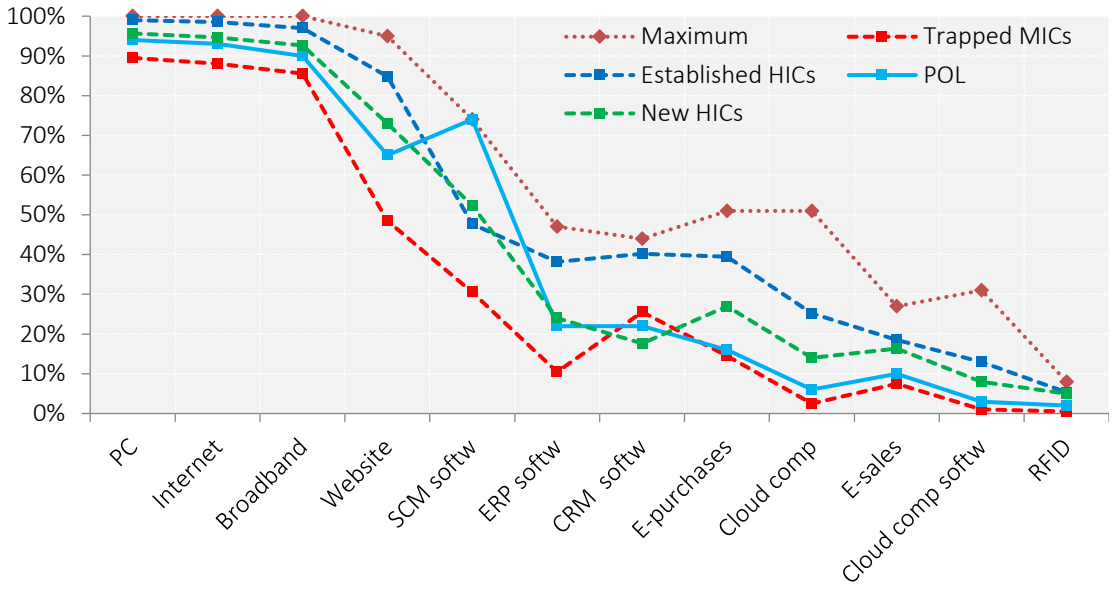
[32] Comin and Hobjin (2010).
[33] Comin and Mestieri (2013).
[34] Both, the speed with which new technologies have reached new countries and the lack of penetration of these new technologies across most firms within countries, have been found to explain a large part of long-term cross-country income trends—they explain up to 80 percent of the Great Income Divergence between rich and poor countries since 1820 (Comin and Mestieri, 2013).
[35] World Bank World Development Report 2016.

website, which is well below the average for established (85 percent) and new (73 percent) high income countries.

Firms in Poland are relatively advanced in using supply chain management software which allows them to management their inventory more efficiently. Customer relationship management (CRM) platforms facilitate sales, customer support, and related interactions with customers or other businesses varies substantially. This software is particularly widespread among formal firms in the retail and wholesale sector and in manufacturing and can be integrated with the ICT systems of customers or suppliers outside of the firm. Seventy-four percent of all formal firms in Poland use supply chain management software to manage their inventories—more firms than in any other European country. This software, which includes supply chain management software to manage inventories, is more often used among manufacturing firms.

In contrast, firms in Poland lag behind most European countries in e-commerce. Only 16 percent of formal sector firms buy goods or services online, and only 10 percent sell online. The use of e-commerce to buy or sell goods and services is much more widespread among established (40 and 19 percent) and new (27 and 10 percent) high income countries. For instance, firms in the Czech Republic are 3 times more likely than Polish firms to purchase goods or services over the internet. The share of firms purchasing online is also larger in Romania (18 percent), despite its lower income per capita. Likewise, the firms on average across all European countries are 1.5 times more likely to sell their goods or services online than Polish firms. E-commerce, especially online sales, are often more intensively used in the service sector, pointing to untapped opportunities for Polish services firms to raise their productivity moving forward.

Figure 25: Many More Efficient Digital Technologies are Not Yet Used by Most Firms in Poland

