Product Market Regulation: Extending the Analysis Beyond OECD Countries

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ABSTRACT/RESUMÉ

Product market regulation: extending the analysis beyond OECD countries

In this paper the recently updated product market regulation (PMR) indicators are extended to a larger set of countries including several non-OECD members. It investigates regulatory patterns in this extended set of countries as compared to the OECD countries and analyses the link between regulation and growth. On average, regulation is more restrictive of competition in non-member countries than in the OECD area. However, there exists considerable heterogeneity within this country grouping as concerns the level of the regulatory stance and its composition as well as the potential past evolution of regulatory processes. Furthermore, growth regressions provide evidence that less restrictive product market regulation is conducive to growth. An improvement of ½ index points of barriers to entrepreneurship would translate into approximately a 0.4% higher average annual rate of GDP per capita growth. However, the results also suggest that for countries that are less advanced, the potential growth benefits of enhancing product market competition may be impaired by other structural weaknesses. In particular, some restrictions of foreign trade and investment might be beneficial for growth in early stages of development.

JEL codes: K20; L51; 011; 043.
Keywords: product market regulation; growth regressions.

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La réglementation des marchés de produits : étendre l'analyse au-delà des pays de l'OCDE

Dans cet article, les indicateurs de réglementation des marchés de produits, qui ont été récemment mis à jour, sont étendus à de nombreux pays, dont plusieurs pays non-membres. Cet article examine la réglementation dans cet ensemble de pays et analyse le lien entre la réglementation et la croissance. En moyenne, la réglementation est plus restrictive pour la concurrence dans les pays non-membres *vis-à-vis* de la zone OCDE. Toutefois, il existe une hétérogénéité considérable au sein de ce groupe de pays en ce qui concerne le niveau de réglementation et sa composition ainsi que l'évolution potentielle des processus de réglementation dans le passé. En outre, des estimations économétriques mettent en évidence qu'une réduction des obstacles à la concurrence est favorable à la croissance. Une amélioration d'un ½ point des obstacles à l'entrepreneuriat se traduirait par un taux annuel moyen de croissance du PIB par habitant qui serait d'environ 0,4% plus élevé. Cependant, les résultats suggèrent également que pour les pays moins avancés dans leur développement économique, les avantages potentiels de croissance résultant d'un renforcement de la concurrence sur les marchés de produits peuvent être altérés par d'autres faiblesses structurelles. En particulier, certaines restrictions au commerce international et à l'investissement étranger pourraient être favorables pour la croissance dans les premiers stades de développement.

Codes JEL : K20 ; L51 ; 011 ; 043.
Mots clés : réglementation du marché des produits ; estimations économétriques.

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PRODUCT MARKET REGULATION: EXTENDING THE ANALYSIS BEYOND OECD COUNTRIES

By Anita Wölfl, Isabelle Wanner, Oliver Röhn and Giuseppe Nicoletti [1]

1.   Introduction

1.   The role of product market policies for competition has been a central part of OECD analyses over the past decade. This document draws on recent updates of indicators of product market regulation (PMR) and additional work made in the context of OECD country surveys, to extend previous analysis of patterns in product market regulation (Wölfl *et al.,* 2009) to countries that were candidates for OECD accession at the time of writing – Chile, Israel, Estonia, Slovenia, Russia (henceforth called "accession countries") and a number of non-member economies, including prominently countries that are in a process of enhanced engagement with the OECD – Brazil, India, China, Indonesia and South Africa (henceforth called "enhanced engagement countries")[2]. Throughout the paper, the PMR indicator values refer to the most recent year for which data were available to construct the PMR indicators (Table A1 provides a detailed overview of data coverage). Hence, they may not fully reflect the current regulatory stance in some (fast-reforming) countries.

2.   The paper also looks at the linkage between such regulation and economic growth in this broader set of countries. Indeed, the wide country and period coverage, which extends over 1998-2008, makes it possible to further explore the linkages between cross-country differences in GDP per capita growth and economy-wide regulatory approaches as captured by the OECD PMR indicator. In particular, this paper analyses to which extent the impact of product market reform may differ across countries depending on their state of economic development.

3.   The following main results emerge from extending country coverage of the PMR indicator and investigating its linkages to growth:

- On average, regulation is more restrictive of competition in accession countries, enhanced engagement and other non-member countries than in the OECD area. Moreover, regulation in enhanced engagement countries is considerably more restrictive than in most accession countries.

- There is, however, a large variety of regulatory settings among the accession, enhanced engagement and other non-member countries surveyed in this paper, with for instance Estonia,

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[2]   Throughout this paper, the country groups refer to the situation as of December 2009 with OECD representing 30 OECD member countries. Since then, Chile, Israel and Slovenia have become full members of the Organisation. The data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Slovenia and Romania being close to settings found in the average OECD country, and China, Russia, Israel and Ukraine being significantly more restrictive.

- The structure of product market regulation also varies across accession, enhanced engagement and other non-member countries:

  − The enhanced engagement countries, Israel and Ukraine are characterised by uniformly restrictive regulation across the areas of state control, barriers to entrepreneurship and barriers to trade and investment covered by the OECD PMR indicator.

  − State control and barriers to trade and investment also remain relatively high by OECD standards in Russia and Croatia.

  − In Chile, Estonia, Slovenia, Bulgaria and Romania, barriers to entrepreneurship and barriers to trade and investment are at a level close to the OECD average, though state control remains above the OECD average in the latter two countries.

- Overall, the cross-country growth regressions examined in this study provide some evidence that easing unnecessary regulatory restrictions is associated with subsequent higher rates of growth in GDP per capita. However, the results suggest also that for countries that are less advanced, the potential growth benefits of enhancing product market competition may be impaired by other structural weaknesses.

- The correlation between pro-competitive policies and growth appears to be mainly driven by measures that lower barriers to entrepreneurship and competition, whose link with growth is found to be robust across specifications and for the whole set of countries. An improvement in the barriers to entrepreneurship indicator by ½ index point, corresponding roughly to the difference between the value of barriers to entrepreneurship of most enhanced engagement countries and the one of the average OECD country, would translate into approximately a 0.4% higher average annual rate of GDP per capita growth over the subsequent decade.

4.   The paper is structured as follows: Section 2 describes the patterns of product market regulation at the aggregate and detailed level for the accession countries as well as for the enhanced engagement and other non-member countries. Section 3 uses the large dataset of OECD, accession and non-OECD countries to analyse potential linkages between product market regulation and growth of GDP per capita.

2. Patterns of product market regulation

5.   OECD product market regulation (PMR) indicators (Box 1) have been extended to include a large sample of OECD member and non-member economies, notably accession and enhanced engagement countries. Country coverage now includes the 30 OECD member countries (three points in time, 1998, 2003, 2008), the five accession countries (data for 2008 only; 2003 and 2008 for Chile), the five countries in enhanced engagement with the OECD (Brazil, China, India, Indonesia, South Africa; one year each; 2003 and 2008 for Brazil) and four additional non-member countries (Bulgaria, Croatia, Romania and Ukraine, one year each).[3] The main purpose of this section is to use this enlarged set of indicators to compare recent patterns of regulation in this additional set of economies with those prevailing in the OECD area.

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[3]   See the Annex for detailed country coverage. PMR indicators for Croatia, Bulgaria and Romania were constructed by the World Bank, based on the OECD questionnaire and methodology in the context of ongoing collaboration between the two international organisations.

2.1 Product market regulation in Chile, Israel, Estonia, Slovenia and Russia

6. Regulations inhibiting competition, as captured by the OECD PMR indicator (see Box 1, as well as Wölfl *et al.* 2009) are, on average, higher in accession countries than in the OECD area (Figure 1).[4] To assess whether differences in PMR scores across countries are indicative of significant differences in economy-wide regulatory approaches, Figure 1 plots confidence intervals around the PMR scores (these result from attributing weights randomly to the sub-indicators entering each aggregate regulatory domain, see Box 2). A country is said to be characterised by relatively restrictive regulation as compared to the OECD average if the lower bound of the confidence interval of this country is above the mean across the OECD countries.

Box 1. The standard economy-wide PMR indicator

Since the end of the 1990s, the OECD has been constructing a system of indicators, termed PMR indicators, to document the stance of product market regulation in OECD countries.[1] The basic idea of the PMR indicators is to turn qualitative information as concerns laws and regulations that may affect competition into quantitative indicators. They aim at measuring regulations that are potentially anti-competitive in areas where competition is viable, and focus on policy settings instead of market outcomes.

The economy-wide PMR indicator which is the focus of this section covers both general and sectoral regulatory issues in the domains 'state control', 'barriers to entrepreneurship' and 'barriers to trade and investment' (Wölfl et al, 2009). These indicators are built in a bottom-up approach that makes it possible to trace the indicator scores back to individual policies (see figure below). The qualitative information on which the indicators are based is mainly derived from answers to a questionnaire by national administrations, the results of which are subject to peer review, thereby guaranteeing a high level of comparability across countries. This information is coded by assigning a numerical value to each of the possible responses to a given question. The coded information is normalised over a scale of zero to six, reflecting increasing restrictiveness of regulatory provisions for competition and aggregated into low-level indicators at the bottom of the indicator tree. At each step up the indicator tree, higher-level (composite) indicators are calculated as weighted averages of their lower-level indicators using equal weights for aggregation.

In 2008, the indicator system was substantially revised to preserve its policy relevance in light of evolving regulatory and competition issues in OECD countries.[2] The "integrated PMR indicator", on the basis of which comparisons between accession countries and OECD countries are performed, integrates previously separate sectoral indicators and embodies thus to a much larger extent than in the past information on sector-specific regulation.[3] This enables and facilitates the analysis of changes in individual (economy-wide or sectoral) regulatory policies in OECD countries and their impact on the overall regulatory stance.

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7. Figure 1 suggests that regulatory approaches vary widely across accession countries. For instance, Estonia is estimated to have a business environment that is relatively liberal by OECD standards as reflected in a PMR score that is not significantly different from the OECD average; regulatory environments in Chile and Slovenia are slightly, but significantly stricter than the OECD average; and Israel and Russia are considerably more restrictive than the average OECD country.

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4   The indicator used here is the "integrated PMR" of Wölfl *et al.* (2009), (see Box 1 for details).

The tree structure of the economy-wide PMR indicator

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1. For more details on the OECD PMR indicator system see Nicoletti _et al_. (1999), OECD (1999), Conway and Nicoletti (2006), Conway _et al_. (2005), Wölfl _et al_. (2009). The OECD PMR indicators are an essential element in the indicator base from which the Going for Growth policy priorities are drawn. The data and indicators are available at www.oecd.org/eco/pmr.
2. For details on this revision, see Wölfl _et al._ (2009).
3. The sectoral indicators that are integrated into the economy-wide indicator include the indicators of regulation in non-manufacturing sectors (Conway and Nicoletti, 2006), which cover _i)_ energy, transport and communication industries, with time series from 1975 to 2007; and _ii)_ retail trade and professional services, with values for 1998, 2003 and 2007. They also include the OECD FDI Regulatory Restrictiveness Indicator that has a high level of sectoral detail over the 1981-2006 period (Golub, 2003, Koyama and Golub, 2006).

Figure 1. Product market regulation in accession and OECD countries, aggregate level, 2008[1,2]

Index points from 0 to 6 (least to most restrictive)
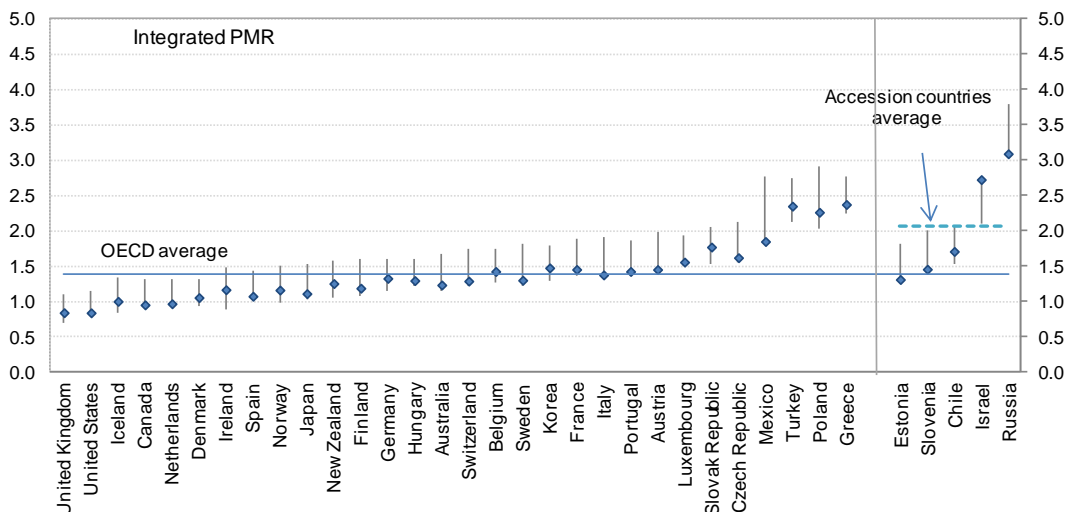
1. Based on the "integrated" PMR indicator (see Box 1 and Wölfl _et al.,_ 2009). Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

2. 90% confidence intervals based on the "random weights" approach (see Box 2)

Source: OECD Regulatory Database.

8.   As concerns individual areas of regulation, the larger incidence of state control in most accession countries when compared to the OECD average (Figure 2) suggests that government interference in business decisions is still significant in these countries, with the exception of Estonia. In Russia, government's relatively strong influence on businesses takes all forms captured by the PMR indicator, i.e. extensive public ownership in both competitive and network industries, as well as price controls and use of command and control regulations. Israel's higher level of state control is due to strong involvement in publicly-owned enterprises, as well as use of command and control regulation. In Slovenia, stronger state control than in the OECD average reflects a more widespread presence of publicly-controlled enterprises, together with a stronger degree of involvement in these enterprises. In Chile, state control on business enterprises is due to a larger set of price controls and the use of coercive instead of incentive-based regulations.

