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REGULATION AND GROWTH: THE CANADIAN EXPERIENCE

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ABSTRACT

Economists have long debated the extent to which governments should intervene in economic activities. These discussions were mostly aimed at finding an industrial organization capable of generating the highest efficiency possible in markets where competition cannot play its role adequately and when market failures hinder the natural market forces (Chevalier, 1995). In many cases the optimal industrial organization involves at least some form of government intervention (regulation, public ownership, supervision, etc.). However, sometimes regulation exists despite the absence of any obvious market failure. In such cases, regulation may be detrimental to economic growth and productivity. In particular regulation that curbs the entry of new firms or that controls firms' strategic variables such as price, may severely limit economic growth by lowering competitive pressures faced by incumbent firms or by hindering the introduction or adoption of more efficient new technologies. This may reduce the efficiency with which these firms operate and may limit their incentive for investment, thereby slowing technological progress.

This report aims at identifying the role played by product market regulation on the level and growth of productivity in Canada. More specifically, the report builds a comprehensive database directly from the acts and regulations characterizing the principal regulatory variables that describe three different industries (electricity, natural gas and retail) in each of the ten Canadian provinces. It then builds a 'regulation index' that characterizes the level of regulation in each industry in each province from 1984 to 2008.

Our measure characterizes the liberalization process in both the electricity and natural gas industries and illustrates that there was variation in the timing of deregulation across provinces. In the retail sector there is interesting and important heterogeneity in the evolution of the level of regulatory activity across provinces. In some the level of regulatory activity decreased enormously, while in others it actually increased.

We then link this measure with a measure of labor productivity in an attempt to determine whether there is a relationship between the two. Our results suggest that there is an important link between regulation and productivity in the electricity sector. In the natural gas and retail sectors we find no evidence of such.

RÉSUMÉ

Les économistes ont longtemps débattu du rôle et du niveau d'intervention de l'État dans l'activité économique. À travers diverses recherches, ceux-ci ont tenté d'identifier une organisation industrielle capable de générer la plus grande efficacité possible au sein de marchés où la concurrence n'est pas en mesure de jouer son rôle adéquatement et où des failles entravent les forces naturelles de marché (Chevalier, 1995). Dans plusieurs cas, l'organisation industrielle la plus optimale implique une certaine part d'intervention étatique (règlementation, contrôle de l'État, supervision, etc.). Cependant, parfois, une forme ou une autre d'intervention existe en dépit de l'absence évidente de failles de marché. Dans de tels cas, la règlementation peut nuire à la croissance économique et à la productivité. En particulier, les politiques limitant l'entrée de nouvelles firmes sur un marché ou celles contrôlant les décisions stratégiques des firmes telles que la fixation des prix, peuvent sévèrement limiter la croissance économique en réduisant les pressions concurrentielles et en entravant l'adoption de technologies plus efficaces.

Ce rapport cherche donc à identifier le rôle joué par la règlementation du marché des produits sur le niveau et la croissance de la productivité au Canada. Plus précisément, le rapport s'appuie sur la construction d'une base de données détaillée, extraite directement à partir des lois et des règlements des dix provinces canadiennes encadrant trois industries (électricité, gaz naturel et vente au détail). En utilisant les informations contenues dans cette base de données, un indice de règlementation a été construit pour chaque industrie afin de caractériser le niveau de règlementation dans chaque province, entre 1984 et 2008.

L'indice permet de synthétiser le processus de libéralisation qui s'est déroulé dans les secteurs de l'électricité et du gaz naturel, tout en illustrant l'hétérogénéité dans le timing et l'intensité de la déréglementation entre les provinces. Dans le secteur de la vente au détail, d'importantes différences existent dans l'évolution du niveau de réglementation entre les provinces. Alors que certaines provinces ont accru considérablement l'activité réglementaire au cours de la période étudiée, d'autres ont plutôt diminué largement la rigidité du cadre réglementaire.

Par la suite, ces mesures agrégées de règlementation ont été associées à la productivité du travail dans le but de déterminer si une relation existe entre ces deux variables. Nos résultats suggèrent que le niveau de règlementation est fortement corrélé à la productivité dans le secteur de l'électricité, alors que pour la vente au détail et le gaz naturel, nous ne trouvons pas de telle relation.

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1. INTRODUCTION

In this report, we study the relationship between regulation and productivity. Our focus is Canada and on the period from the mid-1980's until the mid-2000's when the trend throughout the world was towards deregulation.

There has been considerable analysis of the effect of regulation on productivity, both theoretical and empirical. The theoretical results suggest that regulation that curbs the entry of new firms or that controls firms' strategic variables such as price, may severely limit economic growth by lowering competitive pressures faced by incumbent firms or by hindering the introduction or adoption of more efficient new technologies. This may reduce the efficiency with which these firms operate and may limit their incentive for investment, thereby slowing technological progress. By and large the empirical results support these predictions. Most of the empirical work has focused on OECD countries and the effect of regulation therein. There is also a very small number of studies that have looked at this relationship in the context of Canada.

A feature of almost all of the empirical literature is that it is done at the country level. Panels are constructed linking productivity growth in individual countries to the level of regulatory activity that exists. This is reasonable in countries where regulatory decision-making is done at the federal level, but less so in situations where important industries are regulated at the regional level. This is the case in Canada where individual Provinces have considerable autonomy, and where a number of industries are regulated at the provincial level.

Studies that look strictly at the federal levels of regulatory activity and productivity may therefore be misleading. More specifically, in many studies of this kind, in countries where the level of regulatory activity varies across regions, the normal practice is to use the level of regulatory activity in the most populous province. In Canada, the most populous province is Ontario. Basing analysis just on Ontario ignores any information related to the level regulation in the nine other Canadian provinces, despite the fact that significant differences exist across the country. Disregarding these differences inevitably leads to a bias in the measurements of regulation at the national level and raises significant doubts on any results derived.

Another feature of most empirical studies of the effect of regulation on productivity is that the regulatory variable is almost always constructed via survey analysis. Industry players are invited to respond to surveys testing for the level of regulation in their industry. Rather than adopting this approach, we have developed a measure of regulation by directly identifying legislative reforms from the acts and regulations of each of the Canadian provinces. By doing so, we are able to go back in time and build a database containing the state of regulation for each of the ten Canadian provinces starting in 1984 and up until 2008. This strategy has the advantage of allowing us to remove from the data any form of questionnaire bias and assuring us that the variables will be encoded in the most objective manner possible. The data are therefore representative of the legislative environment in which the firms evolve.

We focus on three industries: electricity, natural gas, and retail. The Canadian context offers an excellent framework to study regional differences in regulation since the provinces have very heterogeneous policies and regulation, especially in these three markets.

Our conclusions show that in Canada, the regulatory framework is not a significant barrier to an enhanced level of productivity in the retail and natural gas market. However, in the electricity sector, the level of regulation is negatively and significantly linked to the level of productivity.

The rest of the report proceeds as follows. In the next section we review the empirical literature studying the relationship between productivity and growth. In Section 3 we describe our data set. We explain the collection strategy used to construct our measure of regulatory activity and the data used to characterize productivity. In this section, we also provide descriptive statistics on the evolution of both productivity and regulation across provinces in each of our three industries. Section 4 offers a quick overview of market trends in regards to regulation and productivity. In Section 5 we present results and analysis. Finally, Section 6 concludes.

2. EMPIRICAL EVIDENCE

Empirical evidence confirming theoretic results linking product market regulation (PMR) to economic performance was rather scarce before the second half of the 1990's. Difficulty surrounding the collection of quality and objective data on the level of regulation and on the competitiveness of the economic environment across countries explains in large part this lack of analysis. However, significant progress has been made in this regard and recent empirical investigations have lead to advancement in the understanding of the impact of PMR on growth and productivity. Most of these macroeconomic studies have identified PMR as an obstacle to economic and productivity growth mainly through its effect on market structure, on incentives for firms inside the market, and on the natural process of creative destruction.[1]

One of the earliest studies examining the macroeconomic evidence linking regulation to economic performance is Koedijk and Kremers (1996). Their study employs both a statistical analysis and a simple cross-sectional approach on a sample of eleven European countries to find a negative and significant relationship between both GDP per capita and total factor productivity growth, and PMR. Further investigation has been more comprehensive in an effort to confirm that the results are not specific to a European context.

For example, Djankov *et al.* (2006) use the business regulation database of the World Bank (Doing Business) to construct an aggregate index of business regulation for a sample of 135 countries. Their results demonstrate that the effect of a more business-friendly environment on growth is positive even after controlling for potential endogeneity (that is, there could be unobserved factors that explain growth and that are correlated with having a more business-friendly environment). Concretely, improving from the lowest to the highest quartile in terms of business regulation generates a 2.3 percentage points increase in average annual growth of GDP per capita. Concretely, for a country showing a growth rate of 1% initially would register a 3.3% growth rate of GDP.

Jalilian, Kirkpatrick and Parker (2007) make use of a World Bank dataset of 117 countries to explore the impact of regulatory structures on growth based on two different techniques of estimation (cross-sectional and panel data methods). Their empirical results from both empirical approaches also strongly suggest a positive link between regulatory quality and economic growth. More precisely, a change of one unit of the aggregate regulatory index is associated with an average increase of 0.6 to 0.9 percentage point in economic growth.