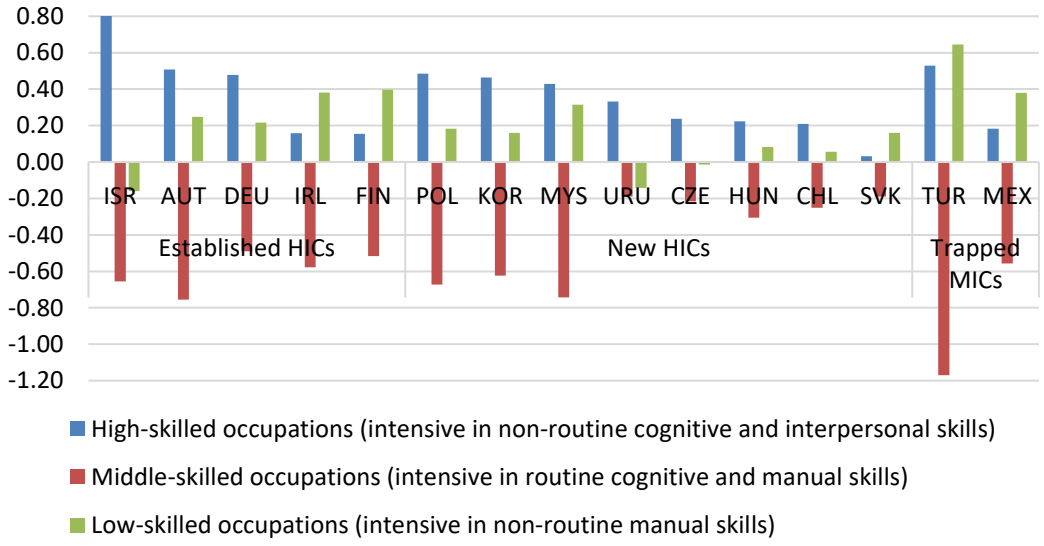


***Source**: Eurostat, 2014 or latest available year (2012 for Turkey). **Note**: The figure shows the share of all non-farming, non-financial enterprises with at least 10 employees that adopted different digital technologies in Poland and established high income countries (Austria, Belgium, Finland, Germany, Ireland, Netherland), new high-income countries (Czech Republic, Hungary, Slovak Republic), and trapped middle income countries (Romania, Turkey). SCM: Supply Chain Management software integrated with ICT systems of customers/suppliers; ERP: Economic Resource Planning software; Customer Relationship Management software; cloud computing ERP: purchase advanced cloud computing services such as ERP, CRM, or computing power; RFID: Radio Frequency Identification technologies used to connect machines (internet of things). The latest available data for Turkey are from 2012.*

Firms in Poland also lag behind their European peers in using cost-efficient cloud-computing services to license software or hardware. Only 6 percent of firms in Poland use cloud computing services to license the use of basic software or computing services instead buying the full versions of the corresponding soft- or hardware. Only 3 percent use efficient cloud computing services to access more advanced software solutions such as Supply Chain Management (SMC), Economic Resource Management (ERP) and Customer Relations Management (CRM) software. The adoption of these cost-effective, modern technologies is much less widespread than in the other new high-income European countries—14 percent use computing services to license the use of basic software or computing services and 8 percent purchase licenses for more advanced software solutions. Finally, only 3 percent use Radio Frequency Identification devices (RFIDs), which are wireless microchips used to connect machines with each other (internet of things), compared to an average of 5 percent of all formal firms in other new high-income countries.

The slow technology diffusion in Poland can have severe consequences for less skilled workers as labor markets in Poland and most other countries are becoming more polarized. The decline in middle-skilled, middle-paying occupations (clerks, plant and machine operators) was strong in Poland (labor share declined 0.67 percentage points annually) and most established HICs (Figure 26). These middle-skilled occupations typically comprise jobs that can be broken down into routine tasks. These jobs are often in business processing, including call centers and bookkeeping, but also comprise clerks or machine operators in manufacturing. Due to their large component of routine labor, these tasks can be relatively easily reconstructed by algorithms and are thus susceptible to automation. As a consequence, these middle-skilled jobs are often replaced by automation and disappearing in Poland and many other countries. They are either replaced by high-skill or poorly paid low skill jobs, comprising non-routine manual labor such as taxi drivers, cleaning personnel, etc.

Figure 26: Labor Markets are Becoming More Polarized



Source: World Development Report 2016. Note: Annual average change in employment. Note: The figure displays changes in employment shares between circa 1995 and circa 2012. The classification follows Autor (2014). High-skilled occupations include legislators, senior officials and managers, professionals, technicians and associate professionals. Middle-skilled occupations comprise clerks, craft and related trades workers, plant and machine operators and assemblers. Low-skilled occupations refer to service and sales workers and elementary occupations.

Moving forward, Poland needs to continue investing in its human assets to facilitate the technological catch-up of many firms in Poland, allowing the country to stay ahead in the race between skills and technology. Investment in skills would also help Poland to mitigate the impact of labor market polarization due to technological progress (Figure 26). That is, the new (digital) technologies complement and augment some skills (typically high-skilled professions such as managers, technicians, or researchers) while replacing others. Since not everybody has the appropriate skills, many can end up falling behind, forced to accept low-paying manual skills occupations such as elementary, service, and sales workers. The level of education and skills in each country

thus determine whether most firms adapt to and make use of technological advances, boosting productivity and thus wages for most workers (with the appropriate skills) or whether they translate into more inequality. The strong increase in tertiary education and high-skilled, high-paying jobs (and the relatively slower increase in low-skilled, low-paying jobs) suggests that Poland's investments in higher education over the past two decades have paid off. But the race between skills and technology continues.