9.   In the other regulatory areas covered by the PMR indicator, the accession countries except Russia and Israel come close to, or are even below, the OECD average. Estonia and Slovenia appear to have been particularly successful in easing barriers to entrepreneurship. This is reflected in fewer restrictions across all forms of barriers, *i.e.* opacity of regulation, administrative burdens for enterprises and barriers to entry in network sectors and other services. In the case of Russia and Chile, there appears to be further scope for reducing administrative burdens on business start-ups. Concerning barriers to trade and investment, Estonia, Slovenia and Chile are close to, or even below, the OECD average in all areas - *i.e.* tariffs, barriers to FDI and regulatory barriers – save for discriminatory procedures in Chile, which seem to be more widespread than in the average OECD country.

Figure 2. Decomposition of PMR in accession countries, 2008 [1]

Index points from 0 to 6 (least to most restrictive)
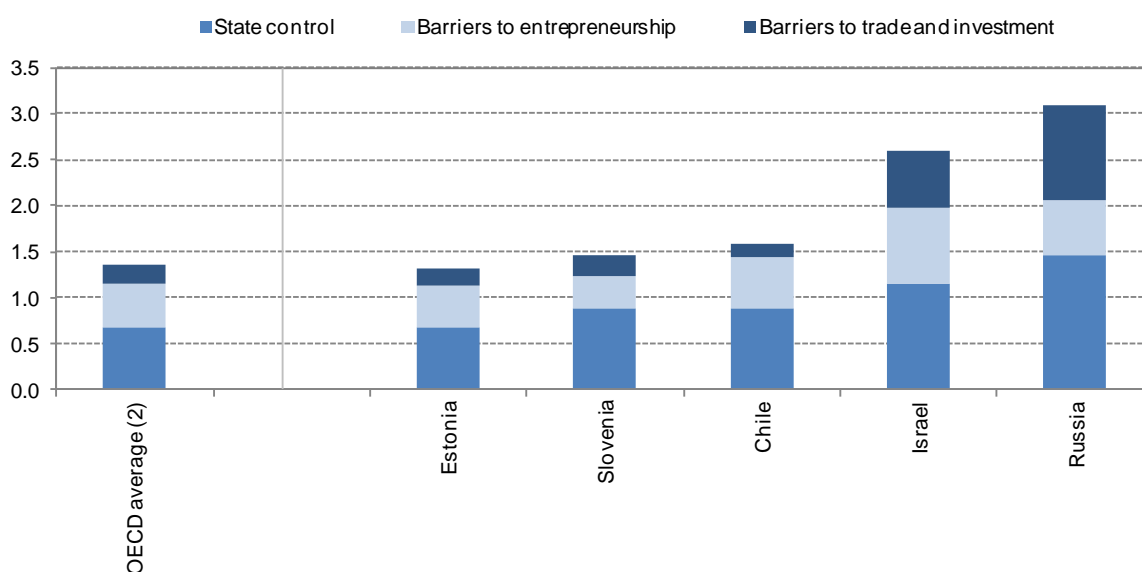
1.   Based on the "integrated" PMR indicator of Wölfl et al. (2009). Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

2.   Simple average.

Source: OECD Regulatory Database.

Box 2: Computation and interpretation of confidence intervals based on random weights

The random weights algorithm assigns weights between zero and one, drawn from a uniform distribution, to each low level indicator and calculates the higher level indicator (after rescaling weights for the sum to be equal to one). This exercise is repeated 10 000 times, and the 90% confidence intervals are obtained by dropping the lowest and highest 5% of the resulting values.

One of the most frequent uses of random weights is to distinguish country groups according to their respective level of regulation. A country is characterised by a relatively liberal regulation if the upper bound of the confidence interval of this country is below the mean value across the OECD countries. Conversely, a country is said to be characterised by relatively restrictive regulation if the lower bound of its confidence interval is above the mean across the OECD countries.

Random weights provide an indication of the sensitivity of the final PMR values to changes in weights. The width of the confidence intervals also reflects to some extent the degree of heterogeneity or consistency of policies within countries. If countries have similar scores for each of the low-level indicators, the confidence intervals will be relatively narrow. In contrast, larger intervals may result for those countries with a larger variance across the sub-level indicators. It has to be noted that – as for the values and thus the ranking of countries – also the width of the confidence intervals depends on the nesting structure characterising the composite indicator (see Figure in Box 1).

2.2 Regulation in emerging and non-OECD transition countries

10. Figure 3 compares the regulatory stance of enhanced engagement and other non-member countries with the ones of accession countries and the average OECD country. Due to issues of data availability for enhanced engagement and other non-member countries, these comparisons are based on a simplified PMR indicator as described in Box 3. However, the correlation between the standard and simplified indicators is around 98% (see Annex for a more detailed comparison). Figure 4 shows the gaps in regulation between these countries and both the OECD and the accession country averages.[5] A positive (negative) gap indicates that a country has a more restrictive (liberal) environment than the average.

Box 3. A simplified PMR indicator

For data availability reasons, providing a general picture of PMR for a large sample of OECD and non-member countries requires such comparisons to be based on a "simplified PMR indicator". It is "simplified" as it is based on a smaller set of data as compared to the standard economy-wide PMR indicator presented above for OECD and accession countries.

For instance, the PMR data collection on most enhanced engagement and other non-member countries had been undertaken based on earlier versions of the PMR questionnaire which did not yet include as much information on sector-specific regulation as in the most recent PMR questionnaire. There is, hence, not sufficient information available to estimate the components of sector-specific regulation (crossed out and in white in the tree structure below) that feed into the standard ("integrated") PMR on which the above analysis is based.[1]

Furthermore, the data collection for most of these non-member countries other than the accession countries has been done in a rather de-centralised way, implying that the questionnaires have sometimes been tailored to reflect country specificities. Thus, in a number of cases comparability required to reduce the information set to a minimum common denominator (see Annex for details).

The simplified PMR indicator is computed for all countries, including OECD and accession countries. Given the data limitations, comparability between OECD member and non-member countries as well as with results presented above based on the integrated PMR is ensured as far as this was possible: The simplified PMR indicator attempts to compute the remaining 15 low-level indicators from which the aggregate PMR score is computed in the same way as is done in the "integrated" PMR presented above and uses equal weights to aggregate low-level indicators (see Annex for a detailed comparison of the simplified and the integrated PMR indicator.)[2]

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[5] Differences in the methodology between this simplified and the standard (integrated) PMR indicator imply slight differences in the average score of the indicator for OECD and accession countries relative to values shown in previous figures.

Tree structure of the simplified PMR indicator

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1. Information allowing to compute "integrated" PMRs for some of the enhanced engagement countries is being assembled in the context of preparatory work for the 2011 issue of OECD Going for Growth.

2. This implies also that the resulting PMR indicators for non-member countries may differ slightly from the ones published in OECD surveys for these countries.

11.   Three main features emerge from these comparisons:

- enhanced engagement countries are characterised by regulatory approaches that are significantly more restrictive than approaches in both the average OECD and accession country;

- most of the other non-member countries for which data are available also show regulatory environments that are significantly less favourable to competition than those of the average OECD country;

- however, regulatory gaps of the other non-member countries *vis-à-vis* the OECD vary a lot, with Romania and Bulgaria closer to accession country gaps and Croatia and Ukraine closer to enhanced engagement gaps.

12.   Breaking down overall PMR into regulatory domains provides a similar picture (Figure 5). The enhanced engagement countries are generally characterised by more restrictive regulation across all regulatory domains as compared to the average OECD country, while the regulatory approaches of other non-member countries such as Bulgaria and Romania show relatively strong state control but relatively low barriers to entrepreneurship and trade and investment. The regulatory structures of these two countries seem hence to be more similar to the ones of Chile, Estonia, and Slovenia as described above. By contrast, in Ukraine restrictions to trade and investment resemble or exceed those found in enhanced engagement countries.

Figure 3. Product market regulation in enhanced engagement and other non-member countries [1,2,3,]

Aggregate level, 2008, in index points from 0 to 6 (least to most restrictive)
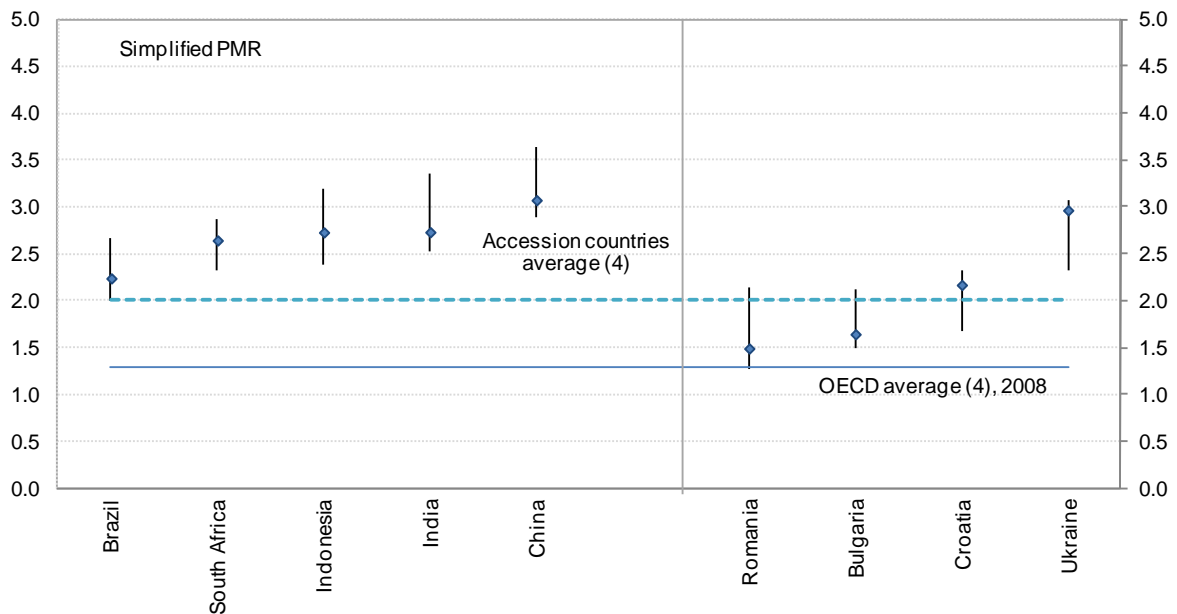
Figure 4. Regulatory gap in enhanced engagement and other non-member countries vis-à-vis OECD and accession countries [1,2]

Aggregate level, 2008, in index points from 0 to 6 (least to most restrictive)
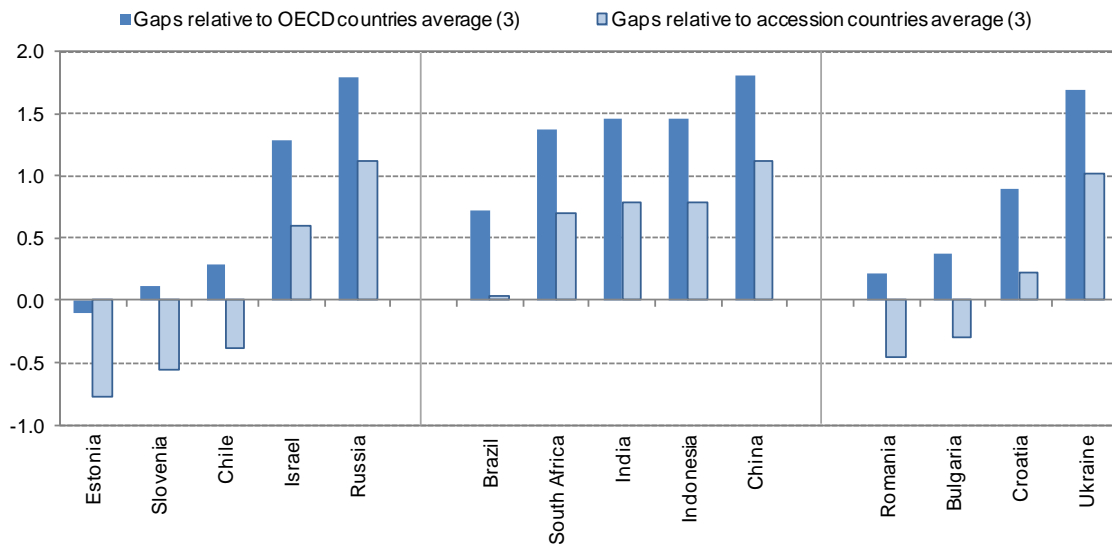
1. Based on a "simplified" PMR indicator (see Box 3). Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

2. Information for Romania, Bulgaria and Croatia collected by the World Bank using the OECD questionnaire and methodology.

3. Simple average.

Source: OECD Regulatory Database.