Gorgens *et al.* (2003) model a more complex relationship between economic performance and regulation. They introduce a non-linear fixed effect model to evaluate the relationship between growth and regulation. The results suggest a variable effect of regulation as the level of

[1] In this literature review we will focus on the impact of regulation on GDP and productivity growth. However, a lot of studies focus on the influence of regulation on other measures of economic performance. See for example: employment (Berger and Daninger, 2005), recession length (Bergoeing *et al.*, 2004) and variance of economic performance (Aghion *et al.*, 2005).

regulation increases. Indeed, high levels of regulation lower growth, but this effect fades as the level of regulation diminishes. More specifically, a change from high to moderate regulation has a substantial effect on growth. However, the authors find no evidence that further deregulation has any effect on growth. These findings have led research towards investigation of the conditionality of the relation between regulation and economic growth. Focus will be given to the following question: are regulation reforms as efficient in countries with poor quality governance as in countries where the quality of institution is markedly higher?

In response to this question, Loayza *et al.* (2004) study the macroeconomic impact of regulation by examining its effect on economic growth and volatility and controlling for the quality of governance and institutions. Making use of six data sources,[2] they construct a unique state-of-the-art database containing indices to measure the regulatory burden for 76 countries. Their results, based on a cross-sectional approach, confirm the hypothesis that regulation has a harming effect on economic performance. However, when controlling for quality of governance results indicate that the negative association between economic growth and regulation is mitigated by the quality of the institutional environment.[3] Moreover, at the maximum level of governance quality, regulation seems to have no impact at all on economic growth. When estimating the importance of regulation on economic performance, they show that if a country's overall index increases by one standard deviation and its level of governance is equal to the world median, then its annual growth rate of GDP per capita would drop by 0.4 percentage point.

In a subsequent study, Loayza *et al.* (2005) examine the effect of regulation on economic growth and on the relative size of the informal sector, again conditional on the quality of governance and institutions. Making use of the same database as Loayza *et al.* (2004), they show that economic growth is negatively and statistically correlated with the overall index of regulation as well as with the labor and product market indices but not with the fiscal regulation index. However, like Loayza *et al.* (2004), they find that these effects were mitigated with the improvement of the overall institutional framework.

One important paper in the assessment of the effect of regulation on productivity is the work of Nicoletti and Scarpetta (2003) who study the link between multifactor productivity and regulation using a panel of 18 OECD countries over the period of 1984-1998. They exploit the heterogeneity of the product market regulatory environments in the OECD to show that a negative and significant relationship exists between economy-wide PMR and multifactor productivity. Nicoletti and Scarpetta (2003) also conclude that the detrimental effect of excessive regulation is mainly due to the slowing down of technological catch-up of the least productive country towards the technological frontier. They introduce a concept of

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[2] Namely Doing Business (The World Bank Group), Index of Economic Freedom (The Heritage Foundation), Economic Freedom of the World (The Fraser Institute), Labor Market Indicators Database (M. Rama and R. Artecona, 2000), The Corporate Tax Rates Survey (KPMG), and International Country Risk Guide (The PRS Group).

[3] The authors estimate the quality of governance by averaging the values of indicators measuring the absence of corruption in the political system, the prevalence of law and order, and the level of democratic accountability. These data are taken from the International Country Risk Guide.

convergence by adding that the further the industry or country is from the technological frontier and the reform leader the greater they benefit from liberalization of markets and state retrenchment. By decomposing PMR, the authors also identify that the lower the proportion of state control and entry barriers, the faster the process of catch-up takes place in manufacturing industries through the diffusion of technological advancement. Moreover, the results suggest that privatization is associated with productivity gains and technological catch-up by increasing the competitive environment and firms' incentives.

Conway *et al.* (2006) use a comparable approach and reach similar conclusions to Nicoletti and Scarpetta (2003). They examine the relationship between PMR and the convergence of labor productivity growth in a sample of 21 OECD countries between 1978 and 2003. They find that the level of PMR affects negatively the process by which positive productivity shocks spread from one country to the other and the integration of new technologies in the generation. More specifically, an excessive regulatory burden might hinder productivity convergence by two principal channels. First, PMR is an important determinant of investments in information and communication technology which in turn is a fundamental driver of productivity convergence. By way of simulation, the authors estimate that the proportion of investment in ICT to total investment would rise, on average, by 2.5 percentage points if the countries would adopt the same regulatory framework of the least restrictive OECD country in each of the industries. Second, restrictive regulation deters the establishment of foreign subsidiaries by multinational enterprises, reducing the international diffusion of technologies and therefore the spread of productivity shocks.

These studies highlight the role that regulation plays in limiting technological diffusion and the consequences for productivity growth. However, while technology is perhaps the main channel by which the regulatory environment affects firms' productivity growth, competition is the main force behind the incentives to invest and to innovate. Empirical evidence is now accumulating towards the positive effects of competition on productivity growth principally by the way of creative destruction predicted by the Schumpeterian model but also by forcing technological leaders to innovate in order to keep their privileged position in the market.

Griffith *et al.* (2006) exploit the reforms carried out under the Single Market Programme (SMP) in the European Union to estimate the effect of regulation on competition, innovation, R&D and ultimately productivity. Using an unbalanced panel of 9 countries between 1987 and 2000, they find that regulation is associated with increased competition and productivity. More specifically, SMP reforms increased substantially product market competition, which in turn increased innovation and productivity growth through augmentation of R&D investment intensity. In fact, the results suggest that an increase of 1 percentage point in R&D intensity is associated with a 0.6 percentage point increase in TFP growth.

Cincera and Galgau (2005) reach similar conclusions while using a two-step procedure to evaluate the effect of product market reform in Europe on macroeconomic performance and more precisely on labor productivity growth. They first estimate the impact of deregulation on firm entry and exit rates while controlling for country and industry specific characteristics such as entry barriers. In the second stage of the estimation, they evaluate the relationship between

firm entry and exit rate and different economic measures such as employment, R&D investment and labor productivity growth. Their results suggest a positive relation between firm entry and exit rates and labor productivity and employment growth. For example, a 1percentage point increase in firm entry and exit rates increases labor productivity growth by 0.6 percentage point per year.

WHAT DO WE KNOW ABOUT REGULATION AND GROWTH IN CANADA?

Based on the empirical results from Conway *et al.* (2006), Conway and Nicoletti (2007) draw certain conclusions regarding the specific case of Canada. First, they note that while economic growth has been impressive for the past decade, labor productivity growth has been rather mediocre for the Canadian economy. These disappointing results come from past regulatory reforms that have not achieved their goals of encouraging a competitive environment particularly in certain non-manufacturing industries such as electricity, railroad transportation, postal services, etc. In the Canadian context, regulation has hindered adoption in new technologies which in turn has negatively impacted productivity. In their simulation exercise, Conway and Nicoletti estimate that the proportion of Information and communications technology investment in total investments would rise from 19 to 21% if the Canadian regulatory reforms between 1977 and 2003 in the networking and other services industries would have brought the regulatory environment at the same level as the most liberal countries in the OECD. Consequently, Canada would have experienced a 1% higher annual productivity growth.

Gu and Lafrance (2008) in a study on the evolution of some regulated industries in Canada find that the sectors where deregulation took place were the ones that experienced the biggest shift in productivity growth. For example, over the 1977-2003 period, productivity growth in the rail transportation, broadcasting and telecommunications and the financial intermediation and insurance carriers sectors in Canada were higher than the business sector average. Meanwhile, during the same period, cultural industries (publishing, data processing and information services; motion pictures and sound recording industries), where there was less deregulation, showed little productivity gains. Finally, while undergoing relatively important deregulation the air transportation industry experienced lower productivity growth but was affected by the recession of 1990, the effects of the 9/11 attack on air transportation and the surge in oil prices. In the second part of the study, a comparison between the Canadian industries and their U.S. counterparts exhibit that the industries that went through the most deregulation showed productivity growth higher or comparable than in the United States. This was the case for broadcasting and telecommunications, transportation (except air transportation) and financial services industries. Again, the cultural industries, much more regulated than in the United States showed little productivity growth compared to their U.S. counterparts.

3. DESCRIPTION OF THE DATA

In this report we develop a database that will allow us to characterize the evolution of the level of PMR in each of the Canadian provinces over the last three decades in three industries: electricity, natural gas, and retail. To our knowledge, this is the only study to characterize economic regulation discrepancies across the Canadian provincial jurisdictions. While enormous work has been done in building international indices, particularly through the OECD PMR program, to our knowledge, very little attention has been paid to regional differences and in particular in the Canadian context, to provincial differences.

There are two main reasons to focus on regional rather than international differences in the study of PMR effects on economic performance. The first relates to the way in which the indices of regulation at the national level are built and to the studies that stem from these indices. As mentioned in the Introduction, in countries where legislative powers are not under the hands of a single administrative level, PMR indices are typically built by summarizing the regulatory information of the whole country. More specifically, for countries with a federal structure data are often selected to reflect the degree of regulation of the most populous states, provinces, or region (see Conway and Nicoletti, 2006 for a discussion). Therefore, the PMR index will ignore any information related to the level of regulation in the other jurisdictions, even when significant differences exist across the country. Ignoring these differences inevitably leads to a bias in the measurements of regulation at the national level and raises significant doubts on the results derived from the use of these indices. Consequently, since Canada is a federal state where the legislative powers are distributed over two levels of legislature (the federal and provincial governments), it appears clearly that it is not well suited for international studies.[4]

The second reason is linked to the characteristics of the analytical framework derived from the international PMR indices. Following the path dependence theory of North (2005), two economies shall generally resort to different institutional frameworks in order to generate similar economic incentives. In so far as the regulatory framework is an integral part of the institutional framework, an identical regulation could therefore have diverse effects in different social, cultural, economic, and political contexts. In this regard, assuming that the relation estimated between regulation and productivity in international studies applies for all the countries studied is too much of a strong assumption.