Pushing the Frontier: The Role of Innovation

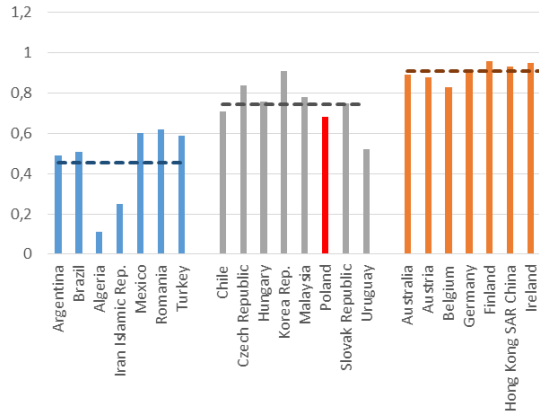
International innovation rankings suggest Poland has scope for climbing up the innovation ladder. Innovation results from interaction and feedback processes in the creation of knowledge.[36] Given the complexity of these processes, it is difficult to measure it with a single macroeconomic indicator. Typically, innovation indicators are grouped into *input indicators* (R&D expenditure is an example) and *output indicators* (e.g.: the output of the R&D activities, including number of scientific publications, patent applications and patents issued).[37] To facilitate international comparisons, these and other indicators are combined to produce synthetic measures of innovation and innovation rankings. In all main measures of innovation Poland lags established HICs but also some new HICs (Figure 27).

[36] An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. Therefore, the broad meaning innovation potential goes beyond mere technological aspects and relies not only on R&D expenditure of firms or governments – however, because R&D expenditure is less complex to measure than other type innovation efforts, it is a useful proxy.

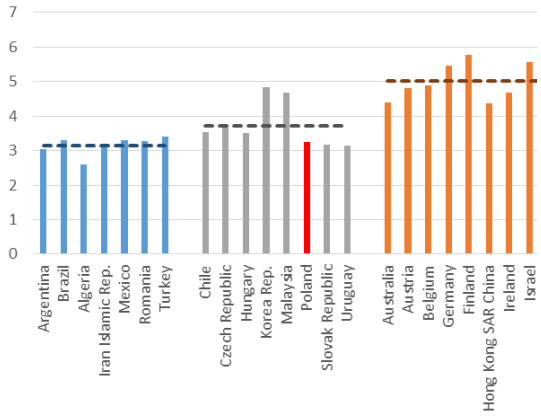
[37] The most innovative countries show high level of (private) R&D expenditure. However, the shortcoming of this measure is that the level of expenditure is only one of the elements conducive for innovation. Other measures refer to the share of employees involved in R&D activities. In terms of output, R&D expenditure should translate into knowledge creation and allow to patent and implement innovations. However, patent application is not always followed by its real implementation (as a patent may create an entry-barrier for its competitors).

Figure 27: Poland Lags in International Innovation Rankings

Global Innovation Index - INSEAD



Global Competitiveness Report, Pillar Innovation



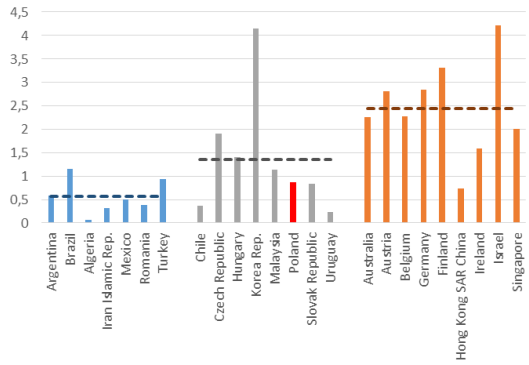
Source: WB WDI, INSEAD, Global Competitiveness Report.

In Poland low innovation inputs are associated with low innovation output. Poland spends less than 1 percent of GDP in R&D, within new HICs, on par with Slovak Republic, but substantially below Czech Republic, Hungary, or Malaysia, and dwarfed by the expenditures of the Republic of Korea at 4 percent of GDP.[38] This is in line with the findings of Albinowski et al (2015) that bridge innovation inputs and outputs by focusing on Polish exports, to find low intensity R&D in the country's exports. Another standard indicator of innovation output is the number of patent applications normalized to the population. In this respect Poland is also outperformed by Czech Republic, Hungary and the Republic of Korea, and by all established HICs (Figure 28).

[38] R&D as a share of GDP in Poland is lower than that reported by trapped MICs such as Brazil and Turkey.