Figure 5. Decomposition of PMR in enhanced engagement and other non-member countries, 2008[1]

Index points from 0 to 6 (least to most restrictive)
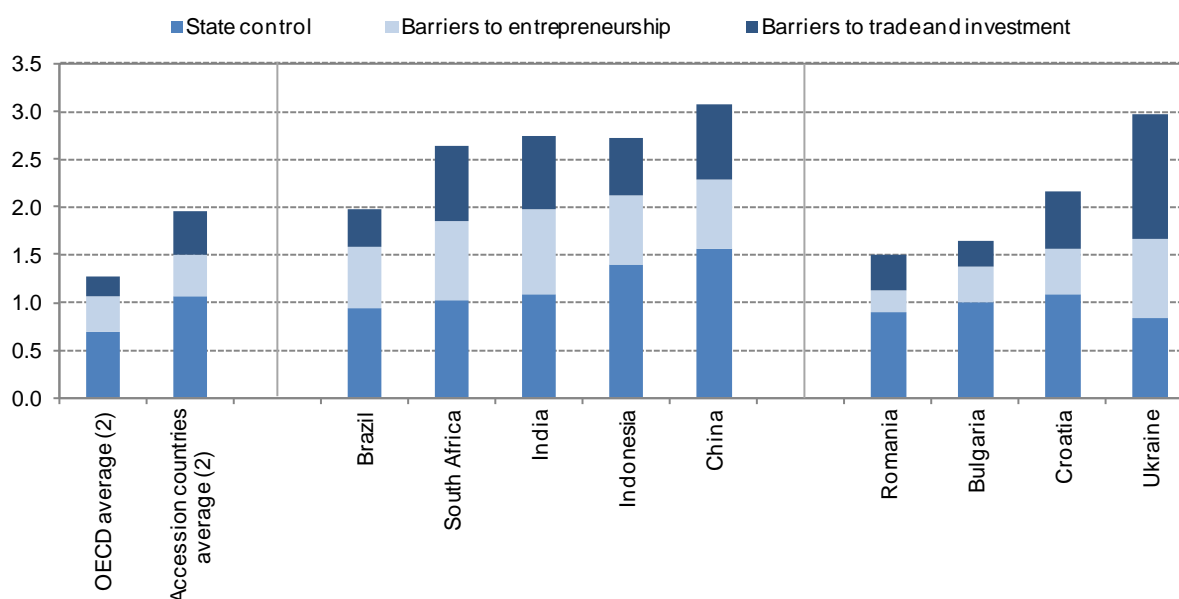
1. Based on a "simplified" PMR indicator (see Box 3). Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

2. Simple average.

Source: OECD Regulatory Database.

13. In enhanced engagement countries the higher level of state control is mainly due to more widespread public control of business enterprises and a stronger use of coercive instead of incentive-based regulations. The main source of the higher overall level of barriers to entrepreneurship differs, however, across enhanced engagement countries. In India and Brazil, it is due to heavy administrative burdens for setting up enterprises. In Indonesia, it is due to a large number of sectors in which entry is restricted by law. In South Africa, it reflects a very burdensome licensing and permits system. The enhanced engagement countries are also relatively restrictive in the barriers to trade and investment captured by the PMR indicator.

2.3. Differences in the extent of product market regulation – some comparative statics

14. The PMR scores of accession countries, enhanced engagement and other non-member countries suggest that, with some exceptions, product market regulation is more restrictive of competition in those countries than in the OECD area. Unfortunately, lack of historical data for non-OECD countries makes it impossible to trace such differences to past product market reform patterns. However, given differences in initial economic conditions, institutional settings and in the pace of integration in the world economy, it is legitimate to expect lags in the reform process of non-member economies relative to implementation of product market reforms in OECD countries.[6]

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6.   For instance, barriers to trade and investment remain highest in countries that have either joined the WTO relatively late (South Africa, China, Croatia, Ukraine) or are still in the process of joining (Russia). For

15.   One way to assess this is to compare the regulatory environment of accession and other countries in 2008 with that which could be observed in OECD countries in 1998 (Figure 6). Comparison of gaps relative to the OECD averages in both 1998 and 2008 can help to highlight the evolution of regulatory approaches in accession and other countries, with positive (negative) gaps indicating more (less) restrictive regulatory approaches than in the average OECD country. Moreover, comparing the upper and lower bounds of the confidence intervals around the PMR values with the 1998 and 2008 average level across OECD countries helps to indicate whether cross-country differences in regulatory environments are significant.

16.   On average, the regulatory stance in accession countries and other European non-member countries in 2008 is as restrictive as the one of the OECD countries in 1998. However, differences can be observed across countries: In Estonia, Slovenia and Chile, as well as Romania and Bulgaria, 2008 regulatory environments were less restrictive than those prevailing in 1998 in the average OECD country, though to different degrees and not for all countries significantly so.[7] By contrast, in Israel, Russia, the Ukraine and in all enhanced engagement countries except Brazil, regulatory environments in 2008 were still significantly more restrictive than in the average OECD country in 1998. In other words, even if these countries had started regulatory reforms about ten years earlier, they would still be among the group of countries that are characterised with a very restrictive regulatory environment.[8]

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overviews of factors that can influence product market reforms in OECD countries, see Høj *et al.* (2006, 2007), Castanheira *et al.* (2006) or Wölfl *et al.* (2009), as well as OECD (2009d).

[7]   In the case of Slovenia, this may relate to a gradualist reform approach and some reform fatigue after EU accession (OECD, 2009c).

[8]   Information concerning the speed and depth with which the additional countries covered in this study have reformed regulations in the past is not available. The assumption here is that these countries would have implemented such reforms in the same way as observed in the average OECD country.

Figure 6. Regulation in accession and non-member countries in 2008 *vis-à-vis* 2008 and 1998 OECD averages[1]
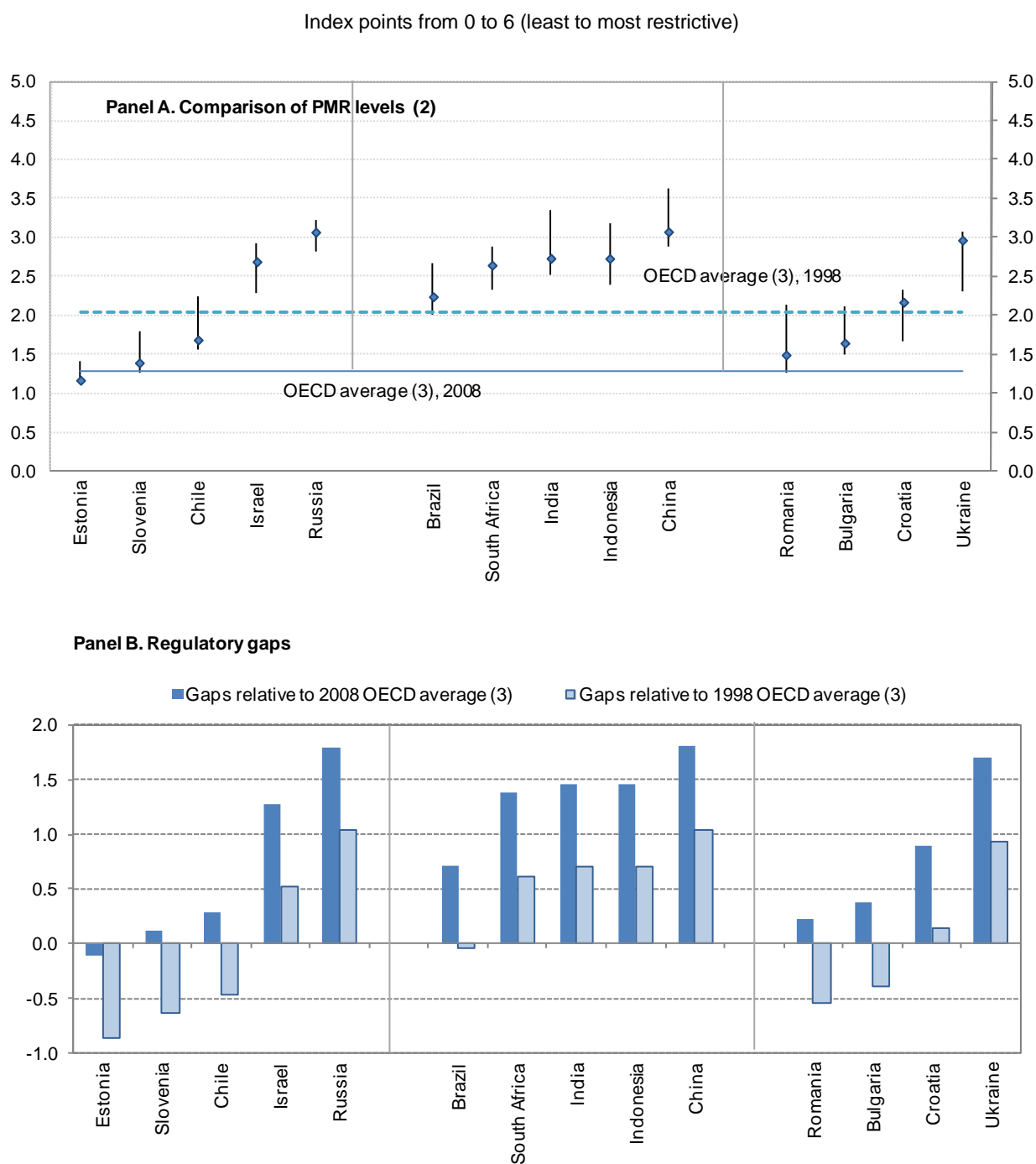
Index points from 0 to 6 (least to most restrictive)

Panel A. Comparison of PMR levels (2)

OECD average (3), 1998

OECD average (3), 2008

Estonia Slovenia Chile Israel Russia Brazil South Africa India Indonesia China Romania Bulgaria Croatia Ukraine

Panel B. Regulatory gaps

■ Gaps relative to 2008 OECD average (3) □ Gaps relative to 1998 OECD average (3)

Estonia Slovenia Chile Israel Russia Brazil South Africa India Indonesia China Romania Bulgaria Croatia Ukraine

1. Based on a "simplified" PMR indicator (see Box 3). Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

2. 90% confidence intervals based on the "random weights" approach (see Box 2).

3. Simple average.

Source: OECD Regulatory database.

17.   These results are confirmed by tests of significant differences that use the so-called Country-Product Dummy (CPD) approach (Table 1). In contrast to the random weights approach that controls for potential errors due to weights, the CPD approach controls for potential measurement errors in the data that underlies the indicators (see Box 4).

Box 4. The Country-Product-Dummy approach (CPD)

The CPD approach was originally developed by Summers (1973) and revived by Diewert (2005) and Prasada Rao (2005), among others, for the computation and statistical comparison of product price indexes across time, countries and products (hence the name). Applied to the PMR, its main assumption is that each country has a given level of regulatory restrictiveness which is not directly observable. However, one can observe a number of measures of regulatory restrictiveness drawn from a population of policies and this observed low level indicator is determined by a country specific term, a policy-specific term that captures the relative levels of each low-level indicator across countries and an error term. Assessing differences in the restrictiveness of policies across countries consists then basically in regressing the low-level indicators on a set of country-time and policy dummies as in the following equation:

$$low\_level\_ind_{cti} = \alpha_{1998,c} C_{1998,c} + \alpha_{2003,c} C_{2003,c} + \alpha_{2007,c} C_{2007,c} + \beta_i P_i + \varepsilon_{cti}, \qquad (1)$$

where c, t and i are country, time and low-level policy indexes; the left hand side variable is the value of each low level indicator at a certain time in a given country; the right hand side contains only dummy variables, *e.g.* $C_{1998,c}$ will take the value of 1 for country C and year 1998, and P_i represent policy dummies. The estimated α coefficients will reflect the country specific level of overall regulation in a given year. Statistical tests on $\alpha_{YEAR,A} > \alpha_{YEAR,B}$ can evaluate whether country *A*'s policies were significantly more restrictive than country *B*'s in a given year.

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18.   Based on Table 1, the CPD results confirm previous insights, namely:

- First, there are strong differences in regulatory stances across accession and non-member countries. Regulatory environments in Chile, Estonia, Bulgaria and Romania, are close to OECD standards - as reflected in PMR scores that are not significantly different from the OECD average, while in Israel and Russia, as well as the enhanced engagement countries, regulatory environments are significantly more restrictive than in the OECD average country.

- Second, many of the countries that are significantly more restrictive than the OECD average country in 2008 would show regulatory approaches that are still significantly more restrictive if compared to the OECD average in 1998.

- Third, similar results are obtained, independent of whether the analysis is based on the integrated or the simplified PMR indicator (for countries in which both indicators are available).

Table 1. Significant differences in PMR *vis-à-vis* OECD average – CPD[1]

| | Integrated PMR vis-à-vis OECD average in | | Simplified PMR vis-à-vis OECD average in | |
	2008	1998	2008	1998
Chile	(+)	(-)	(+)	(+)
Estonia	(-)	(-)***	(-)	(-)***
Israel	(+)***	(+)*	(+)***	(+)*
Russia	(+)***	(+)*	(+)***	(+)**
Slovenia	(+)	(-)***	(+)	(-)**
Brazil			(+)***	(+)
China			(+)***	(+)***
India			(+)***	(+)***
Indonesia			(+)***	(+)**
South Africa			(+)***	(+)**
Bulgaria			(+)	(-)
Croatia			(+)**	(+)
Romania			(+)	(-)
Ukraine			(+)**	(+)

1) Country Product Dummy approach (see Box 4). ***; **; * denote statistical significance at the 1%, 5% and 10% levels, respectively. Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

Source: OECD Regulatory Database.

3. Product market regulation and growth in a large set of countries over the past decade

3.1 Potential role of PMR for GDP per capita convergence[9]

19.   Figure 7 suggests that GDP per capita in several accession and other non-member countries has been catching up rapidly towards the OECD average from low initial per capita incomes over the past decade. China, Estonia and, to a lesser extent, also Ukraine, Bulgaria, Romania, Russia and India, experienced particularly fast convergence.[10] Slovenia was characterised by an already relatively high per capita income at the outset of the transition process, but has enjoyed continued growth which enabled it to move further toward the OECD average. Convergence in other accession or enhanced engagement countries, such as Brazil, Chile, Indonesia and South Africa, has been much more subdued, or altogether absent.

[9]   GDP per capita refers to GDP per working age population (15-64 years) throughout the remainder of the paper.

[10]   Figure 7 plots convergence patterns up to the year 2007. It does not capture the current downturn - and hence – possible divergence patterns in the more recent years as can for instance be observed for Estonia since 2006 (OECD, 2009b).