Therefore, a regional analysis in a country such as Canada permits a social, political, and economic context that is much more homogenous. In other words, the assumption that a reform should have a similar effect on productivity across jurisdictions is more reasonable at a national than international level. Following this discussion, one will understand that while this

[4] Amongst other things, the federal government has general supervision over key industries such as telecommunication, aviation, postal services, etc. However, the provinces still have significant power over certain aspects of PMR since many industries or segments of industries fall within their responsibilities. This is the case for agriculture, energy, natural resources, retail, and to some extent transport.

approach allows to target with more precision the link between regulation and economic performance, its interpretation has to remain in the Canadian context.

3.1 COLLECTION STRATEGY

Unlike the usual methods for building PMR indices, our methodology does not rely on the distribution of a questionnaire to industry or government authorities. Instead, we extract information directly from the acts and regulations of each of the Canadian provinces in order to identify legislative reforms. The data are therefore representative of the legislative environment in which the firms evolve. This strategy allows us to remove from the data any form of questionnaire bias and assures us that the variables will be encoded in the most objective manner possible.

The coding strategy involves three steps. First, the acts and regulations overseeing the industries of interest are identified. This is done mainly by surveying the websites of various government agencies, and by communicating with government employees. Following this first step, the most important regulatory variables are identified and selected to characterize the PMR framework for each industry studied. This selection then guides the collection of the historical data on PMR.

Second, once PMR have been identified, we evaluate the current regulatory environment directly from the latest version of the acts available for each of the ten provinces, and we code the level of PMR in place.

We then engage in a backward investigation process which consists of finding every amendment to the law since 1984. The chronological information regarding the date of past amendments is available at the end of each section of the law. A typical amendment can change one or more sections of an act by modifying the sense of the regulation or it can simply repeal the section. Therefore, we also need to retrace every repealed section of the act and determine whether they were aimed at regulating the product market in some way. Furthermore, sometimes governments adopt new acts which can replace completely another act. Obviously, we need to keep track of these changes.

Using the date of the amendments provided in the act, the annual statutes associated with these amendments are consulted. Combining the information contained in the annual statutes with the previous versions of the acts we evaluate the characteristics of these amendments, and more importantly we identify their implications for our PMR variables. This task has to be done very meticulously since every amendment might be potentially linked to PMR. Once this is done, the amendments are sorted into two groups. The first group of amendments is aimed at modifying PMR and the second group contains those with no implications for PMR.

Third, for amendments that are linked to PMR, the date of the coming into force of the amendment (extracted from the provincial gazettes) is used to encode the change in regulation of the province in our database. This is done for the ten Canadian provinces in the three industries we cover.

Finally it should be noted that in situations where the information from the act or regulation was ambiguous we directly addressed specific questions to the authorities in charge of the sector. This was done when the act did not give enough information regarding particular variables. For example, in alcohol retailing the majority of the acts in the provinces give the power to the liquor commission to set the alcohol retail prices. Using this power, the commissions often introduce pricing controls (minimum and maximum prices or mark-ups). In this case no law article informs us about the pricing regulation in the industry even if it is in effect.

3.2 REGULATION INDEX

Overall this approach allows us to work backwards chronologically to build a database containing the state of regulation for the ten Canadian provinces. Our data cover three sectors of the Canadian economy falling under provincial jurisdiction: electricity, natural gas and retail trade. Our focus is on the period from 1984 to 2008. This period is of particular interest since massive deregulation, privatization, and liberalization occurred around the world at the beginning of the 1980's and continued in the 1990's. The industries studied in this report do not make exception. In each of the three industries, the variables cover different aspect of PMR:

Pricing control

This first category covers all regulation relating to price control. It can take the form of a minimum or maximum price or mark-up. In some other cases, it can simply indicate whether pricing supervision is present or that prices are determined by the market.

Example: Retail prices of gasoline are controlled by independent quasi-judicial commissions in 5 out of 10 Canadian provinces.

Entry regulation

The second category refers to any regulation aimed at restricting the natural flow of incoming firms in a market. Entry regulation can take different forms of barriers to entry such as permits or market exclusivity.

Example: Until 1987 many Canadian provinces required a license or a special permit to operate a road freight business.

Public ownership

The third category refers to any regulation aimed at granting a franchise or exclusivity rights to a public entity in order to operate an economic activity that could be operated by private interest.

Example: In Alberta, the government decided to sell off its crown assets in the liquor retailing industry, transferring the exclusive right to sell alcoholic beverage from the public to the private sector.

Vertical integration

The fourth category refers to the required level of vertical integration in an industry. More specifically, it specifies to what extent the government permits firms in an industry to operate upstream and downstream along the production chain.

Example: In the electricity market, some provinces have unbundled their public utility company breaking the vertical integration of the production process.

Using these variables, we construct a PMR index measuring the level of economic regulation in the Canadian provinces. For each industry (electricity, natural gas and retail), an index is built using a weighted sum of the variables. The weights for the variables are assigned on the basis of the number of variables per category. For example, if three variables were collected for "price control" in the electricity industry, each variable would be assigned a weight of 1/3. The second aggregation step consists of aggregating the regulation categories into a global index for the industry. To do so, an equal weight is given to each category. Formally,

$$PMR\ index_{kpt} = \sum_j c_j \sum_i v_i regulation_{kipt}$$

where $PMR\ index_{kpt}$ is the value taken by the PMR index at time *t* in industry *k* in province *p*, c_j the weight attributed to category *j*, v_i the weight of variable *i*, and $regulation_{kipt}$ the state of regulation at time *t* for variable *i* in industry *k* in province *p* encoded on a scale from 0 to 6. Finally, to create an aggregate energy PMR index, equal weight is given to electricity and natural gas before summing the two indices.

3.3 ENERGY INDICES

In Canada, the energy sector accounts for more than 3% of the GDP. However, it has an important indirect contribution to GDP since without a reliable and efficient distribution of energy across a region the capacity of the economy to function adequately is severely jeopardized.

In this research, the energy sector is split into the electricity and the natural gas markets. These two network industries share a lot of similarities.[5] First, they can be split into four separate functions: generation, transport, distribution and supply. Second, the segments of transportation and distribution of the energy from the generation source to the distribution centers and on to the customers in both these industries are usually thought of as natural monopoly markets.

[5] A network industry consists of two components. On one side is the infrastructure and on the other side the services delivered using this infrastructure as a support. These services can themselves be seen as of two types: intermediate services which of manage and optimize the circulation and dispatching of flows on the infrastructure; and the final services, which satisfies the demand of end-users of the network. (Currien, N., 1994, Régulation des réseaux : approches économiques. Annales des Mines. Réalités industrielles.)

For the sake of protecting consumers, and in response to the natural monopoly conditions in the transport and distribution segments, public authorities typically permitted the implementation of an integrated public monopoly operating all of the upstream and downstream activities (principally in electricity). It was believed that this formula, based on the principle that public enterprises do not aim at maximizing profits, would result in a higher welfare for the economy. In some other cases, private entrepreneurship was encouraged but remained under heavy regulatory supervision.

However, while the transportation and distribution segments do indeed represent natural monopoly situations, the generation and retail segments do not, and so can potentially benefit from a more deregulated market. In fact, a restrictive regulatory environment protecting the position of a single operating firm in a potentially competitive market leads to inefficient practices. Indeed, a monopoly, searching to maximize its benefits, will charge prices higher than the marginal cost, resulting in net losses for the economy as a whole, especially for customers. While the literature agrees that a reduced regulatory burden is favorable in the energy sector, it is not clear yet what specific reforms will maximize the benefits of a more liberalized environment (Steiner, 2001).

For the past 20 years, the energy sector in Canada has undergone significant regulatory reforms. These reforms occurred at a time where significant doubts grew in regards to state intervention in network industries such as electricity and natural gas. This questioning lead to important debates surrounding numerous aspects of network industries: the presence of natural monopolies and the rethinking of its limits in the case of network industries; privatization; and the regulatory environment in place (Chevalier, 1995). In many cases, governments concluded that the regulatory framework was too restrictive and underwent reforms in order to impose increased competition in specific segments of the industry where a rigid regulatory environment was believed to be affecting the efficiency of the market.

While many provinces have reformed to some extent their energy policy, significant heterogeneity in the regulatory framework – mainly in electricity – across provincial jurisdictions is still detectable. In many cases, further deregulation is still being contemplated and changes could occur in some provinces in the near future.

The data on the energy sector were collected from the provincial *Public Utilities Acts*, *Electricity Acts* and *Natural Gas Acts*.

Electricity

In Canada, electricity is primarily under provincial jurisdiction, with only interprovincial and international trade in electricity falling under federal jurisdiction. Therefore, electricity generation, transportation, distribution and retail activities within a province are controlled by a provincial authority.