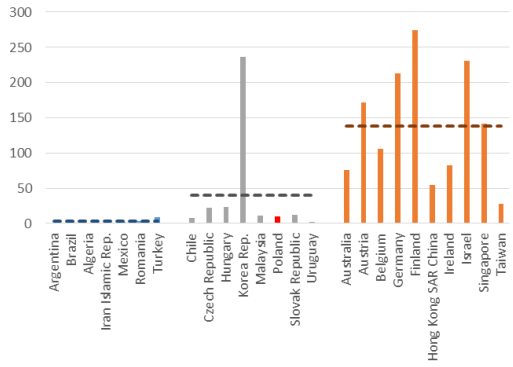
Figure 28:…Which May Reflect the Fact that it Lags Behind in R&D Expenditure and in Patent Applications…

Gross Domestic Expenditure on R&D, Percent of GDP



Source: World Bank World Development Indicators

Number of Patent Applications, Per Million Population



Source: World Bank World Development Indicators

Only a small fraction of Polish enterprises is involved in R&D activities or implement innovations. Poland's low position in innovation rankings is confirmed by the microeconomic analysis at the level of enterprises. Only a fraction of Polish enterprises is involved in R&D activities or implement innovations. These companies are concentrated in a small number of manufacturing sectors, predominantly have foreign ownership and are export-oriented (although as mentioned, exports display low R&D intensity themselves) while their investment in new technologies is usually in the form of purchase of new machinery and equipment – suggesting a process of *technology diffusion* rather than strictly defined innovation.

How can innovation activities be brought to their potential? Low level of innovation in the economy may reflect low innovative potential. On the other hand, there may be a scope to unleash this potential by removing barriers in the institutional and regulatory environment of the innovation process. The innovation potential of the economy is embodied in available human and social capital as well as existing infrastructure and R&D centers. Policies to support innovation are therefore aiming to strengthen this potential by providing education and training to accumulate human capital, building mutual trust to develop social capital and by supporting cooperation of scientific institutions and businesses. To support innovation, it is important to unleash the potential already existing in the economy. These relate to specific institutional environments, regulations governing the innovation processes as well as sources of financing (see Box 4).

International empirical evidence suggests that the institutional and regulatory environment as well as the different players of an innovation ecosystem play an important role. There is a range of instruments to support innovation. Some instruments

of a more active nature include financing (in the form of grants and subsidies).[39] Also important is to support cooperation between universities, governments and businesses.[40] Examples of effective active innovation policies include UK and Germany. Others are 'passive' and are related to framework policies shaping the general business and economic environment, as well as a system of incentives conducive to innovative activities. The main areas include tax policy, product market and labor market regulations. Finally, public interventions can help shape human and social capital (by building knowledge, competencies, skills, and by strengthening social trust, eagerness to cooperate, and maintaining a diversified social network and social participation).

While innovation is key for sustained growth, it can also be a source of income inequalities. Innovative projects are associated with significant risks and highly asymmetric return distribution ('the winner takes it all' effect and accumulation of assets among few winning innovators). Thus, as a side effect innovation can lead to increased uncertainty among entrepreneurs and employees and higher income inequalities. It can also result in lower labor share in value added. On the other hand, these tendencies can be counterbalanced with relevant redistribution policies.

[39] The government can also influence the availability of financing for innovative companies at various stages of their lifecycle. At an early stage of development, innovative companies use their own capital base, which can be supported with public grants or subsidies and for more mature companies with tax exemptions. At later stages the availability of external financing becomes more important with potential instruments including improved access to bank financing (with loan guarantees, subsidies and loans with reduced collateral requirements) and support for venture capital sector (which is not only a source of financing but also plays a vital role in selecting and developing business ideas). A strong stock exchange with high liquidity and market capitalization as well as microloan institutions also improve access to equity financing for start-ups.

[40] It is important for the three key actors: researchers, governments and the private sector to cooperate to create innovative products and services. To achieve this, governments create and support clusters (to support cooperation among companies), technological parks (to moderate cooperation between research institutes and business) and business incubators (focusing on innovative business start-ups).

Box 4: Areas for Improvement in Innovation Support

The areas for improvement of the innovation support policies (in various time horizons) and examples of international best practice are presented below in Table 3, following the recommendations of NBP (2016).

Table 3. Main Areas for Improvement of Innovation Support Policies in Poland

Short Term (up to 8 Years)	Medium Term (8-20 Years)	Long Term (at Least 20 Years)
External evaluation of public innovation support policies (Denmark, Germany)	Product market competitiveness (US, Germany)	Distance to the global technological frontier (US, Israel, Taiwan)
Transparency and consistency of the system of active policies to support innovation (Denmark, Israel)	Labor market competitiveness (Denmark)	Human capital (Finland, Sweden, US, Switzerland)
System of grants and subsidies (Denmark, Sweden, Israel)	Cooperation of universities and companies (Denmark, Finland, Sweden, US, Germany)	Social capital (Denmark, Finland, Sweden)
Tax system (US, Israel, Slovenia)	Clusters, technological parks and business incubators (Denmark, Sweden, US, Germany, Israel)	
Bankruptcy law and execution of liabilities (US, Switzerland)		
Financial markets (US, Germany)		

Source: NBP (2016).