Figure 7. GDP per capita convergence among OECD and selected non-OECD countries

PPP, (current international $)
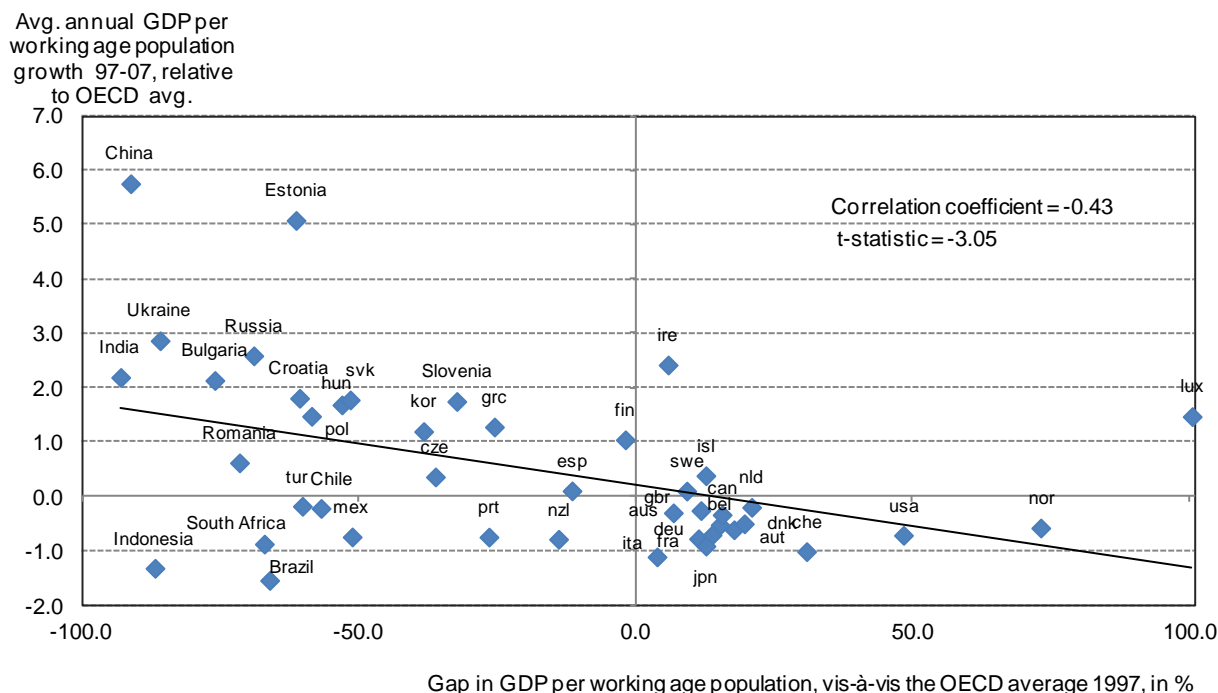
Source: OECD Regulatory database, World Bank, World Development Indicators.

20.   While many factors may be responsible for these differential developments, in the light of growing evidence linking competition to growth (see *e.g.* Aghion and Griffith, 2005), it is legitimate to expect that product market conditions may have had an influence on convergence of GDP per capita levels. Indeed, *prima facie* evidence suggests that there is a strong negative correlation between regulations that restricted competition in the earliest period for which PMR data are available and GDP per capita levels of OECD and non-OECD countries in 2008 (Figure 8).[11,12]

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[11]   It has to be noted, though, that this link may run in both directions: a liberal stance may be less needed at low levels of per capita GDP. The 10-year lag between PMR and GDP per capita may not be sufficient to rule out reverse causation given the strong persistence in GDP per capita gaps over time. Moreover, the policies that are appropriate for low income countries to encourage investment and facilitate convergence may come at the expense of more rigid product markets (Acemoglu *et al.* (2003) and Aghion and Howitt (2005), see also Chang (2003)).

[12]   For OECD countries, PMR indicators are available as of 1998 but for non-member countries regulatory data go back in time only to more recent periods (see section 2.1 as well as the annex for a detailed country coverage of PMR).

Figure 8. GDP per capita and initial PMR[1]

PMR 1998

GDP per working age population, PPP (constant 2005 international $), 2007
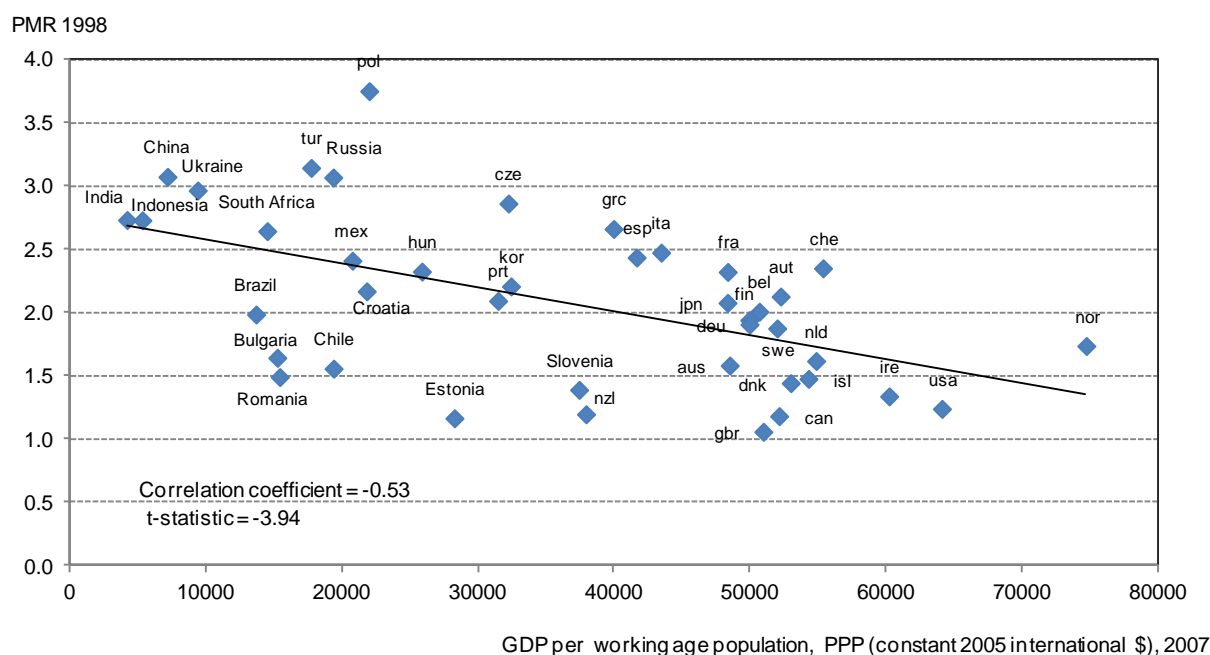
1. Based on a "simplified" PMR indicator (see Box 3). PMR measured in 1998 for OECD countries; 2008 for candidate for accession countries, Brazil and China; 2007 for Croatia, Indonesia, South Africa and Ukraine; 2006 for Bulgaria, India and Romania. Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

Source: OECD Regulatory database, World Bank, World Development Indicators.

3.2   PMR and growth in GDP per capita

21.   The extended time and country coverage of the economy-wide (simplified) PMR indicator makes it possible to investigate the relationship between product market regulation and growth in GDP per capita. This section presents results of standard growth regressions with the PMR indicator featuring among the policy and institutional factors affecting GDP per capita growth.[13] In order to allow for the large number of growth determinants suggested by different growth models, including a range of so-called endogenous growth theories, Bayesian Model Averaging (BMA) techniques have been applied (Box 5). The growth regressions are estimated both for the cross-section of countries over the whole sample period (1998-2007) and for the same countries splitting the sample into two sub-periods (1998-2002 and 2003-2007). In both setups, using beginning of period or sub-period PMR allows for possible lags between regulation and growth in GDP per capita and helps mitigating possible endogeneity problems.[14]

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[13]   Despite this extended time and country coverage, the overall number of observations is still relatively small and PMR data for non-member countries are often only available for one year, with different years for different countries. These limitations still restrict somewhat the scope for regression analysis.

[14]   However, reflecting data limitations, beginning of period PMR for non-OECD countries corresponds to the earliest available PMR data point.

Box 5: The model set-up to analyse the impact of regulation on GDP per capita growth

To test the hypothesis that product market regulations impact economic growth the following Barro (1991) type growth regression is estimated:

$$y = \alpha + \beta * PMR + \delta * X + \varepsilon \,, \tag{1}$$

where *y* is the average annual GDP growth rate per person aged 16-64 over a particular time period; PMR is the product market regulation indicator at different levels of disaggregation; and *X* is a matrix of control variables. Equation (1) is estimated using two different setups. The first setup is a cross section over the entire time period, *i.e.* with the dependent variable (*y*) being the average growth rate per person over the period 1998-2007. The second setup consists in estimating equation (1) over two cross sections, where the dependent variable is the GDP growth rate over the two non-overlapping sub-periods (1998-2002 and 2003-2007).[1]

In order to allow for a large number of growth determinants suggested by different growth models, including a range of so-called endogenous growth theories, Bayesian Model Averaging (BMA) techniques have been applied (see *e.g.* Sala-i-Martin *et al.* 2004 and Fernandez *et al.* 2001a for seminal contributions). The variables chosen in the BMA regressions are standard variables used in growth regressions based on country samples that cover – like in this paper – countries of different levels of development (see the annex for a detailed description and definitions of the full list of the variables included in the analysis).

BMA can accommodate both a relatively large number of controls and a small number of observations and accounts for the so-called *model uncertainty* associated with the process of selecting the control variables. Ignoring such model uncertainty can result in biased parameter estimates, overconfident (too narrow) standard errors and misleading inference and predictions (Draper, 1995). Taking model uncertainty seriously implies a departure from conditioning on a particular model and instead calculating quantities of interest by averaging across different models. BMA allows examining a large number of models, weighing each model according to a fitness criterion, and providing a probability distribution for each coefficient estimate. To judge the effectiveness of a regressor in explaining growth, the interpretation of the results follows a rule of thumb proposed by Jeffreys (1961) and refined by Kass and Raftery (1995). According to this rule, the evidence of a regressor having an effect is weak, positive, strong, or decisive if the posterior inclusion probabilities lie between 50-75%, 75%-95%, 95%-99% or are greater than 99%, respectively (see the annex for a detailed description of the BMA approach including the contentious choice of priors in Bayesian analyses see).

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1. As for non-member countries only one observation of regulation is available, the panel regressions assume that for those countries PMR did not change between the two sub-periods.

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22.   In general, the results in Table 2 are broadly in line with previous research based on cross-section databases as concerns the implied 1.6% rate of (conditional) GDP per capita convergence as well as the coefficient estimates for investment.[15] However, population growth and human capital accumulation are not significant in any regression. This result may be due to smaller heterogeneity in terms of population growth and human capital among the countries in this sample as compared to the sample underlying standard growth regressions.

23.   Aggregate product market regulation is found to significantly affect growth in the cross-section regression only (Table 2). In short, those countries that had relatively liberal regulation in 1998 are estimated to have grown faster in average GDP per capita terms over the subsequent decade. Taking these results causally, the coefficient estimates indicate that, all else equal, a reduction in the overall indicator by

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[15]   Mankiw *et al.* (1992) find a rate of convergence between 1.4% and 2% depending on the sample used; their estimates for the investment rate are between 0.01 and 0.02 and, for population growth, they are between -0.02 and -0.03. In contrast to the model in Mankiw *et al.* (1992) in which the dependent variable is total growth over the whole observation period, in this paper the dependent variable is measured as the average annual growth rate.

½ index point, which would be roughly equivalent to moving from the average PMR scores of accession countries to the average score of OECD countries in 1998, would translate into a 0.3% higher average annual rate of growth of per capita GDP.[16] There is no significant effect of aggregate PMR on growth if the regressions are run for the panel instead of the cross-section, though. As shown below, this results mainly from a composition effect.

Table 2. Regulation and growth in GDP per capita, aggregate PMR – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.016 ***	99.4	-0.011 *	77.1
Ln(population growth)	-0.003	21.5	-0.005	21.9
Ln(investment/GDP ratio)	0.032 **	95.9	0.035 ***	99.4
Secondary enrollment ratio	0.000	19.1	0.000	10.6
Ethnic fragmentation	-0.002	21.1	-0.001	8.8
Government consumption	0.000	26.8	0.000	8.5
Inflation	0.000	21.4	-0.001 *	81.8
% of land area in tropics and subtropics	-0.033 **	98.4	-0.031 *	94.3
Rule of Law	0.000	14.1	-0.005 +	55.0
Domestic credit to private sector	0.000	26.6	0.000	46.5
Crisis dummy			-0.018	48.3
PMR	-0.006 *	79.7	-0.003	45.5
Obs	43		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99

Source: OECD Regulatory database, World Bank, World Development Indicators

24. As shown in Table 3, most of the correlation between PMR and growth appears to be driven by the domain 'barriers to entrepreneurship' (see Box 3 for the definition of the regulatory domains), which is now also significant in the panel setup.[17] Again taking these results causally, the estimated coefficients suggest that an improvement in the barriers to entrepreneurship indicator by ½ index point, corresponding roughly to the difference between the value of barriers to entrepreneurship of most enhanced engagement

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16   These values appear to be very strong. One has to note, however, that it would take substantial reform efforts to change the regulatory environment such that it would reflect a move of the PMR index by half an index point. For a reference, on average, the PMR score of the OECD countries moved from around 2.2 index points in 1998 to around 1.3 index points in 2008.

17   The importance of barriers to entrepreneurship in curbing growth relative to other regulatory domains is consistent with earlier results from industry-level panel regressions of productivity growth (or its determinants) on measures of regulation that were more narrowly focused, but for which longer time series indicators are available (Nicoletti and Scarpetta, 2005; Conway *et al.* 2006, 2007; Aghion *et al.* 2007).

countries and the one of the average OECD country, would translate into approximately a 0.35% to 0.4% higher average annual rate of GDP per capita growth over the subsequent decade.