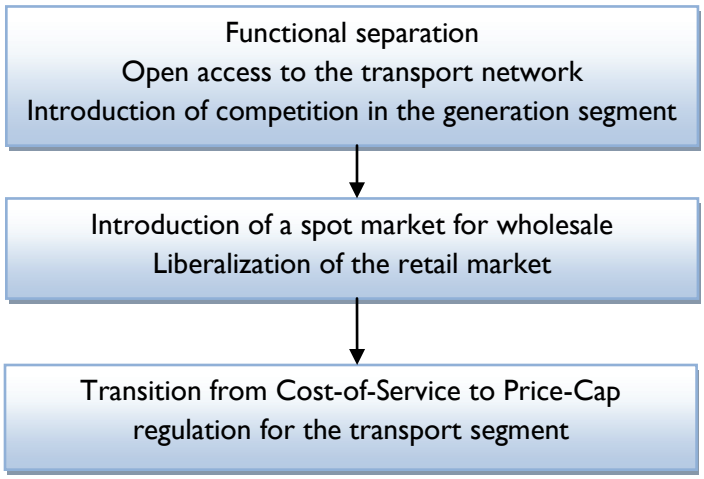
The structure of the electricity industry, in terms of capital and competition, is very complex and dependant of numerous heterogeneous factors, including the allocation of natural resources. This allocation gives enormous incentives to produce electricity using a specific technology. In

the same way, the type of generating technology influences market structure and will dictate the form and extent of the regulatory framework necessary to control the market. For instance, in Québec, the fact that a massive proportion of power is generated from hydro where large amounts of capital are necessary to start a plant, is thought to require the presence of public ownership of the generation segment. In other words, the fact that Québec has enormous potential in hydroelectric power supply limits the potential for entrants, and promotes the involvement of public authorities in the electricity sector. On the other hand, in Alberta where most electricity is generated by traditional thermal generation (coal, fuel and natural gas) and where initial capital is less substantial, the environment provides greater incentive to smaller initiatives and therefore private entrepreneurship. This might explain partly why Alberta's energy market is much more deregulated than Québec's.

In general, the deregulation process of the electricity industry is progressive. More precisely, regulatory reforms will start by gradually liberalizing the production market (wholesale), functionally separating the different segments of the industry and opening access to the transport network (see Figure 1). Afterwards, provinces can push further the deregulation process by introducing a spot market where quantities and prices are established by market forces. At the same time, the retail market is liberalized by granting the customers (industrial, commercial and residential) the option to choose their electricity supplier. Finally, one of the last steps in deregulating the electricity market is to modify the way the prices in the transport segment are regulated by introducing a *Price-Cap* regulation instead of the traditional *Cost-of-Service*.

FIGURE 1

ELECTRICITY DEREGULATION PATH (MODIFIED FROM STEINER, 2001)



In order to identify the effect of regulation on economic performance in the electricity sector, information on ten specific PMR is collected. These variables are listed in Table 1 and are regrouped into their respective PMR category (entry regulation, public ownership, pricing control, vertical integration). They are then used to build a regulation index for the electricity sector using the weights shown in Table 1.

Natural gas

The natural gas sector displays specific geographic characteristics which distinguish this industry from the electricity industry, particularly in regards to the generation segment of the production chain. Indeed, contrary to the electricity sector, where every province (except Prince Edward Island) is an electricity producer, few provinces possess and exploit natural gas resources on their territory. This implies that the generation segment is concentrated in a limited number of provinces and that deregulation of the generation segment is independent of the volition of the non producing provinces (such as Québec). This situation gave rise to a much less vertically integrated industry than in the electricity sector. In fact, with natural gas, the generation segment has almost always been separated from the transport, distribution and retail segments of the industry.

In order to identify the effect of regulation on economic performance, nine PMR are identified for the natural gas sector. In the same way as for the electricity market, these variables are used in order to build a regulation index for the natural gas sector as shown in Table 2.

3.4 RETAIL INDEX

The data for the retail industry were collected from the provincial acts and regulations. We focus on retail-store opening hours, and on restriction on the sale of liquor and petroleum products. Our collection is not exhaustive in the sense that there is a small number of other retail markets that are the subject of regulatory oversight (for instance pharmaceuticals). However, in most other markets oversight is largely at the federal level and so we focus here on the aforementioned industries. Moreover, these are the main industries studied in earlier work on regulation and growth (along with pharmaceuticals).

In Canada, retail represents a big portion of the economy, accounting for about 7.5% of GDP in 2009. While retail has been traditionally characterized by the presence of intense competition with many (often small) actors, and little regulatory oversight, currently many provinces still maintain a certain degree of regulation over some aspects of retail distribution. The main regulations affecting operations in the retail industry still in place today are on store opening hours and on the ability to set prices freely. These regulations were typically introduced to improve worker or consumer protection, or to establish particular holidays.

Store opening hours

At first sight, one might think that regulation surrounding store opening hours might have only a marginal effect on economic performance or productivity, simply displacing the moment when

consumption is effectively realized. However, many studies have extensively analysed the impact of store opening hours on economic performance, with many of them finding significant effects on welfare, employment, firm dynamics and therefore productivity.

The main findings from these studies were regarding:

Welfare: Consumer welfare is markedly enhanced by the extension of opening hours that allows consumers more time to make their choice and thus enhances the "entertainment" value of shopping (EC, 1996).

Prices and mark-ups: Average prices may increase marginally in the short run due to an increased cost for labor (Nooteboom, 1983). Québec's liberalization experience of Sunday shopping in the 1990's suggests that mark-ups may increase and that rebates may be reduced (Lanoie, *et al.*, 1994; Tanguay, *et al.*, 1995). However, longer-term impacts of deregulation need to be assessed in order to take into consideration the behavior of incumbents to the new competitive environment and the reaction of potential entry of new large firms (Lanoie *et al.*, 1994)

Employment: The effect of store opening hours deregulation on employment is generally positive mainly due to an increase in the labor demand to cover longer opening hours. The positive impact might also originate from an increase in sales and therefore the need for increased staff on the floor. In terms of productivity, if the growth in employment is higher than the growth in sales, this could lead to a slight decrease in productivity, each employee generating less added-value (Pilat, 1997).

Firm dynamic: One of the effects of the liberalization of store opening hours on firm dynamics is the potential replacement of smaller stores by larger ones, more capable of responding to longer opening hours. In many studies, it has been found that small stores lose market share to larger stores following the deregulation of hours (Pilat, 1997). Labor productivity should therefore be enhanced by the dominance of larger shops generally more productive than smaller ones.

Productivity: Store opening hours can also have a direct effect on the level of productivity. In particular when the deregulation of store opening hours facilitates the meeting between the supply and the demand by increasing the variability and flexibility of merchants to establish optimal opening hours. In other words, the liberalization of store opening hours does not necessarily imply that stores are open for a longer period of time but enables them to align their opening hours with consumer demand (Pilat, 1997). The increase in productivity is generated from increased sales while total opening hours remain stable but more suited to consumer needs.

Price control

Many provinces have adopted limitations on pricing for alcohol sales and gasoline retail during the period studied. The main impact of these new regulations is through firm dynamics in the market. For example, when stores are not allowed to compete over prices following a price-

floor regulation, the level of competition in the market is reduced significantly and favors the survival of less productive firms/stores, reducing by the same token the productivity level in the industry (see Carranza *et al*. (2010) for an analysis of the effect of the price floor in Québec's retail gasoline industry on productivity).

In order to identify the effect of regulation on economic performance, seven product-market regulations are identified for the retail-distribution sector. To build the index we focus on economic regulation rather than administrative-burden regulation, which although a potentially important influence on productivity level, is in many ways very difficult to measure objectively.

TABLE 1

ELECTRICITY PMR VARIABLES AND WEIGHTING SCHEME

	Category weights	Variable weights	Coding of data			
Entry regulation						
How are the terms and conditions of third party access (TPA) to the electricity transmission grid determined?	1/4	1/3	Negociated TPA 0		No TPA 6	
Is there a liberalized wholesale market for electricity?		1/3	Yes 0		No 6	
Is there a liberalized retail market for electricity?		1/3	Yes 0	Industrials only 3	No 6	
Public ownership						
What is the ownership structure of the largest company in the generation segment?	1/4	1/3	Private 0		Public 6	
What is the ownership structure of the largest company in the transport segment?		1/3	Private 0		Public 6	
What is the ownership structure of the largest company in the supply segment?		1/3	Private 0		Public 0	
Pricing control						
How are retail prices regulated for residential customers?	1/4	1/3	No price control 0	Approbation 3	Cost of service 4.5	Fixed Price 6
How are retail prices regulated for industrial customers?		1/3	No price control 0	Approbation 3	Cost of service 4.5	Fixed Price 6
Are wholesale prices regulated?		1/3	No price control 0	<165TwH 3	Yes 4.5	Intrinsic 6
Vertical integration						
What is the overall required degree of vertical integration in the electricity industry?	1/4	1/1	Functional seperation 0		Integrated 6	

TABLE 2

NATURAL GAS PMR VARIABLES AND WEIGHTING SCHEME

	Category weights	Variable weights	Coding of data			
Entry regulation						
To what customers are gas marketers allowed to sell on the retail market?	1/4	1/2	All 0	Industrial and commercial only 3		None 6
What is the market structure in the retail segment of the natural gas industry?		1/2	LDC and marketers 0	Marketers 3		LDC 6
Pricing control						
How are retail prices regulated for residential customers?	1/4	1/4	No price control 0	Approbation 3	Pass-through 4.5	Fixed price 6
How are retail prices regulated for industrial customers?		1/4	No price control 0	Approbation 3	Pass-through 4.5	Fixed price 6
How are retail prices regulated for commercial customers?		1/4	No price control 0	Approbation 3	Pass-through 4.5	Fixed price 6
How are distribution prices regulated?		1/4	No price control 0	Market based 3	Supervision 4.5	Cost of service 6
Public ownership						
What is the ownership structure of the largest firm in the gas distribution sector?	1/4	1/1	Private 0			Public 6
Vertical integration						
Is direct extraction of large industrial consumers allowed?	1/4	1/2	Yes 0			No 6
Is there a forced separation between retail and distribution segments?		1/2	Yes 0			No 6

TABLE 3

RETAIL DISTRIBUTION PMR VARIABLES AND WEIGHTING SCHEME

	Category weights	Variable weights	Coding of data		
Entry regulation					
Are stores allowed to open on Sundays?	1/3	1/4	Yes 0	For some period 3	No 6
Do regulations specify particular opening and closing hours on weekdays?		1/4	No 0		Yes 6
The regulating power over shop opening hours has been transferred to municipal authorities?		1/4	No 0		Yes 6
Do regulations specify the number of compulsory holidays per year?		1/4	No 0		Yes 6
Pricing control					
Are alcohol prices subject to price control?	1/3	1/2	No 0		Yes 6
Are retail prices of gasoline subject to price control?		1/2	No 0		Yes 6
Public ownership					
What is the ownership structure of the alcohol retail industry?	1/3	1	Private 0	Mix (private and public) 3	Public 6

3.5 PRODUCTIVITY MEASURES

Labor productivity measures are constructed using the Statistics Canada productivity database. Productivity is measured as the ratio between value added and hours worked. Value added is measured as the sum of labor compensation (wages) and the surplus (profits) or the compensation of capital.