Source: Authors' elaboration based on NBP (2016)

6. Conclusions

During the last 25 years, Poland's economy has grown uninterruptedly. At an average rate of 3.7 percent per year, it multiplied the income by a factor of 2.5. It did so in a stable manner, through increasing the productivity of its workers, and with a concomitant process of diversification of assets. This note described this process and it compared it to that displayed by three types of countries: the established HICs – those that have consolidated their status as high income economies; the new HICs – those that have only recently achieved high income status through rapid growth, Poland being one of them; and the trapped MICs – those that have not managed to consolidate fast and stable growth over the past decades. Then, it extracts some lessons for other countries, as well as insights for Poland to continue on this path. Three main lessons and insights are extracted:

Lesson 1: Poland's growth process was facilitated by a process of diversification of its underlying assets, including institutions, physical and human capital.

As the production processes undertaken by Polish firms grew more complex, the supply of skills in the market grew, matching to some extent private sector demand. Institutions also evolved, and sources of physical capital were added in a great deal through increased integration of capital markets, and EU structural funds.

Lesson 2: integration into the EU bloc boosted productivity-driven growth through the synergetic combination of three elements: increased openness to trade, investment and talent, increased domestic competition and regulatory harmonization with the EU, and low policy uncertainty through a commitment to EU- institutions.

The combination of these elements made investments in productivity-enhancing investments *fertile*, and their returns *appropriable* for the investor. The productivity gains associated with these three factors materialized through a process of structural transformation in which resources were reallocated to more productive sector, and within sectors, a Darwinian process of reallocation towards more productive firms. At the level of the average firm, substantial productivity gains – experienced both by domestic and foreign firms - were also achieved through increased competition, improved management, and innovation.

Lesson 3: To consolidate its growth, Polish firms need to continue taking advantage of technological diffusion and increase their innovative capabilities.

Evidence reveals that there is still scope for catching up through closing the gaps in technology adoption that remains heterogeneous across firms. Still, these gains may at some point be exhausted, which points to the importance of strengthening the innovation ecosystem needed to facilitate frontier pushing productive activities.

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World Bank Development Report 2016

Appendix

Decomposing Productivity Growth

We decompose overall growth by employing the dynamic Olley-Pakes decomposition with entry and exit (DOPD) method proposed by Melitz and Polanec (2015). This method was proposed as an extension of the previous OP decomposition method (Olley and Pakes, 1996) to take into account the contributions of entry and exit. It tracks individual firms over time to analyse the pattern of market share reallocations across firms and its consequences for aggregate productivity. Total factor productivity, Φ, in two periods (1 and 2) can be defined as follows:

$$\Phi_1 = S_{S1}\Phi_{S1} + S_{X1}\Phi_{X1} = \Phi_{S1} + S_{X1}(\Phi_{X1} - \Phi_{S1}),$$

$$\Phi_2 = S_{S2}\Phi_{S2} + S_{X2}\Phi_{X2} = \Phi_{S2} + S_{X2}(\Phi_{X2} - \Phi_{S2}),$$

where S is the market share of survivors (S), entrants (E) and exiters (X). It follows that aggregate productivity change can be decomposed according to the following relationship:

$$\Delta\Phi = (\Phi_{S2} - \Phi_{S1}) + S_{E2}(\Phi_{E2} - \Phi_{S2}) + S_{X1}(\Phi_{S1} - \Phi_{X1}).$$

Aggregate TFP is, therefore, decomposed into components for the three groups of firms: survivors, entrants, and exiters. The survivors' component can be further decomposed using the OP decomposition:

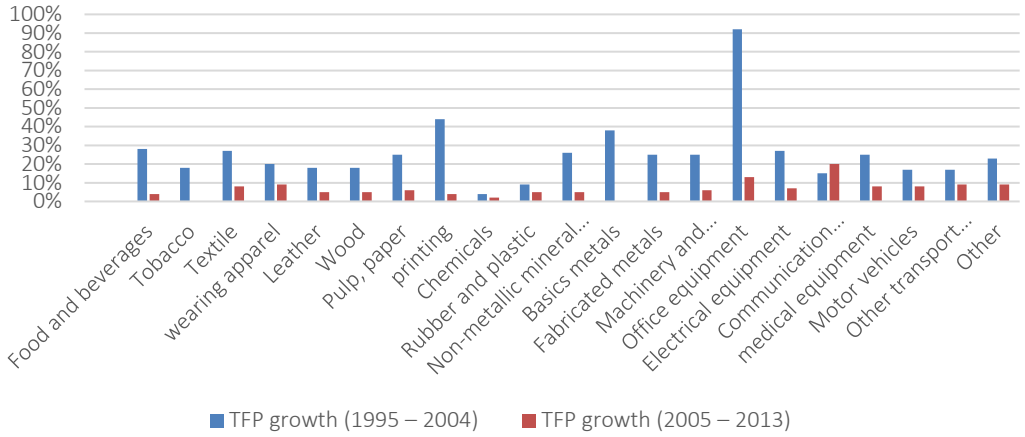
$$\Delta\Phi = \Delta\varphi_S + \Delta COV_S + S_{E2}(\Phi_{E2} - \Phi_{S2}) + S_{X1}(\Phi_{S1} - \Phi_{X1}).$$

The first component is separated to distinguish the contribution of surviving firms into one induced by a shift in the distribution of firm productivity (the unweighted mean change in the productivity of surviving firms φ_S) and another one induced by market share reallocations (the covariance change between market share and productivity for surviving firms COV_S).