25.   Once the effects of different regulatory domains are distinguished, product market regulation is also significant in the panel results. This suggests that the aggregate effect of PMR for growth in GDP per capita may be the result of compensating effects on growth of different regulatory domains. Indeed, the effect of 'barriers to entrepreneurship' appears to be offset by the insignificant correlations between 'state control' and growth as well as between 'barriers to trade and investment' and growth. As concerns state control, this is coherent with results from empirical analysis that suggest that privatisation can only bear fruits if it was combined with liberalisation (Megginson and Netter, 2001), though other results have pointed to an independent effect of privatisation as well (Nicoletti and Scarpetta, 2003). As concerns barriers to trade and investment, an insignificant effect may reflect differences in the effect of these barriers for countries at different economic stages of economic development as will be analysed below.[18]

Table3. Regulation and growth in GDP per capita, regulatory domains – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.016 ***	99.8	-0.014 *	89.7
Ln(population growth)	-0.002	14.5	-0.003	14.0
Ln(investment/GDP ratio)	0.031 **	96.7	0.033 **	98.7
Secondary enrollment ratio	0.000	18.7	0.000	9.8
Ethnic fragmentation	-0.004	34.4	-0.001	8.3
Government consumption	0.000	30.1	0.000	8.0
Inflation	0.000	15.1	-0.001 *	81.1
% of land area in tropics and subtropics	-0.028 **	98.3	-0.031 **	96.9
Rule of Law	0.000	9.6	-0.003	38.1
Domestic credit to private sector	0.000	14.5	0.000	40.6
Crisis dummy			-0.018 +	50.0
State control	0.000	17.6	0.000	9.2
Barriers to entrepreneurship	-0.008 *	94.4	-0.007 *	81.5
Barriers to trade and investment	0.000	17.2	0.000	9.6
Obs	43		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99

Source: OECD Regulatory database, World Bank, World Development Indicators

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[18]   Additional results in the annex provide evidence that the results are in general robust to the inclusion of different measures of human capital and a variable capturing *de facto* trade openness.

26. The results in Table 4 indicate that the link between barriers to entrepreneurship and growth is due mainly to the sub-domain 'barriers to competition' - which captures legal barriers to entry and antitrust exemptions (see Box 3 for a description of the detailed regulatory areas within the three domains). No evidence is found that any of the other sub-domains affects growth. Caution, however, is warranted in interpreting these results as the sub-domains are highly correlated in this small sample and thus individual effects on growth may be difficult to identify.

Table 4. Regulation and growth in GDP per capita, disaggregated regulatory areas – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.016 ***	99.9	-0.006 +	55.7
Ln(population growth)	-0.001	10.0	-0.004	17.4
Ln(investment/GDP ratio)	0.020 *	84.1	0.032 **	98.9
Secondary enrollment ratio	0.000	39.2	0.000	19.0
Ethnic fragmentation	-0.003	28.5	-0.001	7.9
Government consumption	0.000	9.7	0.000	3.5
Inflation	0.000	5.3	0.000 +	50.4
% of land area in tropics and subtropics	-0.028 ***	99.4	-0.020 *	80.2
Rule of Law	0.000	6.9	-0.009 *	86.5
Domestic credit to private sector	0.000	8.9	0.000	12.3
Crisis dummy			-0.026 +	68.0
Public ownership	0.000	13.8	-0.001	19.4
Involvement in business operation	0.000	5.7	0.000	2.8
Administrative burdens on start-ups	0.000	20.2	0.000	12.5
Regulatory and administrative opacity	0.000	18.7	0.000	3.3
Barriers to competition	-0.009 ***	99.9	-0.009 ***	99.3
Explicit barrier to trade and investment	0.000	6.5	0.000	3.8
Other barriers to trade and investment	0.000	5.8	0.000	3.5
Obs	43		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99

Source: OECD Regulatory database, World Bank, World Development Indicators

3.3   The impact of PMR dependent on the level of economic development

27.   Does the role of product market regulation differ for countries with different levels of development? Acemoglu *et al.* (2003) and Aghion and Howitt (2005) for instance argue that countries that are relatively less advanced in their development process (and, hence, far from the technological frontier) may reap some limited benefits from policies aimed at achieving rapid capital deepening even if these policies introduce some product market rigidities especially *vis-à-vis* foreign competitors.[19] This would imply that for countries with low GDP per capita, PMR or some elements of it may have no or even positive effects on growth.[20]

28.   Two different approaches are used to test for heterogeneity in the effects of regulation on growth: The first approach consists of running the basic growth equations as above but interacting PMR with the initial level of GDP per capita in order to account for parameter heterogeneity. The second approach uses threshold models that identify regimes (and hence country groups) according to GDP per capita levels in which the impact of PMR on growth are different (see Box 6 for more details).

29.   Tables 5 and 6 present results from the interaction model. In line with the theory, the regression results suggest that PMR and, in particular, barriers to entrepreneurship are more damaging for countries with higher levels of per capita GDP. This is reflected in a significant negative coefficient of the interaction term between PMR and GDP per capita.

30.   Figure 9 plots the composite effect of PMR, i.e. the effect of PMR on growth for different levels of GDP per capita as measured by the sum of the coefficient of PMR and the coefficient of the interaction effect multiplied with the respective GDP per capita level of each country, for all countries of the sample and for those interaction effects that are at least weakly significant. Interestingly, barriers to entrepreneurship seem to hamper growth for all countries of the sample as reflected in a combined effect that always lies below the horizontal axis. In contrast, barriers to trade and investment appear to be beneficial for growth for countries with relatively low initial GDP per capita as reflected in a combined effect of barriers to trade and investment that lies above the horizontal line for countries with an initial per capita income of less than 15 000 US$ PPP.

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[19]   The PMR indicator measures formal regulation and only to a limited extent *de facto* regulation. As such, the PMR may not capture fully the actual regulatory environment in those countries where one can observe a large discrepancy between de facto and de jure regulations. Easing and simplifying formal regulations is nonetheless a pre-condition for improving the business environment, especially *vis-à*-vis foreign investors who are less familiar than domestic ones with such regulations.

[20]   Indeed, Gørgens *et al.* (2005) show in a dynamic regression model that the effect of regulation on growth varies across countries with different levels of development: While lower regulation spurs growth in high income countries, such an effect cannot be observed for low income countries.

Box 6: Analysing the role of PMR for growth depending on the initial level of development

Whether the role of product market regulation differs for countries with different levels of development is tested using two approaches:

The first approach to test for parameter heterogeneity is an interaction model that can be formulated as follows:

$$y = \alpha + \beta_1 PMR + \beta_2 PMR \cdot GDP + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon, \quad (2)$$

where a significant coefficient β_2 presents evidence for parameter heterogeneity and the marginal effect of PMR on growth is given by $\beta_1 + \beta_2 * GDP$, i.e. the marginal effect of PMR varies with the level of GDP per capita. It should be noted, however, that this model assumes that the marginal effect varies *continuously* with the level of GDP per capita.

The second approach applied is the panel threshold methodology developed by Hansen (1999). This approach assumes that the marginal effect of PMR on per capita GDP growth varies *across* regimes, i.e. country groups which are separated by the level of GDP per capita. The marginal effect is, however, assumed constant *within* the regimes. This threshold model to test for potential non-linearities in parameters can be formulated as follows:

For the case of two regimes the following threshold models are estimated:

$$\Delta y = \alpha + \beta_1 PMR + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon \quad if \quad T \le \rho \quad (3a)$$

$$\Delta y = \alpha + \beta_2 PMR + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon \quad if \quad T > \rho \quad (3b)$$

or for the three regime case:

$$\Delta y = \alpha + \beta_1 PMR + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon \quad if \quad T_1 \le \rho \quad (4a)$$

$$\Delta y = \alpha + \beta_2 PMR + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon \quad if \quad T_2 \ge \rho > T_1 \quad (4b)$$

$$\Delta y = \alpha + \beta_3 PMR + \sum_{k=1}^{K} \gamma_k X_k + \varepsilon \quad if \quad T_2 > \rho \quad (4c)$$

where ρ is the threshold variable (log of initial GDP per capita) and T the threshold value that separates the regimes. The threshold value is determined endogenously as follows: First the linear model and the two-regime model are estimated. A grid search with steps of 0.5 % of the distribution is carried out to find the value of the threshold variable that minimises the sum of squared residuals of the estimated two-regime model. Hansen (1999) shows that $\beta_1 = \beta_2$ can be tested using a likelihood ratio test and he proposes to derive the distribution of the test statistic via bootstrapping with repeated random draws with replacements, as it does not follow a standard asymptotic distribution. If the null hypothesis of the linear model is rejected against the two-regime model, a further test of the two-regime model against a three-regime model is carried out (for more details see also Egert *et al.*, 2009).

In contrast to the linear and interaction models presented above, the threshold model does not apply BMA. In order to reduce the number of control variables, only those variables were included that have a posterior inclusion probability equal to or larger than 75% (positive evidence) in either the linear or the interaction models.

Table 5. Regulation and growth in GDP per capita, interaction results, aggregate PMR – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.002	26.9	0.002	29.5
Ln(population growth)	-0.010	41.3	-0.010	36.1
Ln(investment/GDP ratio)	0.033 **	98.7	0.033 ***	99.1
Secondary enrollment ratio	0.000	18.6	0.000	13.1
Ethnic fragmentation	-0.002	23.0	-0.001	14.1
Government consumption	0.000	24.4	0.000	9.5
Inflation	0.000	25.7	-0.001 *	77.4
% of land area in tropics and subtropics	-0.032 ***	99.1	-0.035 **	98.5
Rule of Law	0.000	14.2	-0.005 +	54.4
Domestic credit to private sector	0.000 +	60.7	0.000 +	74.7
Crisis dummy			-0.034 +	74.9
PMR	0.052 *	89.8	0.066 *	91.1
PMR*ln(GDP p.c.)	-0.006 *	93.7	-0.007 *	93.5
Obs	43		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99 Source: OECD Regulatory database, World Bank, World Development Indicators

Table 6. Regulation and growth in GDP per capita, interaction results, regulatory domains – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.004	29.1	-0.002	17.3
Ln(population growth)	-0.010	43.1	-0.004	18.6
Ln(investment/GDP ratio)	0.032 **	98.7	0.034 ***	99.6
Secondary enrollment ratio	0.000	18.0	0.000	10.1
Ethnic fragmentation	-0.005	37.5	-0.001	9.1
Government consumption	0.000	21.7	0.000	5.4
Inflation	0.000	7.8	0.000 +	57.5
% of land area in tropics and subtropics	-0.028 **	98.8	-0.031 **	98.0
Rule of Law	0.000	11.1	-0.004 +	50.4
Domestic credit to private sector	0.000	17.6	0.000 +	56.2
Crisis dummy			-0.042 *	83.2
State control	0.000	4.9	0.001	4.0
Barriers to entrepreneurship	0.042 *	77.0	0.011 +	59.5
Barriers to trade and investment	0.008	19.2	0.045 +	59.6
State control*ln(GDP p.c.)	0.000	5.8	0.000	4.6
Barriers to entrepreneurship*ln(GDP p.c.)	-0.005 *	85.6	-0.002 +	60.3
Barriers to trade and investment*ln(GDP p.c.)	-0.001	18.2	-0.004 +	59.4
Obs	43		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99

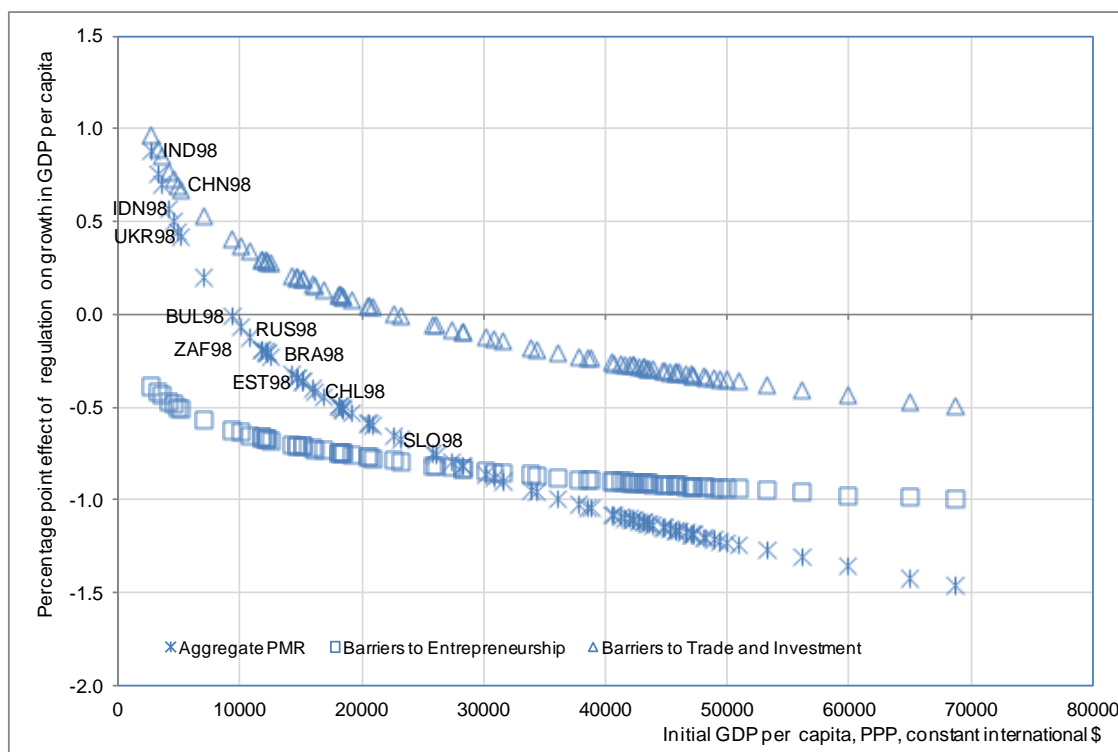Source: OECD Regulatory database, World Bank, World Development Indicators

Figure 9. Effects of PMR dependent on initial GDP per capita

Notes: These effects reflect the percentage point change in average annual GDP per capita growth for a given level of GDP per capita if the index of PMR would change by one index point. They are computed from the coefficients of panel estimations of the interaction model (see Table 5 for the aggregate PMR and Table 6 for the regulatory domains). GDP per capita is measured as GDP per working age population.