Industry specific productivity data are available at the medium NAICS level of aggregation (66 industries) and the time span covered is 1984 to 2008. However, for the energy sector disaggregated productivity data for electricity and natural gas are incomplete. For confidentiality reasons, many observations are not divulged by Statistics Canada. In fact, data for only 5 provinces are available at the medium level of aggregation (Québec, Ontario, Manitoba, Alberta, and British Columbia). Therefore, data at the small level (20 industries) of aggregation are also used. At this level, electricity, natural gas, and water treatment are combined to form one distinct industry, utilities.

4. DESCRIPTIVE EVIDENCE OF MARKET TRENDS

4.1 ELECTRICITY

As discussed earlier, many provinces have unbundled their electric utility and introduced a liberalized wholesale market. Some provinces have pushed the experience further by deregulating the retail market and/or removing any regulation over price in the downstream retail sector. Figure 2 offers a general overview of the deregulation process that took place over the last 25 years in the energy sector in the Canadian provinces. We can see clearly that all provinces but Prince Edward Island deregulated to some extent their electricity market. However, Prince Edward Island is the only province in Canada that cannot supply on its own most of its electricity needs. Indeed, the province has almost no control over production since buying the vast majority of its power from outside the island (New Brunswick). This situation explains why its index did not move in a similar manner to other provinces.

While there is no significant difference in trends across Canadian regions, it appears that the West/Prairies – except for Alberta – were less active in terms of deregulation. This reflects the survival of large publicly owned vertically integrated monopolies in British Columbia, Manitoba and Saskatchewan. On the other hand, Nova Scotia, Ontario and Alberta experience significant liberalisation.

Figure 3 offers another perspective of the deregulation trend in the electricity industry. From this graph, one can see clearly that most provinces have moved from a heavy regulatory environment to a much more competitive market.

Alberta was the first Canadian province to rethink its energy policy in the early 1990's. The first significant step towards a competitive energy industry occurred on January 1st 1996 with the *Electricity Utilities Act* coming into force. This reform which created a Power Pool provided a competitive, real-time spot market for electric energy (the only other province to have adopted such a liberalized wholesale market is Ontario). At the same time, the opening of the transmission grid permitted eligible persons to trade energy on the Power Pool.

The reform also decoupled power from asset ownership for the regulated units operating in the province. Several purchase arrangements were made, and purchasers were able to resell energy into the marketplace and/or consume the energy directly. Afterwards, any new power had to be sold through the Power Pool.

Since that time, several legislative reforms have encouraged the transition from an industry dominated by vertically integrated utilities and monopoly territories to one where market forces are intended to determine the price of energy, but also the new generation capacity and the supply mix. These reforms, amongst other things, have also made it possible for customers to choose their electricity supplier and negotiate price directly.

FIGURE 2

EVOLUTION OF THE ELECTRICITY INDEX, 1984-2008

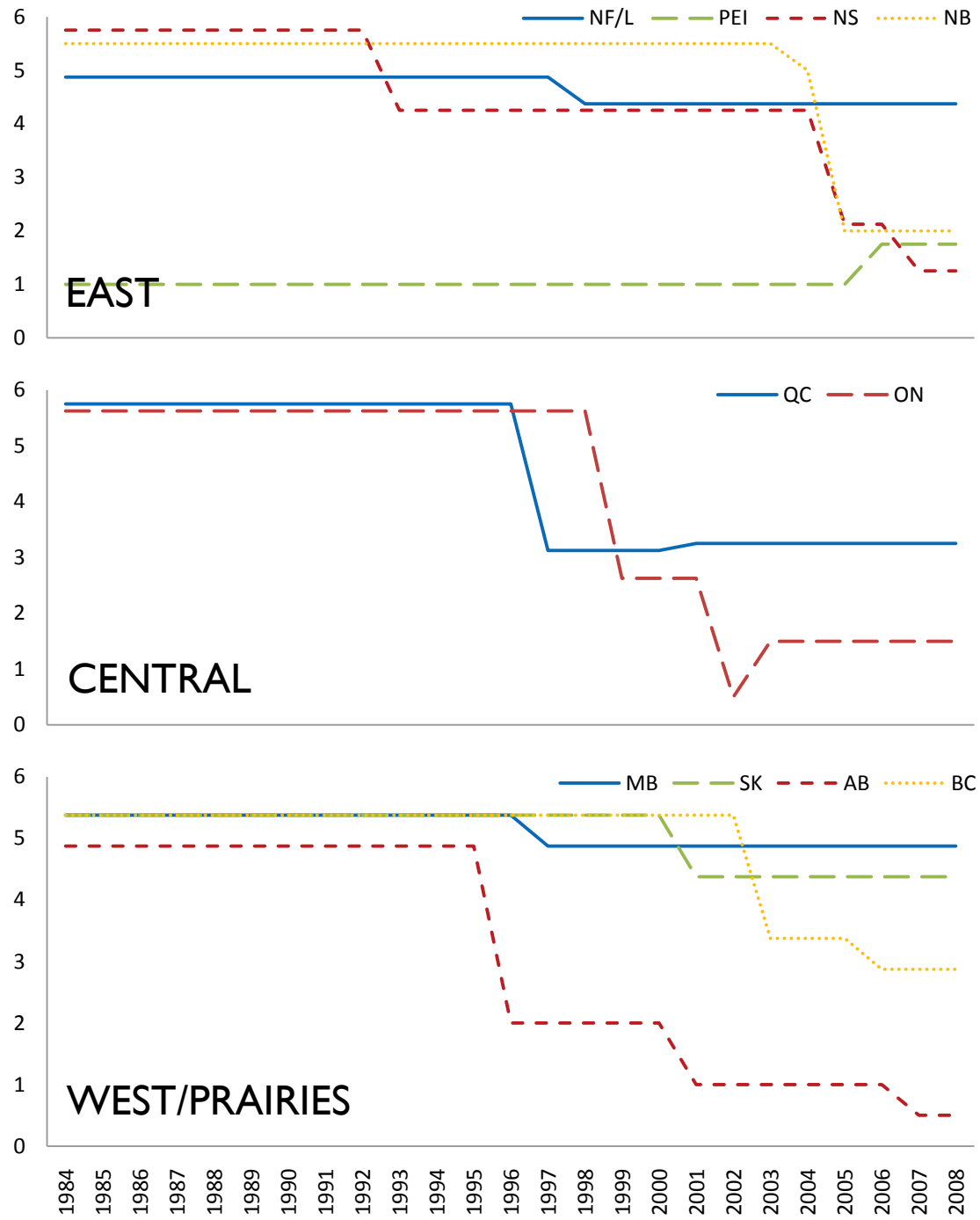
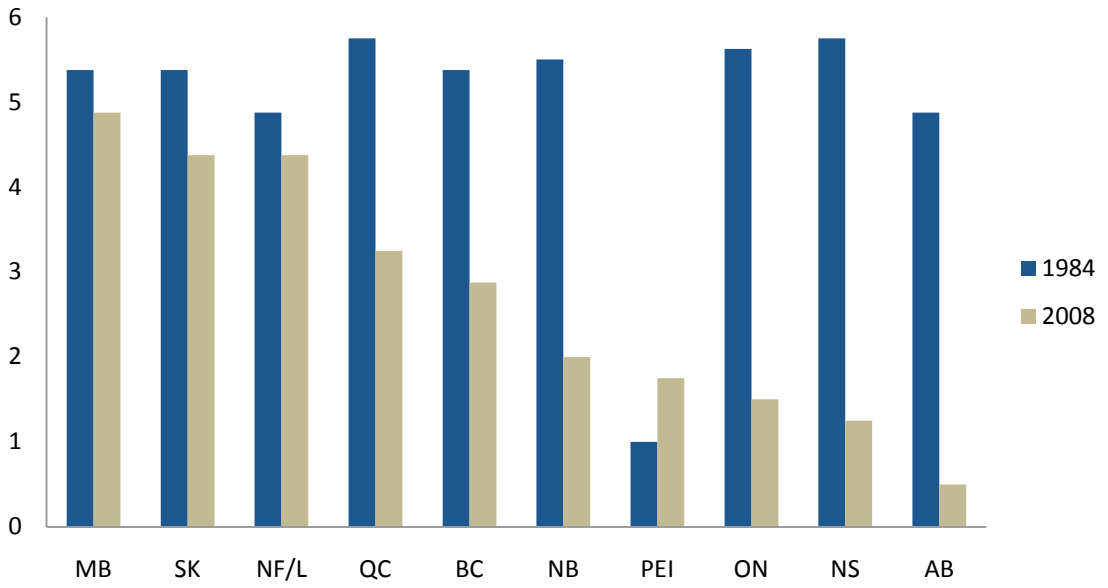