Table 4: TFP Decomposition (1997-2013)

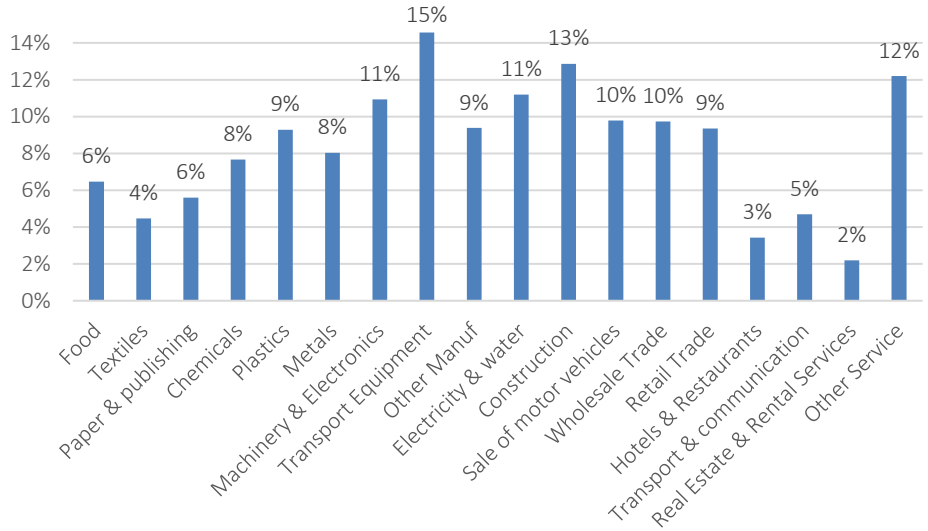
Year	**Overall change in TFP**	**Within-firm effect**	**Between-firms effect**	**Entrants**	**Exiters**
1997	0.23	0.077	0.159	0	0
1998	0.17	0.03	0.133	0.001	0
1999	0.21	0.042	0.163	0	0
2003	0.4	0.049	0.365	0.001	0
2004	0.29	0.036	0.258	0.002	-0.002
2005	0	0	-0.007	0.001	-0.001
2006	0.09	0.069	0.035	0.001	-0.001
2007	0.07	0.081	-0.009	0.001	-0.001
2008	0.07	0.039	0.025	0.002	-0.001
2009	0.01	0.004	0.035	0.003	-0.002
2010	0.04	-0.018	0.048	0.001	-0.001
2011	0.05	0.029	0.027	0.002	-0.001
2012	-0.03	0.014	-0.032	0.002	-0.001
2013	0.09	0.056	0.048	0.002	-0.001
1997-2013	0.12	0.036	0.089	0.001	-0.001

Figure 29: Aggregate TFP Growth by Sector



Source: Authors' calculations

Figure 30: Fast-Growing firms (Gazelles) Emerged in Most Sectors and are More Often Services Firms



Source: Authors' calculations from F01 dataset. Firms > 10 employees. Note: Incidence of Gazelles by sector in 2006.

Did deeper integration with Germany following EU accession impact firm performance through trade and investment linkages?

Data description

The empirical analysis uses data from the F01 data set, a census of Polish firms with more than 10 employees for the period 1995-2014. This data set comprises information on about 19,000 manufacturing firms. Data for the period 2000-2002 are available only for firms with more than 50 employees, and hence are excluded from the main analyses. The F01 data set contains information on a set of firm attributes, including employment, wages, capital stock, export and foreign ownership status, industry and region. Unique firm identifiers make it possible to follow firms over time. As is standard in the empirical trade literature, the analysis excludes the coke and refined petroleum sector because of highly volatile data. The data have an unbalanced structure. Table 5 reports the number and proportion of firms by the number of years they are observed in the data.

Table 5: Number and Percentage of Firms by Total Number of Years in the Sample

Number of years	Number of firms	%
1	4,914	16.34
2	3,748	12.46
3	2,782	9.25
4	2,245	7.46
5	2,661	8.85
6	1,841	6.12
7	1,484	4.93
8	1,294	4.30
9	1,105	3.67
10	1,131	3.76
11	1,064	3.54
12	2,817	9.37
13	544	1.81
14	466	1.55
15	353	1.17

16	375	1.25
17	1,252	4.16

Notes: Authors' calculations using the F01 dataset. Data include firms with more than 10 employees and exclude the period 2000-2002.

The econometric analysis considers four different measures of firm performance, which are summarized in Table 6. Total factor productivity (TFP) is measured using the standard Levinsohn and Petrin (2003) methodology in which total expenditure on material inputs is used to control for unobservables. To allow for differences in technologies across sectors, different production functions were estimated for each 2-digit sector.