Source: OECD Regulatory Database.

31.   The results based on the second approach, i.e., using the panel threshold methodology proposed by Hansen (1999), broadly confirm the findings of the interaction models (Table 7). In both specifications the approach identifies three separate regimes. The aggregate PMR measure is significantly negatively correlated with GDP per capita growth for middle and high income groups with the largest negative effect for the highest income countries in the sample. However, some regulation may be desirable for the lowest income countries as suggested by the significantly positive coefficient in the lowest regime. The disaggregate analysis based on the regulatory domains sheds some more light onto these findings. Barriers to entrepreneurship are the driving force behind the negative relationship between regulation and growth for the highest income group. In contrast, barriers to trade and investment appear beneficial for countries in the lowest income regime. Trade barriers, however, curb growth as the level of development increases, as reflected in the significantly negative coefficient for the middle income regime.[21] Consistent with the previous results, state control *per se* does not appear to have any effect on growth, independent of the level of development.

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[21]   The insignificant coefficient in the highest regime might be due to the limited variability of trade barriers in high income countries.

Table 7a. Regulation and growth in GDP per capita, threshold results I

	Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coefficient with aggregate PMR	**Coefficient with regulatory domains**
Ln(GDP p.c.)	0.006	-0.006
Ln(investment/GDP ratio)	0.055 ***	0.036 ***
Inflation	-0.001 ***	-0.001 ***
% of land area in tropics and subtropics	-0.040 ***	-0.034 ***
Domestic credit to private sector	0.000 ***	
Crisis dummy	-0.028	-0.048 ***
PMR		
Low regime (lngdp p.c. ≤ 9.6)	0.009 ***	
Middle regime (10 ≥ lngdp p.c. > 9.6)	-0.006 **	
High regime (lngdp p.c. > 10)	-0.012 ***	
State control		
Low regime (lngdp p.c. ≤ 9.6)		0.004
Middle regime (10.25 ≥ lngdp p.c. > 9.6)		0.001
High regime (lngdp p.c. > 10.25)		-0.002
Barriers to entrepreneurship		
Low regime (lngdp p.c. ≤ 9.6)		-0.016
Middle regime (10.25 ≥ lngdp p.c. > 9.6)		0.007
High regime (lngdp p.c. > 10.25)		-0.008 **
Barriers to trade and investment		
Low regime (lngdp p.c. ≤ 9.6)		0.014 **
Middle regime (10.25 ≥ lngdp p.c. > 9.6)		-0.013 ***
High regime (lngdp p.c. > 10.25)		0.002
Memorandum:	LR stat. p-value	LR stat. p-value
H0: linear vs H1: 2.regime model	16.342 0	7.661 0
H0:1 regime vs H1: 3.regime model	3.532 0	9.492 0
R^2 adj.	0.65	0.61
Obs.	86	86

Notes: Constant always included but not reported.*, ** and *** denote statistical significance at the 10%, 5% and 1% levels. Standard errors are in parenthesis. P-values are bootstrapped. For details see Hansen (1999).

Source: OECD Regulatory database, World Bank, World Development Indicators

Table 7b. Regulation and growth in GDP per capita, threshold model, country groups

Aggregate PMR			Regulatory areas		
Low regime (lngdp ≤ 9.6)	*Middle regime (10 ≥ lngdp > 9.6)*	*High regime (lngdp > 10)*	*Low regime (lngdp ≤ 9.6)*	*Middle regime (10.25 ≥ lngdp > 9.6)*	*High regime (lngdp > 10.25)*
India (98, 03)	Croatia (98, 03)	Korea (03)	India (98, 03)	Turkey (98)	Portugal (98, 03)
China (98,03)	Estonia (98, 03)	Czech Republic (98, 03)	China (98,03)	Croatia (98, 03)	Slovenia (03)
Indonesia (98, 03)	Poland (98, 03)	Slovenia (98, 03)	Indonesia (98, 03)	Estonia (98, 03)	New Zealand (98, 03)
Ukraine (98, 03)	Chile (98, 03)	Greece (98, 03)	Ukraine (98, 03)	Poland (98, 03)	Spain (98, 03)
Bulgaria (98, 03)	Hungary(98, 03)	Portugal (98, 03)	Bulgaria (98, 03)	Chile (98, 03)	Greece (03)
Romania (98, 03)	Mexico (98, 03)	New Zealand (98, 03)	Romania (98, 03)	Hungary(98, 03)	Finland (98, 03)
Russia (98, 03)	Slovak Rep. (98, 03)	Spain (98, 03)	Russia (98, 03)	Mexico (98, 03)	Italy (98, 03)
South Africa (98, 03)	Korea (98)	Finland (98, 03)	South Africa (98, 03)	Slovak Rep. (98, 03)	Australia (98, 03)
Brasil (98, 03)		Italy (98, 03)	Brasil (98, 03)	Korea (98, 03)	Japan (98, 03)
Turkey (98, 03)		Australia (98, 03)	Turkey (03)	Czech Republic (98, 03)	Ireland (98, 03)
		Japan (98, 03)		Slovenia (98)	Sweden (98, 03)
		Ireland (98, 03)		Greece (98)	France (98, 03)
		Sweden (98, 03)			United Kingdom (98, 03)
		France (98, 03)			Germany (98, 03)
		United Kingdom (98, 03)			Belgium (98, 03)
		Germany (98, 03)			Iceland (98, 03)
		Belgium (98, 03)			Canada (98, 03)
		Iceland (98, 03)			Austria (98, 03)
		Canada (98, 03)			Denmark (98, 03)
		Austria (98, 03)			Netherlands (98, 03)
		Denmark (98, 03)			Switzerland (98, 03)
		Netherlands (98, 03)			United States (98, 03)
		Switzerland (98, 03)			Norway (98, 03)
		United States (98, 03)			Luxembourg (98, 03)
		Norway (98, 03)			
		Luxembourg (98, 03)			
			19 observations	*21 observations*	*46 observations*
20 observations	*15 observations*	*51 observations*			

ANNEX

1.   Integrated and simplified PMR indicators

1.1   Some basic definitions

32.   Reflecting data availability and the purpose of the analysis, product market regulations in different accession and non-member countries are measured using two versions of the economy-wide PMR indicators: the standard (integrated) PMR indicator and a simplified PMR indicator (see Box 1 for more detailed information about the construction and differences between these two versions):

- The comparisons between accession countries and OECD countries are performed on the basis of the "integrated PMR indicator". The integrated PMR is the OECD PMR indicator presented in the *Going for Growth* 2009 publication (see Wölfl *et al.* 2009). It is called integrated because it brings into the economy-wide PMR indicator a large set of information about sector-specific regulations that has not yet been covered in previous generations of the economy-wide PMR. Sector-specific regulation is summarised in two separate sets of indicators: the indicators of regulation in non-manufacturing sectors (NMR indicators) [22] as well as the FDI-restrictiveness index.[23]

- The comparisons of regulations in the larger set of OECD member and non-member countries, including notably enhanced engagement countries, are only possible on the basis of a "simplified PMR indicator", which is based on a much smaller set of data, compared to the standard (integrated) economy-wide PMR indicator. For several non-member countries, the PMR information was collected based on an earlier version of the PMR questionnaire (see Box 3) which did not include as much information on sector-specific regulation as the most recent PMR questionnaire. There is, hence, insufficient information available to estimate the components of sector-specific regulation that feed into the "integrated" PMR. Furthermore, the questionnaires for non-member countries have sometimes been tailored to reflect country specificities; hence for some countries not even the whole set of information asked for in the 2003 questionnaire is available, implying that some components of the PMR indicator had to be estimated. The simplified PMR can be seen as a "maximum common denominator"-PMR using information available for both OECD and non-OECD countries. In order to ensure comparability between OECD member and non-member countries and to increase comparability across indicators for those countries for which both the integrated and simplified indicators can be computed, the components of the simplified PMR for which sufficient data were available are computed so as to reflect as closely as possible the structure and content of the integrated PMR. This implies in particular that the simplified PMR indicator uses equal weighting for aggregation.

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[22]   The NMR indicators comprise regulation in the network sectors Energy (electricity and gas), Transport (air, rail and road transport), and Communication (post and telecommunications) (ETCR) as well as in retail trade and professional services. For more detailed information, see Conway and Nicoletti (2006).

[23]   The OECD FDI regulatory restrictiveness index (FDI-indicator) measures different forms of discrimination against foreign firms, such as *i)* restrictions on foreign ownership, *i.e.* limitations of the share of companies' equity capital in a particular sector that are not applied to domestic firms; *ii)* obligatory screening and approval procedures for foreign affiliates; *iii)* operational constraints or controls for affiliates of foreign companies, including constraints to the mobility of foreign professionals working in these affiliates. For more information, see Golub (2003) as well as Golub and Koyama (2006).

33.   As already mentioned, the main difference between the simplified and the integrated PMR relate to the extent to which sector-specific regulation is covered. Such differences are highlighted as shaded areas in the flow chart in Box 2 of the main text.

Box A1. Two versions of the OECD economy-wide PMR indicator

The economy-wide PMR indicator attempts to transform information on regulation in the areas of state control, barriers to entrepreneurship and barriers to trade and investment into a quantitative (composite) indicator. It is constructed using a bottom-up approach which makes it possible to trace the composite indicator scores back to individual policies. At the bottom, qualitative information based on a standard questionnaire is coded by assigning a numerical value to each of the possible responses to a given question. The coded information is normalised over a scale of zero to six, reflecting increasing restrictiveness of regulatory provisions for competition. These data are then aggregated into low-level indicators at the roots of the indicator tree (see also Box 1) by assigning subjective weights to the various regulatory provisions. At each step up the branches of the tree, higher-level (composite) indicators are calculated as weighted averages of their lower-level indicators using equal weights.

In contrast to regulatory or governance indicators that have been developed by other institutions, the OECD PMR indicators are policy focused and reflect formal laws and regulations instead of opinion surveys that would reflect subjective assessments of market participants. They mostly measure regulations that are potentially anti-competitive in areas where competition is viable, and generally do not reflect market outcomes. The data on which the indicators are based are mainly derived from a survey of member countries, with only a small fraction being based on external data sets, thereby guaranteeing a high level of comparability across countries. Finally, the indicators are subject to peer review by the national administrations of OECD member countries.

The individual regulatory domains and low-level indicators that constitute the aggregate PMR indicator are defined as follows.[1]

The domain **State control** reflects the extent to which governments influence firm decisions through public ownership, price controls or other forms of coercive – instead of incentive-based – regulation. This consists of:

- **Scope of public enterprises:** measures the pervasiveness of state ownership across business sectors as the proportion of sectors in which the state controls at least one firm. (integrated and simplified PMR)

- **Government involvement in network sectors:** measures the extent of public ownership in the energy, communications and transport sectors. (integrated PMR only)

- **Direct control over business enterprises:** measures the existence of government special voting rights in privately-owned firms, constraints on the sale of state-owned equity stakes, and the extent to which legislative bodies control the strategic choices of public enterprises. (integrated and simplified PMR, but for OECD and accession countries this is based on more disaggregated data as compared to other non-member countries)

- **Price controls:** reflects the extent of price controls in competitive sectors, such as air travel, retail trade, road freight, professional services, and mobile communications. (integrated and simplified PMR, but the simplified PMR does not cover price controls in professional services)

- **Use of command and control regulation:** indicates the extent to which government uses coercive (as opposed to incentive-based) regulation in general and in specific service sectors. (integrated and simplified PMR, but the simplified PMR does not cover conduct regulation in professional services)

The domain **barriers to entrepreneurship** reflects obstacles to easy access to information on existing regulation, general or sector-specific administrative burdens for business start-ups and other general or sector-specific regulations that hinder entry of firms. It consists of:

- **Licenses and permits systems:** reflects the use of 'one-stop shops' and 'silence is consent' rules for getting information on and issuing licenses and permits. (integrated and simplified PMR)

- **Communication and simplification of rules and procedures:** reflects aspects of government's communication strategy and efforts to reduce and simplify the administrative burden of interacting with government. (integrated and simplified PMR)

- **Administrative burdens for corporations:** measures the extent of administrative burdens on the creation of corporations. (integrated and simplified PMR)

- **Administrative burdens for sole proprietors:** measures the extent of administrative burdens on the creation of sole proprietor firms. (integrated and simplified PMR)

- **Sector-specific administrative burdens:** reflects administrative burdens in the road transport and retail distribution sectors. (integrated and simplified PMR)

- **Legal barriers:** measures the pervasiveness of barriers to entry across business sectors as the proportion of sectors in which there are explicit legal limitations on the number of competitors. (integrated and simplified PMR)

- **Antitrust exemptions:** measures the scope of exemptions to competition law for public enterprises. (integrated and simplified PMR)

- **Barriers to entry in network sectors:** measures various kinds of entry barriers in network sectors, as well as the degree of vertical integration in energy, rail transport and telecommunication sector. (integrated PMR only)

- **Barriers to entry in services:** measures barriers to entry in retail trade and professional services. (integrated PMR only)

The domain **Barriers to trade and investment** captures barriers to foreign ownership of firms, tariffs and other non-tariff barriers to trade. It consists of:

- **Barriers to foreign direct investment (FDI):** measures general and sector-specific restrictions on foreign acquisition of equity in public and private firms, obligatory screening procedures and operational controls for affiliates of foreign firms (*e.g.* nationality requirement for key personnel). (integrated and simplified PMR; but for OECD and accession countries, sector-specific barriers to FDI are measured by the FDI restrictiveness index)

- **Tariffs:** reflects the average of most-favored-nation tariffs, computed from detailed product data on tariffs. (integrated and simplified PMR; but for OECD countries, tariffs are computed based on more detailed data and more elaborated aggregation as compared to non-member countries)

- **Discriminatory procedures:** reflects the extent of discrimination against foreign firms at the procedural level. (integrated and simplified PMR)

- **Regulatory barriers:** reflects other non-tariff barriers to trade, such as mutual recognition agreements or international harmonisation. (integrated and simplified PMR)

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1. Differences between the standard (integrated) PMR and the simplified PMR that is used for comparisons between OECD member and non-member countries are highlighted within brackets.