FIGURE 3

ELECTRICITY INDEX IN 1984 AND 2008



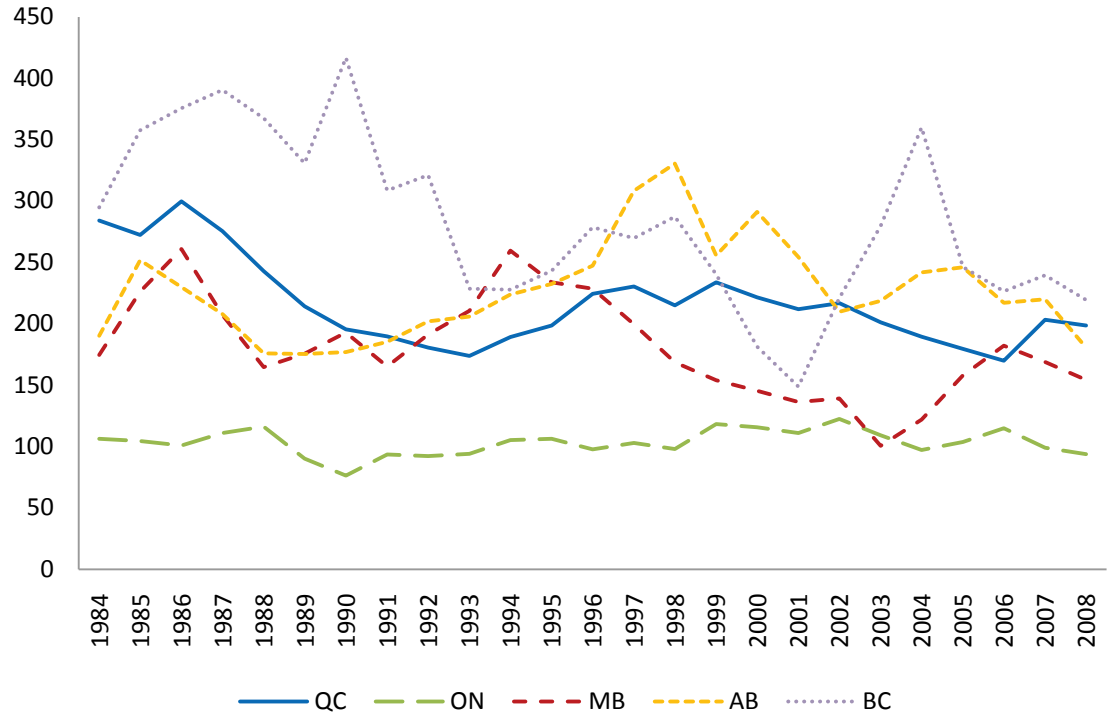
Overall, eight out of the ten Canadian provinces liberalized their wholesale market: Québec (1997), Newfoundland (1998), Saskatchewan (2001), Ontario (2002), British Columbia (2003), New Brunswick (2004), Nova Scotia (2007); eight of the ten provinces permitted third party access to their transmission grid: Alberta (1996), Québec (1997), Manitoba (1997), Ontario (1999), Saskatchewan (2001), Nova Scotia (2005), New Brunswick (2005), and British Columbia (2006); and six provinces separated their electric utilities: Alberta (1996) Québec (1997), Ontario (1999), British Columbia (2003), Nova Scotia (2005), and New Brunswick (2005).

Québec experienced deregulation starting in June 1997 with the creation of the Régie de l'énergie, which is now responsible for regulating the electricity market in Québec. While Québec's electricity market was the scene of further free market rules and regulations from this point on, this deregulation process was achieved much more in order to maximize the export potential of its low cost hydroelectric resources than to encourage further competition in the domestic market. Hydro-Québec's deregulation translated into the unbundling and vertical separation of the public society into four divisions: Hydro-Québec Production, Hydro-Québec TransÉnergie, Hydro-Québec Distribution, Hydro-Québec Équipement. The unbundling allowed Hydro-Québec to conform to US FERC Order No. 888 and opened the door to export to the US electricity market.

FIGURE 4

EVOLUTION OF LABOR PRODUCTIVITY, ELECTRICITY, 1984-2008

(Dollars per hour)



Québec's actual position towards deregulation is limited to functional separation and open access to third party and does not encourage intense competition in the market. Hydro-Québec maintains its monopoly position over every segment of the industry, with the exception of a small fraction of the generation segment. The wholesale market is only partially liberalized as the first 165 TWh has to be supplied by Hydro-Québec Production, and no Power Pool exists for the balance. The retail market is exclusively served by the provincial monopoly, Hydro-Québec Distribution, exception made of nine municipal distribution networks – Alma, Amos, Baie-Comeau, Coaticook, Joliette, Magog, Saguenay, Sherbrooke and Westmount – and one electric cooperative in Saint-Jean-Baptiste de Rouville.

Figure 4 presents the evolution of labor productivity for the electricity industry. [6] Comparing Figures 2 and 4, it is hard to identify an obvious relationship between regulation and productivity. Indeed, Figure 4 shows that many provinces have experienced a decrease in

[6] Sector specific data on productivity for the time frame we are studying are only available for the five biggest Canadian provinces: Québec, Ontario, Manitoba, Alberta, and British Columbia. The estimations will be restricted to these provinces for the electricity and natural gas estimations. Data for retail distribution and utilities are available for all 10 Canadian provinces and covers our time frame.

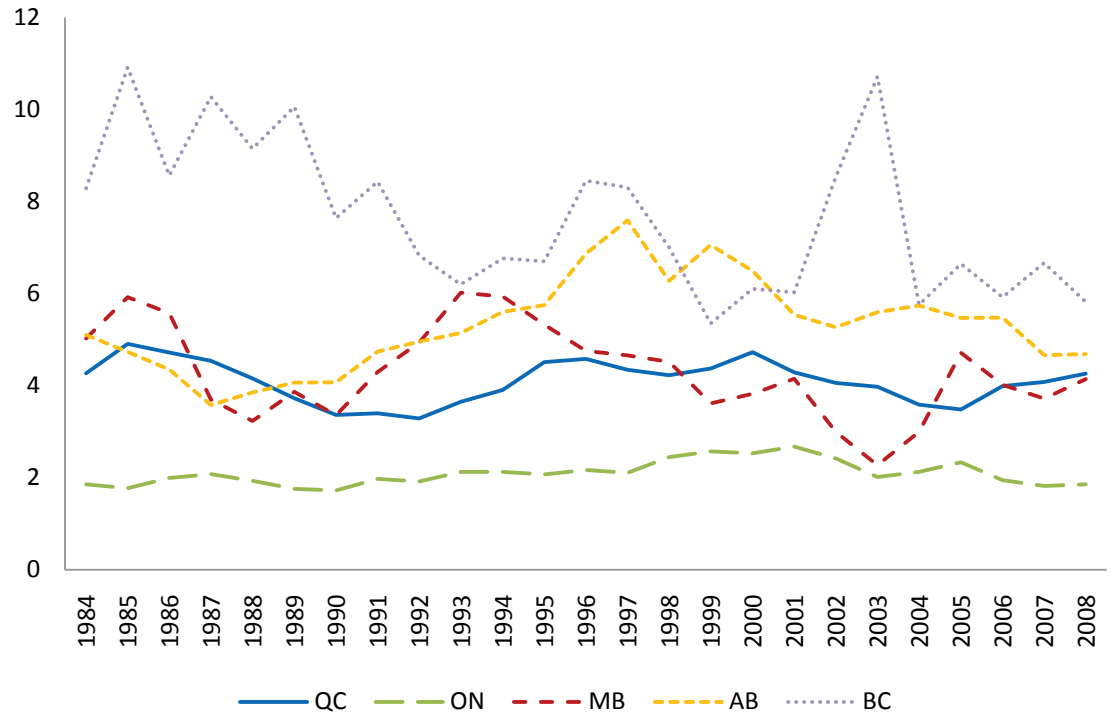
productivity over the studied period while at the same time all the provinces deregulated their electricity sector. For example, labor productivity in Québec's electricity industry dropped from $284/h to less than $200/h.

In our empirical analysis below we will also make use of an alternative measure of productivity for the electricity sector calculated as the ratio between kilowatts produced and hours worked. This measure provides an indication of the efficiency with which the labor input is used to generated electricity. Figure 5 presents the evolution of this alternative labor-productivity measure for the electricity industry. One can see that it follows a very similar pattern to the standard measure of labor productivity.

FIGURE 5

EVOLUTION OF LABOR PRODUCTIVITY, ELECTRICITY, 1984-2008

(Kilowatts produced per hour)



4.2 NATURAL GAS

The *Agreement on Natural Gas Prices and Markets* signed between the Government of Canada and the primary gas-producing provinces (Alberta, British-Columbia and Saskatchewan) on October 31th 1985 was the building block of a massive deregulation process which spread across the Canadian provinces thereafter.