Table 6: Descriptive Statistics on Measures of Firm Performance

Variable	1995-2014	Before 2004	After 2004
TFP (log)	4.485	4.311	4.563
	(1.017)	(1.000)	(1.015)
Employment	167.108	216.906	146.699
	(376.356)	(464.626)	(331.344)
Wages	29.766	21.764	33.334
	(93.154)	(78.110)	(98.919)
Exporter (=1 if yes)	0.663	0.646	0.670
	(0.473)	(0.478)	(0.470)
Foreign owned (=1 if yes)	0.181	0.16	0.19
	(0.385)	(0.367)	(0.392)

Notes: Authors' calculations using the F01 dataset. Data include firms with more than 10 employees and exclude the years 2000-2002.

Table 6 reveals that manufacturing firms in the sample employed on average about 167 workers during the period 1995-2014. The summary statistics also reveal that average firm size declined in the post-accession period from about 217 employees before 2004 to 147 employees after the EU accession. About 66% of firms are exporters and 18% are foreign owned. These proportions moderately higher in the post-accession period. Total factor productivity is also higher in the post-2004 period.

Table 7 shows that these indicators of firm performance vary substantially across manufacturing industries. Total factor productivity tends to be higher, on average, in the sectors "Motor vehicles, other transport", "Electrical, communications, medical", and "Pulp, paper and printing". The

former two sectors are also characterized by a relatively high average firm size and wages. They are also sectors with a relatively high share of exporters and, especially, of foreign-owned firms.

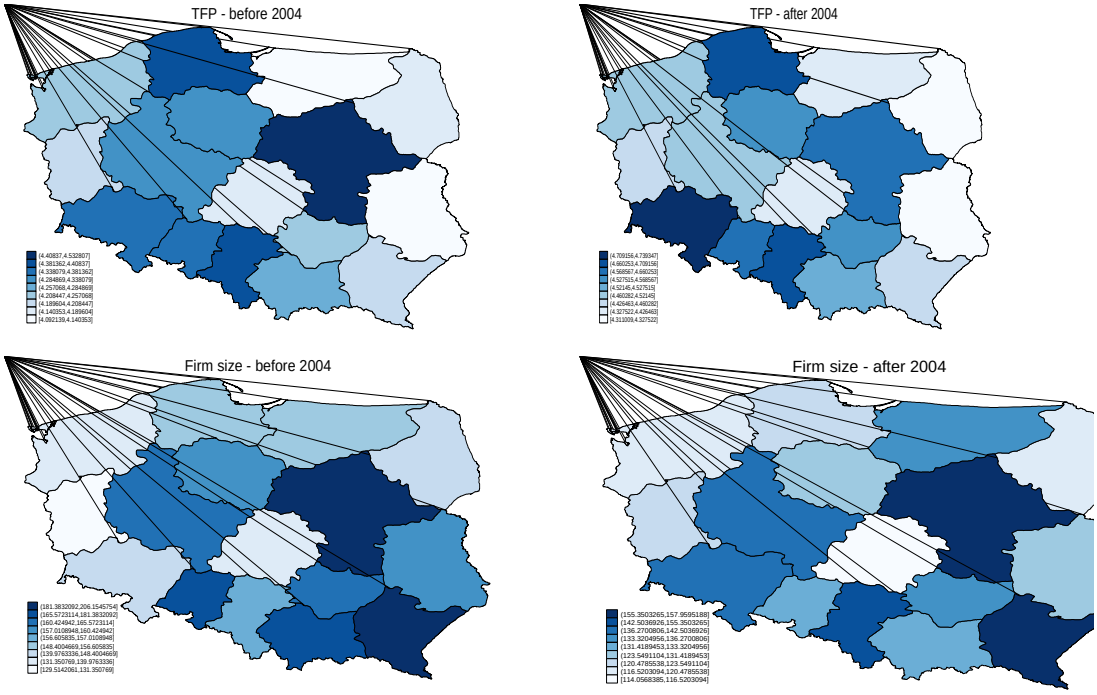
Table 7: Descriptive Statistics by Sector