1.2   Detailed data coverage

34.   For accession countries, enhanced engagement countries and other non-member countries, the PMR data and indicators were obtained in the following ways:

- The OECD PMR indicators have been recently computed for the five accession countries, Slovenia, Estonia, Israel, Chile and Russia, as well as Brazil and China, using the same (2008) questionnaire and the same methodology as for the OECD member countries.[24]

- PMR indicators have been compiled for several non-member countries over the past five years in the framework of OECD outreach activities or economic assessments. These include Chile (OECD, 2003), Brazil (OECD, 2005a), India (OECD, 2007a), Indonesia (OECD, 2008a), South Africa (OECD, 2008b) and Ukraine (OECD, 2007b). These indicators are computed from information that was collected based on a previous (2003 or 1998) version of the PMR questionnaire and the indicators as they are published in the surveys were originally computed using the PMR methodology of Conway *et al.* (2005).[25,26]

- Finally, the World Bank has collected the information necessary to compute the OECD PMR indicators for Croatia, Bulgaria, and Romania, based on the 2003 PMR questionnaire and the PMR methodology of Conway *et al.* (2005).

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[24] It is envisaged to extend the country coverage for the integrated PMR indicator equally to all enhanced engagement countries in the course of the next full round of the Going for Growth exercise. The data collection and indicator construction is ongoing for India, Indonesia and South Africa.

[25] See Wölfl *et al.* (2009) for a comprehensive comparison of the differences between the old methodology and the currently used integrated PMR indicator.

[26] It has to be noted that the simplified PMR indicator uses the questionnaire replies based on such previous questionnaires, but computes the low-level indicators using the methodology of the integrated PMR indicator. In particular, the simplified PMR indicator uses equal weights for aggregation instead of weights based on principal components analysis that were used in the old methodology of Conway *et al.* (2005).

Table A1. PMR coverage for non-member countries

	Integrated PMR	Simplified PMR	Sources and remarks
Accession countries			
Chile	2008	2008	2008 questionnaire: see table A5.
		2003	1998 questionnaire; OECD Economic Surveys Chile (2003)
Estonia	2008	2008	2008 questionnaire: see table A5.
Israel	2008	2008	2008 questionnaire: see table A5.
Russia	2008	2008	2008 questionnaire: see table A5.
Slovenia	2008	2008	2008 questionnaire: see table A5.
Enhanced engagement countries			
Brazil		2003	2003 questionnaire; OECD Economic Surveys Brazil (2005)
		2008	2008 questionnaire: see table A5.
China		2008	2008 questionnaire: see table A5.
India		2006	2003 questionnaire; OECD Economic Surveys India (2007)
Indonesia		2007	2003 questionnaire; OECD Economic Surveys Indonesia (2008)
South Africa		2006/2007	2003 questionnaire; OECD Economic Surveys South Africa (2008)
Other countries			
Bulgaria		2006	2003 questionnaire: World Bank: Fay *et al.* (2007a)
Croatia		2007	2003 questionnaire: World Bank: De Rosa *et al.* (2009)
Romania		2006	2003 questionnaire: World Bank: Fay *et al.* (2007b)
Ukraine		2006/2007	2003 questionnaire; OECD Economic Surveys Ukraine (2007)

35.   As for OECD countries and for all versions of the PMR indicator, some general rules have been applied concerning the treatment of missing values for non-member countries:

- Some missing values could be filled by drawing on external data sources, notably in the case of particular network sectors, such as telecommunications or energy markets.

- For some non-member countries, none or only partial data was available for the different components that constitute the low-level indicators "administrative burdens for start-ups". In these cases, information from the World Bank Doing Business indicator has been used. For both, OECD and non-member countries, the costs that have to be incurred in order to register a business are adjusted for Purchasing Power Parities (PPP). For those countries for which PPP data was not available from the OECD database, PPP ratios from the World Bank Development Database have been used.

- For OECD countries, average tariffs are computed from very detailed data (*i.e.* from tariff data of the 6-digit level of the Harmonised System product classification) using standard estimation and aggregation techniques. Since the same level of detail was not available for non-members, tariffs for these countries were computed either as simple averages of MFN tariffs (as in Conway *et al.* 2005) or from other sources (*e.g.* tariff data as used in country surveys, such as for Russia).

- For OECD and accession countries, sector-specific barriers to foreign ownership are measured by means of the FDI restrictiveness index.[27] For Romania, Croatia and India the FDI restrictiveness

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[27]   The Investment Division, Secretariat of the OECD Investment Committee, in the Directorate for Financial and Enterprise Affairs, is currently working on an update and extension of this index in co-operation with the OECD Economics Department.

indices were not available. Hence, only information on barriers to foreign ownership in two sectors were covered.

- Applying the same rule as for the OECD countries (Wölfl *et al.* 2009), in some cases missing values could be filled by drawing on replies to earlier questionnaires if this information was available.

- In the few remaining cases in which information was missing, the low-level indicators were computed as weighted average from the available information for each specific low-level indicator. For instance, in the case of Russia, no information was available about regulation in professional services and road freight transport implying that the low-level indicators of the integrated PMR indicator that cover regulations of these sectors are computed as weighted averages of the remaining components for which information is available (*i.e.* price controls, use of command and control regulation, sector specific administrative burdens and barriers to entry in network sectors).

1.3 Integrated versus simplified PMR

36. Both the integrated and simplified PMR indicators can be computed for the OECD countries and the accession countries. Thus, the scores of the simplified and the integrated PMR can be compared for these two groups of countries. Such a comparison is informative for two reasons:

- The main difference between the integrated and the simplified PMR indicator is the coverage of sector-specific regulation. Comparing the two indicators can provide information concerning the role of sector-specific regulation, notably in network sectors.

- Comparing the indicator scores of the simplified PMR indicator with those of the integrated PMR makes it possible to assess the extent to which the simplified PMR indicator can be seen as a good approximation of the integrated PMR indicator. The assessment is important because the regressions presented in the main text and in Section 2 of this annex are based on the scores of the simplified PMR indicator in order to cover the largest possible sample of OECD member and non-member countries.

37. Figure 10 plots the values of the simplified against the integrated PMR for OECD and accession countries for 2008. Two results can be highlighted:

- For most countries, the values of the integrated PMR are higher than those of the simplified PMR indicator. This is consistent with earlier findings for OECD countries (Wölfl *et al.* 2009) that it is notably in several network or competitive services sectors where scope for future reform is most needed. This result does also prevail for the accession countries where the scores for government involvement in network sectors, barriers to entry in network sectors and barriers to entry in other services are close to or higher than those of the average OECD country (Figure 2).

- Despite discrepancies for some countries, the differences between the scores of the simplified and integrated PMR indicator are very small and there is a very strong correlation between these two versions of the economy-wide PMR indicator. These results would seem to support the use of the simplified PMR indicator in regression analysis, even though the integrated PMR constitutes a more complete indicator.[28]

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28   Since it was the aim of this paper to analyse the link between regulation and growth for a large set of OECD member and non-member countries, the regressions that are presented in the main text and in the

Figure 10.   Integrated versus simplified PMR[1]
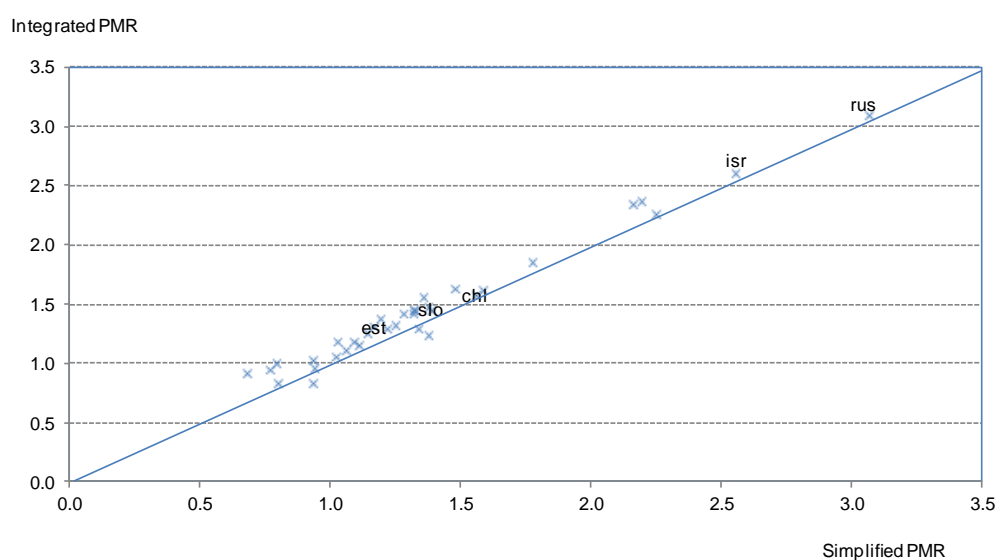
1.   Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

   Source: OECD Regulatory Database.

2.   Bayesian Model Averaging

38.   An advantage of Bayesian Model Averaging (BMA) over other approaches to deal with model uncertainty, such as extreme bounds analysis (Leamer, 1983, Levine and Renelt, 1992), is that BMA is soundly based on statistical theory with all results directly following from elementary probability theory, notably the definition of conditional probability, Bayes' *theorem* and the law of total probability. Intuitively, BMA asks the researcher to specify candidate regressors that are clearly linked to distinct theories. BMA then allows for any sub-set of regressors to appear in a given model. Given the data, BMA first estimates a posterior distribution of each regressor coefficient for every model that includes the regressor. It then combines all posterior distributions into a weighted average posterior distribution, with weights given by the posterior model probabilities.

39.   Here the following regression model is considered, where the dependent variable per capita GDP growth, y, is regressed on an intercept, α, and candidate regressors chosen from a set of k variables in the design matrix X of dimension $n \times k$. Further, β is defined as the full k-dimensional vector of regression coefficients. An $n \times k_j$ submatrix of variables in X is denoted by X_j and M_j the model with regressors grouped in X_j, such that

$$y = \alpha + X_j \beta_j + \varepsilon, \tag{1}$$

annex use the simplified PMR indicators. Regressions run on the sample of countries for which the integrated PMR is available leads to qualitatively similar results, though.

where $\beta_j \in \Re^{k_j}$ $\left(0 \le k_j \le k\right)$ groups regression coefficients corresponding to the submatrix X_j. The exclusion of any given regressor in a particular model implies that the corresponding element in β is zero. Equation (1) can incorporate parameter heterogeneity in the model averaging approach, since interaction terms can be part of the set of regressors *k*.

40.　　　Since BMA allows for any sub-set of variables in *X* to appear in any model M_j, there are 2^k possible sampling models. BMA specifies that the posterior distribution of the slope coefficients β is the weighted posterior distribution under each of the models, $P(\beta \mid y, M_j)$, with the weights given by each model's posterior model probability $P(M_j \mid y)$. The posterior distribution given the data can then be expressed as

$$P(\beta \mid y) = \sum_{j=1}^{2^k} P(\beta \mid y, M_j) P(M_j \mid y).$$
(2)

41.　　　Equation (2) is the fundamental equation of BMA. It states that the posterior distribution of the quantity of interest is only conditional on the data and *not* on a particular model. Inference based on the posterior distribution incorporates information across all possible models.

Table A2. List of variables used in the BMA regressions [29]

Variable code	Description	Source	Growth Theory
lngdp	Ln initial GDP per person aged 15-64	WDI[1]	Solow
lnpopgr	Ln average growth of population 15-64	WDI[1]	Solow
lninvest	Ln of average growth of fixed capital formation as % of GDP	WDI[1]	Solow
secenrolgross	Gross secondary enrolment ratio in 1998. Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialised teachers.[2]	WDI[1], UNESCO	Human Capital
govcons	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.	WDI[1], World Bank NA, OECD NA	Macro Policies
infl	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals.	WDI[1], IMF	Macro Policies
rule	Rule of Law. The extent to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement and property rights, the police, and the courts, as well as the likelihood of crime and violence.	Kaufmann et al. (2008)	Institutions
ethnic	Probability that two randomly selected persons belong to a different ethnic group	Alesina et al. (2003)	Political Instability
kgatrstr	Percentage of land area in tropics and subtropics	CID[4]	Geography
domcred priv	Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, trade credits and other accounts receivable that establish a claim for repayment. For some countries these claims include credit to public enterprises.	WDI[1], IMF, OECD	Financial Development

Note: 1) World Bank World Development Indicators

2) Break in series between 1997 and 1998 due to due to change in International Standard Classification of Education. Recent data are provisional.

3) World Bank staff estimates from various sources including census reports, the United Nations Population Division's World Population Prospects, national statistical offices, household surveys conducted by national agencies, and Macro International.

4) Centre for International Development at Harvard University: Gallup, Mellinger, Sachs geography dataset

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[29]   Another variable that is found to affect growth is infrastructure investment (see Egert *et al.,* 2009, for some empirical evidence). Infrastructure investment is not included among regressors as data are not readily available for several non-member countries.

42.   The implementation of BMA is subject to several challenges and the methods and assumptions to overcome these challenges distinguish the various BMA approaches. The most important challenge is the choice of the prior distribution specification, which is always contentious in Bayesian analysis. BMA requires the specification of two types of priors: (a) *prior model probabilities* and (b) a *prior parameter distribution*. With respect to the prior model probabilities this paper follows the common practice in the growth literature and assumes a uniform distribution over the model space, which expresses each model as equally likely.[30] Under this assumption the posterior model probability simplifies to

$$P(M_j \mid y) = \frac{l_y(M_j)}{\sum\limits_{h=1}^{2^k} l_y(M_h)}, \tag{3}$$

where $l_y(M_j)$, is the marginal (or integrated) likelihood of model M_j. Thus, the posterior model probability can be viewed as a measure of the relative data fit.