The agreement provided, for the first time, the legal framework for gas buyers to directly contract with producers, marketers and other agents at freely negotiated prices. Prior to the agreement, the price of natural gas sold in interprovincial trade had been regulated by a joint agreement between the federal government and Alberta, the largest supplier of natural gas in the country. Furthermore, prior to the settlement, gas buyers in nonproducing provinces could purchase their gas requirements only from a pipeline company at a "bundled" price which included the cost of gas and the cost of transportation (NEB, 1996). Following the agreement, the generation segment, mainly concentrated in the Western provinces, became fully competitive.

In the years following the agreement, the Canadian provinces moved at different speeds towards deregulation of the downstream segment of the industry notably in order to give further latitude to customers in the choice of their natural gas supplier. Ontario (1986), Saskatchewan (1987) and Québec (1987) were the first provinces to allow customers to purchase natural gas directly from a gas marketer instead of the local distribution company (LDC). Some provinces have gradually deregulated this aspect of the retail market by first allowing industrial customers to choose their natural gas supplier and later on allowing any customers to do so (residential, commercial, and industrial). This is the case for Alberta (1995), Manitoba (2000) and British Columbia (2007).[7]

The distribution segment of the industry, which can be considered a natural monopoly situation offers one of the last aspect of differentiation between the levels of deregulation between Canadian provinces. In fact, very few provinces still maintain public control over this segment of the industry, and grant to the private sector the role of distributing natural gas to customers while being regulated by an independent agency. To date, only Manitoba and Saskatchewan maintain public ownership in the natural gas industry.

Recently, Nova Scotia and New Brunswick have initiated the exploitation of natural gas resources on their territories flowing from the Sable Island area. Prior to 2001 and 2005, neither New Brunswick or Nova Scotia had any natural gas distribution. Both provinces have now granted franchises to LDC in order to distribute natural gas to end-use customers. However, each of the two provinces has used different regulatory strategies in order to control the emerging activities of their franchises – especially in regards to price control.

Figure 6 and 7 offer a snap shot of the evolution of the natural gas regulation in the Canadian provinces.[8] As in the electricity industry, we can see that every province (except Manitoba) has deregulated their natural gas industry. As discussed earlier, Manitoba and Saskatchewan remain the provinces with the most rigid environments, due mostly to the presence of publicly-owned utilities distributing natural gas across each province.

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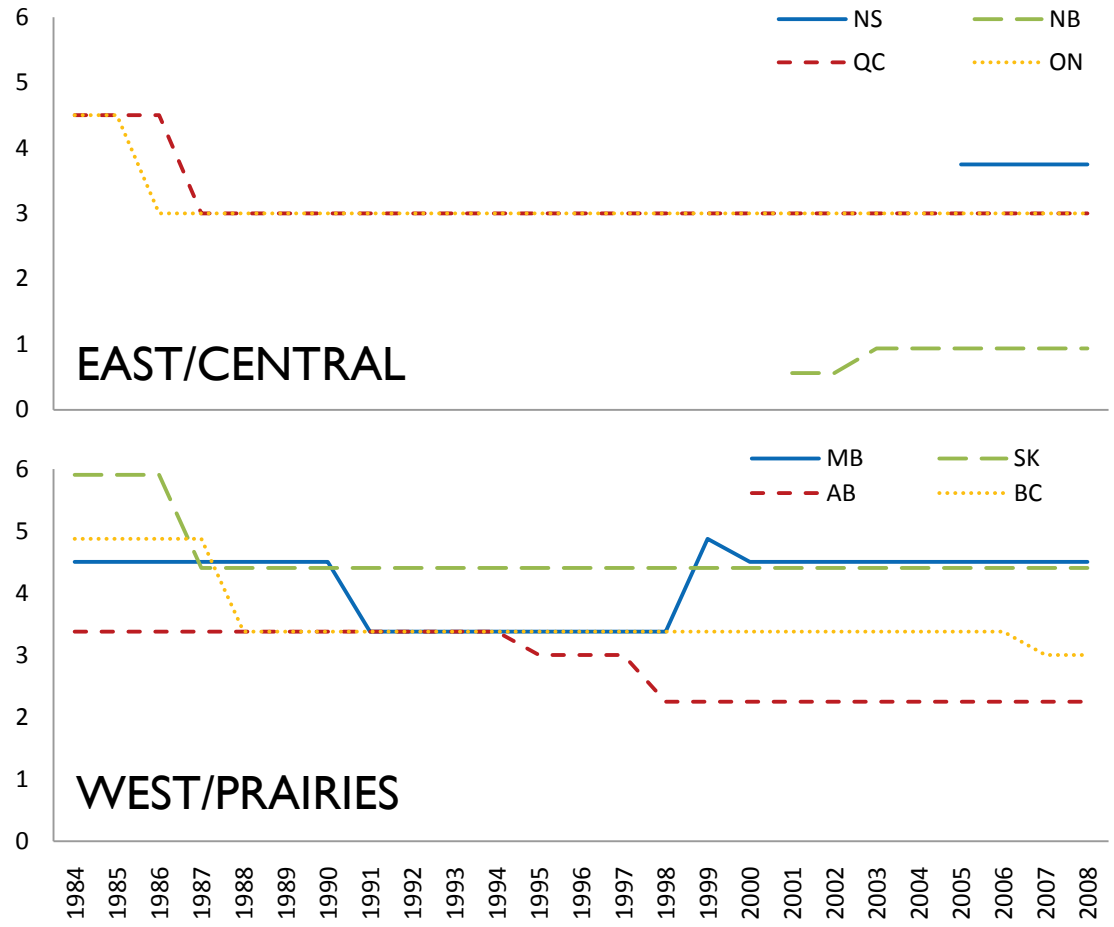
[7] Newfoundland/Labrador and Prince Edward Island are excluded of the analysis for the simple reason that there is currently no natural gas distribution in these Atlantic Provinces.

[8] New Brunswick and Nova Scotia don't have data for 1984 since there was no natural gas distributed on the territories at that time.

FIGURE 6

EVOLUTION OF THE NATURAL GAS INDEX, 1984-2008



On the other hand, New Brunswick offers the least rigid environment encouraging its LDC to use market based price instead of the normal cost of service price used in all the other Canadian provinces. This start-up strategy allows the LDC to charge prices below the break-even point in order to build a clientele and become economically viable in a near future. Nova Scotia did not follow the same path and used a much more traditional regulatory framework to guide the activities of Sempra Atlantic Gas Inc.

Central provinces (Quebec/Ontario) have moved to a deregulated market very earlier (1986) and have been quite stable since.

FIGURE 7

NATURAL GAS INDEX IN 1984 AND 2008

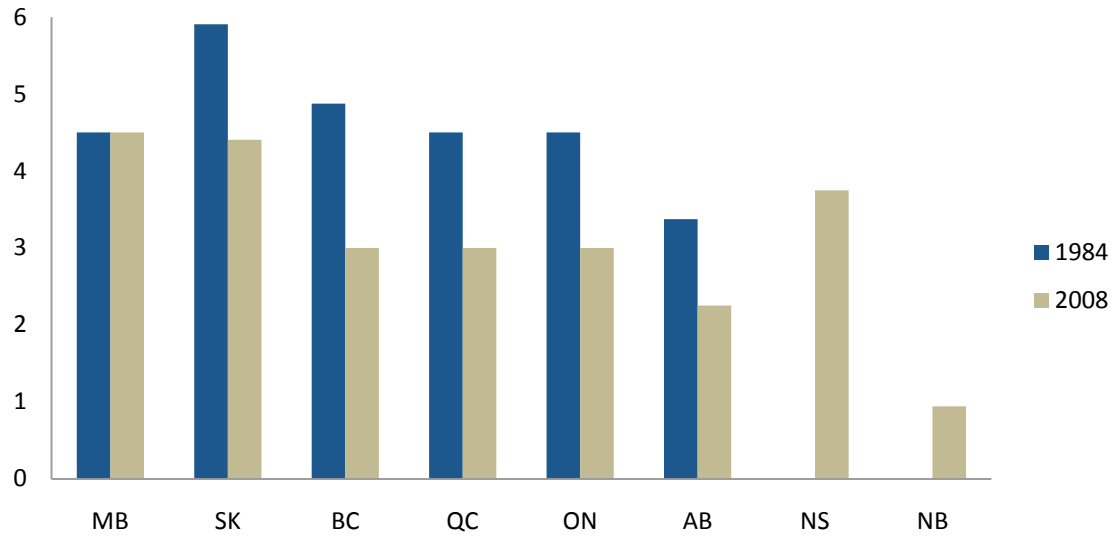


FIGURE 8

EVOLUTION OF LABOR PRODUCTIVITY, NATURAL GAS, 1984-2008

(Dollars per hour)