Sector	TFP	Employment	Wages	Exporter	Foreign	Observations	Firms
Food and beverages	3.865	150.522	23.851	0.453	0.101	36074	5702
	(0.847)	(283.814)	(73.228)	(0.498)	(0.302)		
Tobacco	2.743	777.117	36.909	0.843	0.525	186	22
	(0.958)	(823.255)	(24.901)	(0.365)	(0.501)		
Textile, wearing apparel and leath	3.974	153.097	21.979	0.754	0.187	18953	3278
	(0.922)	(232.208)	(150.534)	(0.431)	(0.39)		
Wood	3.626	124.882	22.25	0.777	0.154	9482	1675
	(0.691)	(193.104)	(56.508)	(0.416)	(0.361)		
Pulp, paper and printing	5.313	117.257	30.655	0.611	0.171	8667	1447
	(0.884)	(213.489)	(37.576)	(0.488)	(0.377)		
Chemicals	4.684	255.322	38.598	0.771	0.247	7015	1060
	(0.886)	(549.504)	(65.823)	(0.42)	(0.432)		
Rubber and plastic	4.066	121.993	27.389	0.772	0.232	14814	2329
	(0.708)	(266.57)	(16.239)	(0.419)	(0.422)		
Non-metallic mineral products	4.456	169.12	32.104	0.544	0.196	10961	1828
	(0.856)	(294.687)	(93.297)	(0.498)	(0.397)		
Basics and fabricated metals	4.64	139.67	32.529	0.711	0.19	28448	4843
	(0.78)	(369.555)	(70.938)	(0.453)	(0.392)		
Machinery and equipment	5.009	150.43	36.082	0.662	0.146	16032	2530
	(0.791)	(326.056)	(51.857)	(0.473)	(0.353)		
Electrical, communication and me	5.227	201.273	36.202	0.704	0.235	12297	1920
	(0.949)	(421.861)	(82.225)	(0.456)	(0.424)		
Motor vehicles and other transpor	5.419	349.587	39.594	0.777	0.291	10272	1459
	(0.989)	(794.051)	(146.005)	(0.417)	(0.454)		
Other	4.612	200.685	25.339	0.822	0.195	10707	1844
	(0.874)	(439.949)	(177.264)	(0.382)	(0.396)		

Notes: Authors' calculations using the F01 dataset. Data include firms with more than 10 employees and exclude the years 2000-2002.

Figure 31 reports average TFP and firm size by region before and after 2004. Inspection of this figure provides suggestive evidence that TFP and employment growth were relatively stronger in a number of western regions that are geographically closer to the border with Germany.

Figure 31: TFP and Firm Size by Region



Source: Authors' calculations using the F01 dataset.

Data on Germany's export and outsourcing potential by sector and by region (where possible) are obtained from the Eurostat, OECD and UNIDO (Table 8). To mitigate concerns about endogeneity, these measures are constructed using data for the pre-accession period. For example, data on Germany's pre-accession exports by sector refer to the average of export flows over the period 1994-2004. To conduct placebo tests, where possible we collected similar data for Russia and other neighbor countries, notably Ukraine and Lithuania. We also constructed two binary summary measures of German industrial capability and outsourcing potential. The first takes value one for sectors that show above-median levels in at least one of the individual measures (summary: all measures), the second takes value one for sectors that show above median levels of exports or FDI (summary: exports and FDI).

Table 8: Industry-Level Data on German Industries, 1994-2004

Variables	Unit of observation	Source	Countries
Exports	Sector (2 digit)	OECD	Germany, Russia, Ukraine, Lithuania
FDI	Sector (2 digit with some aggregations)	EUROSTAT	Germany
Wages	Sector (2 digit) and region (nuts2)	EUROSTAT	Germany
Gross investment	Sector (2 digit) and region (nuts2)	EUROSTAT	Germany
Invest. per employee	Sector (2 digit) and region (nuts2)	EUROSTAT	Germany
Output	Sector (2 digit)	UNIDO	Germany, Russia, Ukraine, Lithuania
Employment	Sector (2 digit)	UNIDO	Germany, Russia, Ukraine, Lithuania
Gross Capital Formation	Sector (2 digit)	UNIDO	Germany, Russia, Ukraine, Lithuania

Empirical Strategy

We assess the impact of deeper integration with Germany on firm performance by estimating the following model:

$$y_{ist} = \beta_1 Post_t + \beta_2 X_s^G \times Post_t + \gamma Z_{ist} + \mu_i + d_t + \varepsilon_{ist} \qquad (1)$$

where y_{ist} is a measure of performance of firm *i* in sector *s* at time *t*; Z_{ist} is a set of control variables at the firm level; $Post_t$ is a dummy variable that takes value 1 for the post-accession period (i.e. from 2005 to 2014).[41] The variable X_s^G is a measure of Germany's industrial capability and outsourcing potential by sector at the time of accession. It includes alternative measures such as

[41] We keep the number of controls to a minimum to avoid the problem of bad controls as German influence is likely to affect the outcome indirectly through various channels that we will discuss.

sector-level exports, output, investment, wages, employment, and outward FDI, each measured in the pre-accession period.

The main coefficient of interest is β_2 which corresponds to the interaction between the post-accession dummy and the pre-determined sector-level measure of Germany's potential to influence the Polish manufacturing sector. Equation (1) can be viewed as a difference-in-differences specification, where all firms are treated after EU accession but with a different "intensity of treatment" given by their sector exposure to Germany's industrial capability and outsourcing potential. Standard errors are clustered at the sector level.

Equation (1) is estimated using a linear fixed effect estimator (OLS). When considering export participation, a linear probability model is used. Standard errors are clustered at the sector level. For robustness, we consider several alternative specifications.

We further perform placebo tests where replace Germany's industry-level measures by analogous measures for Russia, Ukraine and Lithuania. In each of these cases, we would not expect to observe positive effects on firm performance following EU accession.