43.   Computation of the marginal likelihood requires the choice of parameter priors. Here, the approach of Raftery (1995) and Hoeting *et al.* (1999) is followed, assuming the diffuse Unit Information Prior (UIP) that allows for a simple approximation of the marginal likelihood with the Bayesian Information Criterion (BIC). The BIC approximation is viewed as a conservative fitness measure to evaluate model performance. In a recent paper Eicher et al. (2010) demonstrate that even though the choice of the appropriate prior structure crucially depends on the particular dataset considered, the UIP together with the *uniform model prior* is generally superior in terms of predictive performance to a range of alternative priors suggested in the growth context.[31]

44.   Based on these fundamental assumptions and the corresponding equations, BMA allows to compute several important summary statistics. For instance, the posterior mean and the posterior standard deviation of a particular coefficient are given by:

$$E(\beta_i / y) = \sum_{j=1}^{2^k} E(\beta_{ij} / y, M_j) P(M_j / y), \tag{4}$$

$$Var(\beta_i / y) = \sum_{j=1}^{2^k} (Var(\beta_{ij} / y, M_j) + (E(\beta_{ij} / y, M_j))^2) P(M_j / y) - E(\beta_i / y)^2, \tag{5}$$

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[30]   See *e.g.* Fernandez *et al.* (2001a,b). The uniform prior is a special case of a more general model prior proposed by Mitchell and Beauchamp (1988) in that it assumes the prior probability of the inclusion of a specific regressor is constant across models and equal to 0.5. Sala-i-Martin *et al.* (2004)'s specification of the Mitchell and Beauchamp model prior favors smaller models. Alternatively, Brock et al. (2003) advocate tree-structured model priors that take into account dependencies among regressors.

[31]   Another important choice concerns the selection of a sampling algorithm over the model space. As the number of models increases exponentially with the number of regressors, evaluation of the sum in equation (2) quickly becomes infeasible and sampling algorithms are needed. Fernandez *et al.* (2001a,b) use the Markov Chain Monte Carlo Model Composition (MC3) sampling algorithm developed by Madigan and York (1995) to search the model space, while Sala-i-Martin *et al.* (2004) use a ''stratified'' Coinflip sampler. MC3 is a technique that allows for sampling of complex high dimensional distributions as it simulates a random walk across the search space to converge at a stationary posterior distribution. The method employed in this paper follows Raftery (1995), who suggests the Leaps-And-Bounds-All-Subsets-Regression-Algorithm of Furnival and Wilson (1974) to reduce the candidate model space. The Leaps algorithm performs an exhaustive search for the best subsets of candidate variables for predicting the dependent variable in linear regression; it returns a specified number of best models for each model size. Generally, the qualitative differences based on the different samplers are small but not negligible.

45.	In addition, by summing over all models that contain a particular regressor, $P(\beta_i \neq 0 \, / \, y)$, the *posterior inclusion probability* of that regressor can be obtained. This statistic provides a probability measure of how important a regressor is to explain the dependent variable.

46.	The model specific means $E(\beta_{ij} \, / \, y, M_j)$ and variances $Var(\beta_{ij} \, / \, y, M_j)$ can be conveniently approximated with the maximum likelihood point estimate (MLE) and variance (Raftery, 1995), which is equivalent to the OLS estimates in linear regression models. Using this MLE or OLS approximation together with the BIC approximation for the posterior model probability, the BMA approach used in this paper is substantially similar to the Bayesian Averaging of Classical Estimates (BACE) approach of Sala-i-Martin *et al.* (2004).

47.	The variables chosen in the BMA regressions are standard variables used in growth regressions based on country samples that cover – like in this paper – countries at different levels of development. Table A2 provides a detailed list of the control variables, their data sources and the growth model that each of them represents. Since one domain of the PMR indicator is barriers to trade and investment, trade openness is not included among controls in BMA regressions, though.

## 3.	Robustness checks:

### 3.1.	The choice of the proxy for human capital

48.	An issue arises as to how to measure correctly the stock of human capital that is available within a country, a factor that is likely to have an influence on growth. In practice, the stock of human capital is difficult to measure, notably on a cross-country comparable basis for a large set of countries of OECD and non-member countries.

49.	In the regressions presented in the main text and in this annex, two different types of measures are used in order to proxy for the stock of human capital or its change over time:

- The regressions presented in the main text use secondary enrolment as proxy for the change in the stock of human capital. Being a flow measure of human capital it does not capture the total stock that would have been accumulated in the past in a country. However, if used in growth regressions, it proxies for the change in human capital in the same way as the investment rate proxies the change in physical capital.[32]

- All regressions have also been run by replacing this variable with the percentage of working age population with secondary and/or tertiary education (Lutz *et al.* 2007). This second variable typically requires detailed data on the level of education by age group. It is hence very difficult to construct this variable on a cross-country comparable basis for a large set of OECD and non-member countries and for a time series which would allow to *i)* compute the change in human capital over time or to *ii)* provide the data for the same years for all controlling variables in the regression.[33]

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[32]	Furthermore, enrolment in secondary education does not measure the human capital of the current working age population, but rather the change in human capital of the working age population in future years.

[33]	The measures used in these alternative regressions are based on a dataset by Lutz et al. (2007). This dataset used back projecting methods in order to compute the educational attainment distributions for four categories (no education, primary, secondary and tertiary education) by five-year age groups from 1970 to 2000 for 120 countries. Another study by Morrisson and Murtin (2009) would have provided a longer time

50.   Regressions including these alternative measures are presented in Table A3. In general, the results are relatively robust to the choice of the proxy for human capital. Differences prevail only in the panel specification where human capital as proxied by the percentage of secondary or tertiary education would have a weakly significantly positive effect on growth.

Table A3. Regulation and growth in GDP per capita, alternative measures of human capital - BMA

	Cross section analysis Dependent variable: Average GDP growth per person aged 16-64 Period 1998-2007				Panel analysis Dependent variable: Average GDP growth per person aged 16-64 Period 1998-2003 and 2003-2007			
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.016 ***	99.8	-0.015 ***	99.6	-0.013 *	87.2	-0.008 +	62.0
Ln(population growth)	-0.002	13.8	-0.001	12.2	-0.002	11.6	-0.001	8.0
Ln(investment/GDP ratio)	0.031 **	97.1	0.031 **	97.7	0.035 ***	99.0	0.037 ***	99.5
Ethnic fragmentation	-0.004	34.1	-0.004	31.1	-0.001	7.6	-0.001	8.4
Government consumption	0.000	34.0	0.000	32.4	0.000	9.4	0.000	9.8
Inflation	0.000	14.3	0.000	14.1	-0.001 *	77.3	0.000 +	60.1
% of land area in tropics	-0.028 **	98.5	-0.026 **	96.6	-0.031 **	96.9	-0.020 +	74.0
Rule of Law in 1998	0.000	9.6	0.000	10.0	-0.004	48.0	-0.008 +	70.5
Domestic credit to private sector	0.000	16.6	0.000	13.5	0.000	41.5	0.000	21.5
Tertiary education	0.009	27.8			0.017	34.6		
Secondary and tertiary education			0.005	38.2			0.017 +	67.9
Crisis dummy					-0.023 +	58.0	-0.034 *	75.3
State control	0.000	16.3	0.000	15.6	0.000	7.0	0.000	4.9
Barriers to entrepreneurship	-0.008 *	94.1	-0.007 *	90.6	-0.006 +	73.8	-0.003	47.8
Barriers to trade and investment	0.000	17.1	0.000	14.9	0.000	7.1	0.000	6.0
Obs	43		43		86		86	

Notes: Constant always included but not reported. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99

Source: OECD Regulatory Database.

3.2.   Including trade openness

51.   In the regressions in the main text, the variable 'trade openness' has not been included among controls in BMA regressions testing the linkage between PMR and growth although trade openness is typically perceived as a main driver of growth. The reason for excluding it in the main text is collinearity with the regulatory domains and the resulting difficulties in interpreting the parameter coefficients. Table A4 suggests indeed that collinearity might be a problem as the variable 'trade openness' itself is only weakly related to growth in the panel setup but the probability of inclusion of both barriers to trade and investment and barriers to entrepreneurship is reduced. The latter can be explained as barriers to

series with more recent data, but did not cover all countries of the sample for which the regressions of this paper are run.

entrepreneurship include barriers such as administrative burdens or legal barriers to competition that influence domestic as well as foreign competitors.

Table A4. Regulation and growth in GDP per capita, including trade openness – BMA

	Cross section analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2007		Panel analysis Dependent variable: Average growth in GDP per person aged 16-64 Period 1998-2003 and 2003-2007	
	Coeff	**Post Inclusion Prob.**	**Coeff**	**Post Inclusion Prob.**
Ln(GDP p.c.)	-0.018 ***	100.0	-0.017 **	98.2
Ln(population growth)	-0.002	13.8	-0.004	17.3
Ln(investment/GDP ratio)	0.027 *	92.5	0.024 *	84.8
Secondary enrollment ratio	0.000	25.2	0.000	13.8
Ethnic fragmentation	-0.009 +	56.9	-0.007	37.3
Government consumption	0.000	31.9	0.000	5.1
Inflation	0.000	15.3	-0.001 *	85.2
% of land area in tropics and subtropics	-0.029 ***	99.0	-0.031 **	96.5
Rule of Law	0.000	6.0	-0.002	34.4
Domestic credit to private sector	0.000	8.7	0.000	18.7
Trade Openess (lagged)	0.000	37.9	0.000 +	60.2
Crisis dummy			-0.022 +	61.2
State control	0.000	16.9	0.000	3.4
Barriers to entrepreneurship	-0.004 +	70.2	-0.003	43.1
Barriers to trade and investment	0.000	7.4	0.000	3.7
Obs	42		84	

Notes: Constant always included but not reported. All standard deviations are robust. + posterior inclusion prob. >=50 and <75; * posterior inclusion prob. >=75 and <95; ** posterior inclusion prob. >=95 and <99; *** posterior inclusion prob. >=99;   Lagged trade openness; Luxembourg excluded.

Source: OECD Regulatory database, World Bank, World Development Indicators

4   PMR for accession and enhanced engagement countries, integrated PMR

Table A5. Indicator values, integrated PMR, for accession and enhanced engagement countries[1]

	Chile	Estonia	Israel	Russia	Slovenia	Brazil	China	OECD average
Product market regulation	**1.58**	**1.31**	**2.60**	**3.09**	**1.46**	**1.94**	**3.30**	**1.36**
State control	**2.66**	**2.01**	**3.44**	**4.39**	**2.65**	**2.67**	**4.63**	**2.04**
1. Public ownership	**2.62**	**2.24**	**3.30**	**4.28**	**3.86**	**2.93**	**5.33**	**2.93**
Scope of public enterprise sector	2.45	1.91	3.27	4.64	3.82	2.73	6.00	3.08
Government involvement in infrastructure sector	1.67	2.74	2.96	4.01	3.60	2.25	5.48	3.30
Direct control over business enterprise	3.74	2.07	3.65	4.19	4.15	3.82	4.50	3.20
2. Involvement in business operation	**2.70**	**1.78**	**3.59**	**4.50**	**1.44**	**2.42**	**3.94**	**2.42**
Price controls	1.55	1.25	2.29	5.00	1.69	0.33	4.38	2.64
Use of command & control regulation	3.85	2.31	4.88	4.00	1.19	4.50	3.50	2.53
Barriers to entrepreneurship	**1.65**	**1.40**	**2.48**	**1.78**	**1.08**	**1.97**	**2.89**	**1.42**
1. Regulatory and administrative opacity	**0.31**	**1.15**	**2.21**	**1.00**	**0.16**	**1.93**	**0.25**	**1.55**
Licence and permits system	0.00	2.00	3.00	2.00	0.00	2.00	0.00	1.87
Communication and simplification of procedures	0.63	0.30	1.41	0.00	0.32	1.86	0.50	0.91
2. Administrative burdens on startups	**3.27**	**1.56**	**2.44**	**2.32**	**1.65**	**2.40**	**5.58**	**1.68**
Administrative burdens for corporation	3.50	1.25	2.50	2.33	1.50	1.75	5.25	1.36
Administrative burdens for sole proprietor firms	4.00	1.75	3.00	3.00	2.00	3.00	5.50	1.53
Sector specific administrative burdens	2.31	1.69	1.83	1.64	1.44	2.44	6.00	1.55
3. Barriers to competition	**1.36**	**1.49**	**2.78**	**2.01**	**1.44**	**1.57**	**2.83**	**1.77**
Legal barriers	0.29	0.29	3.16	2.00	1.14	2.86	1.43	1.52
Antitrust exemptions	0.00	0.00	0.00	1.16	0.00	0.00	0.00	1.37
Barrier to entry in network sectors	2.23	2.29	3.36	2.22	2.15	2.43	5.39	1.57
Barrier to entry in services	2.92	3.40	4.60	2.67	2.48	1.00	4.50	1.76
Barriers to trade and investment	**0.43**	**0.52**	**1.90**	**3.11**	**0.64**	**1.19**	**2.37**	**0.63**
1. Explicit barriers to trade and investment	**0.86**	**1.05**	**1.53**	**2.62**	**1.29**	**2.39**	**2.47**	**1.08**
Barriers to FDI	0.32	1.02	1.33	3.50	1.49	1.49	3.22	1.34
Tariffs	0.00	1.00	1.00	3.00	1.00	3.00	2.00	1.31
Discriminatory procedures	2.25	1.13	2.25	1.38	1.38	2.67	2.21	1.08
2. Other barriers	**0.00**	**0.00**	**2.27**	**3.60**	**0.00**	**0.00**	**2.27**	**0.79**
Regulatory barriers	0.00	0.00	2.27	3.60	0.00	0.00	2.27	0.87

1. Countries for which data were available to compute the integrated PMR indicator. Indicator values refer to one particular year and may no longer reflect the current regulatory stance in some (fast-reforming) countries.

Source: OECD Regulatory database, World Bank, World Development Indicators

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