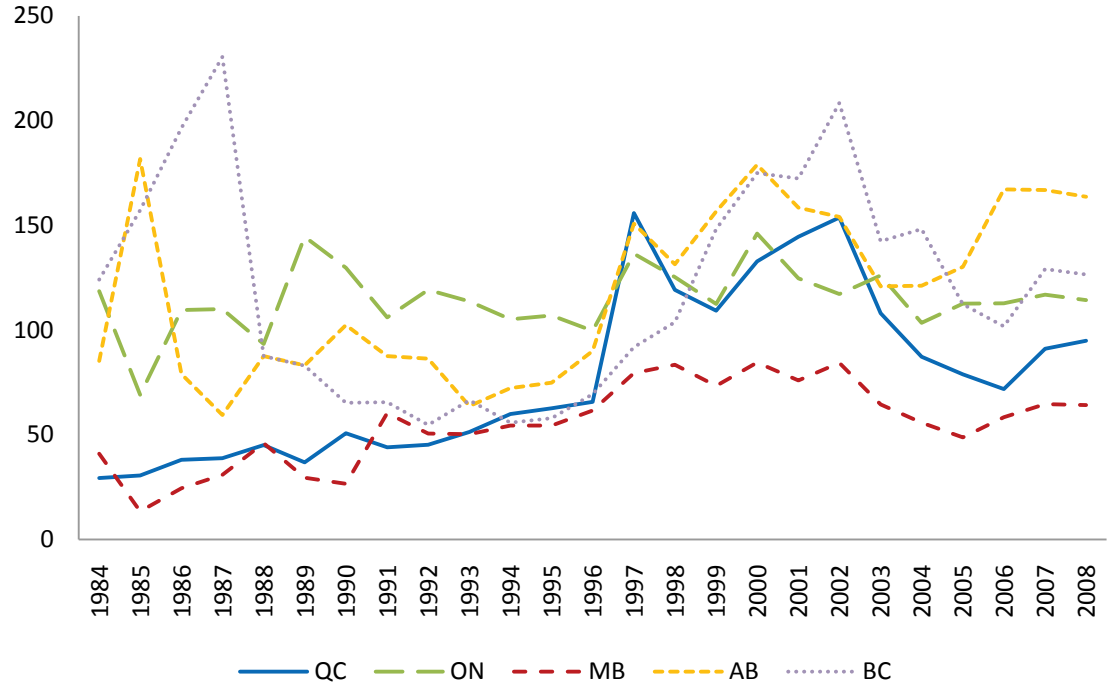


Figure 8 shows the evolution of labor productivity in the natural gas industry. One can see that the productivity level is very volatile and does not exhibit a significant upward or downward trend. Therefore, it is difficult to link the evolution of the regulation index to the evolution of labor productivity with a simple graphical analysis.

4.3 ENERGY

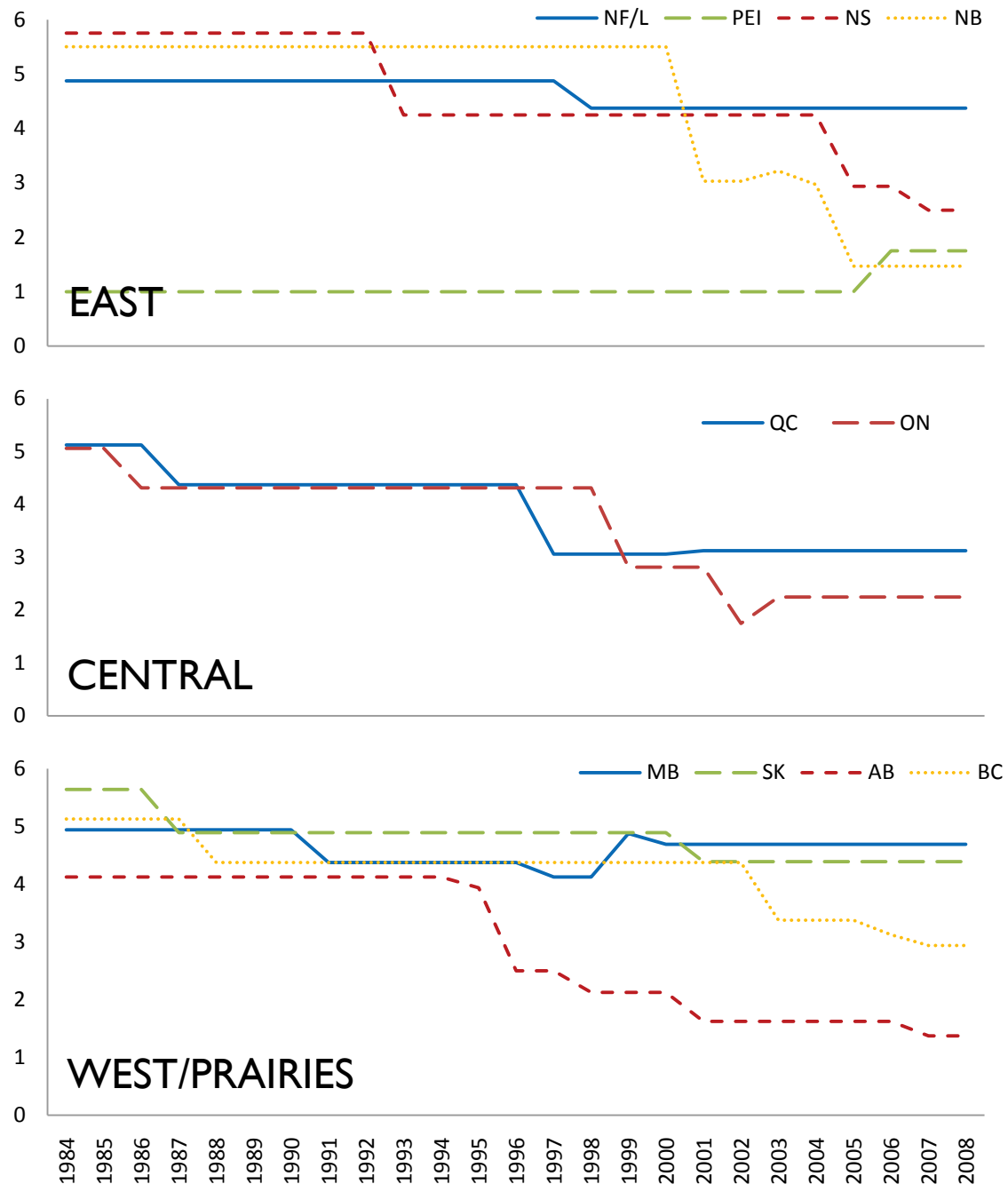
We have also aggregated the electricity and natural gas indices to create an Energy index. As predicted, the index is downward slopping which is coherent with the observations made in the electricity and natural gas market. From Figure 9, it can be clearly seen that Alberta has always been at the forefront of the deregulation trend in Canada in the energy industry.

Figure 10 gives a better portrait of the extent of the deregulation trend in Canada in the energy sector. All the Canadian provinces have deregulated either their electricity or natural gas sector or both.

Figure 11 displays the evolution of labor productivity for utilities. As observed in the labor productivity graphs for natural gas and electricity, no general trend can be observed. However, we can see that productivity has been very volatile for all the provinces except Ontario where it has been fluctuating around $100/hour for the past 25 years. For the four other provinces – and for all the Canadian provinces in general – labor productivity was much more unpredictable than the growth pattern of labor productivity in the overall economy.

FIGURE 9

EVOLUTION OF THE ENERGY INDEX, 1984-2008

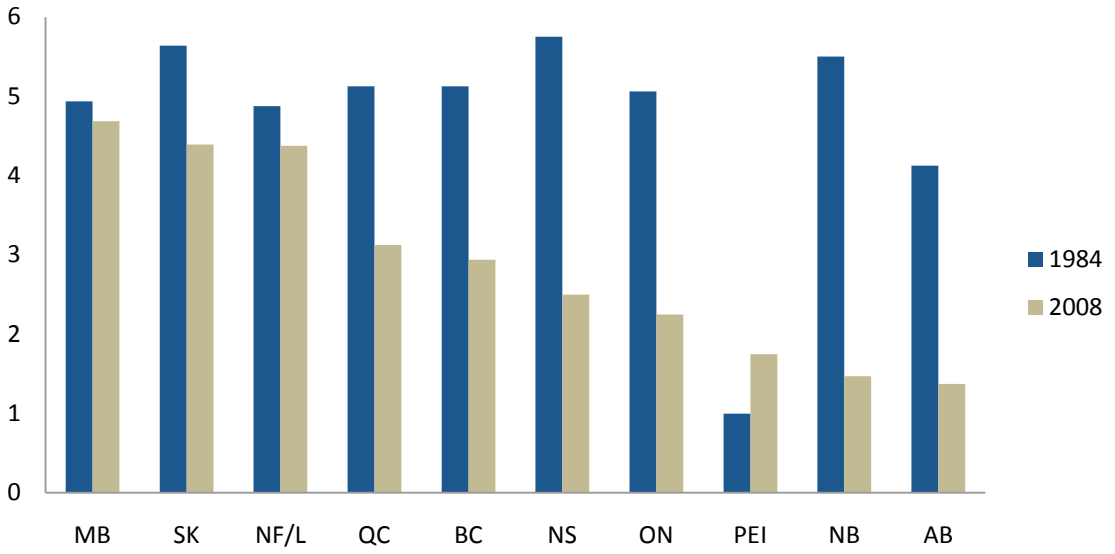


When comparing these figures to the evolution of the regulation index for energy, it starts to become obvious that there is not a strong correlation between regulation and productivity in the energy sector. The regulation index has a very clear downward-sloping trend, while the

productivity measure has no apparent pattern. The graphical analysis suggests that it is unlikely that regulation is the primary determinant of productivity in the energy sector.

FIGURE 10

ENERGY INDEX IN 1984 AND 2008



Furthermore, when looking at the evolution of productivity and the level of regulation in the provinces, the link is no more apparent. In fact, Table 4 shows that many provinces that have a very restrictive energy sector have registered some of the best performances in terms of productivity growth during the past 25 years. For example, Saskatchewan, a province still heavily regulated in terms of energy has seen its labor productivity grow 74.6%. Other provinces, such as New Brunswick, have made tremendous deregulation efforts and saw their productivity level drop 38.4%.

FIGURE 11

EVOLUTION OF LABOR PRODUCTIVITY, UTILITIES, 1984-2008

(Dollars per hour)

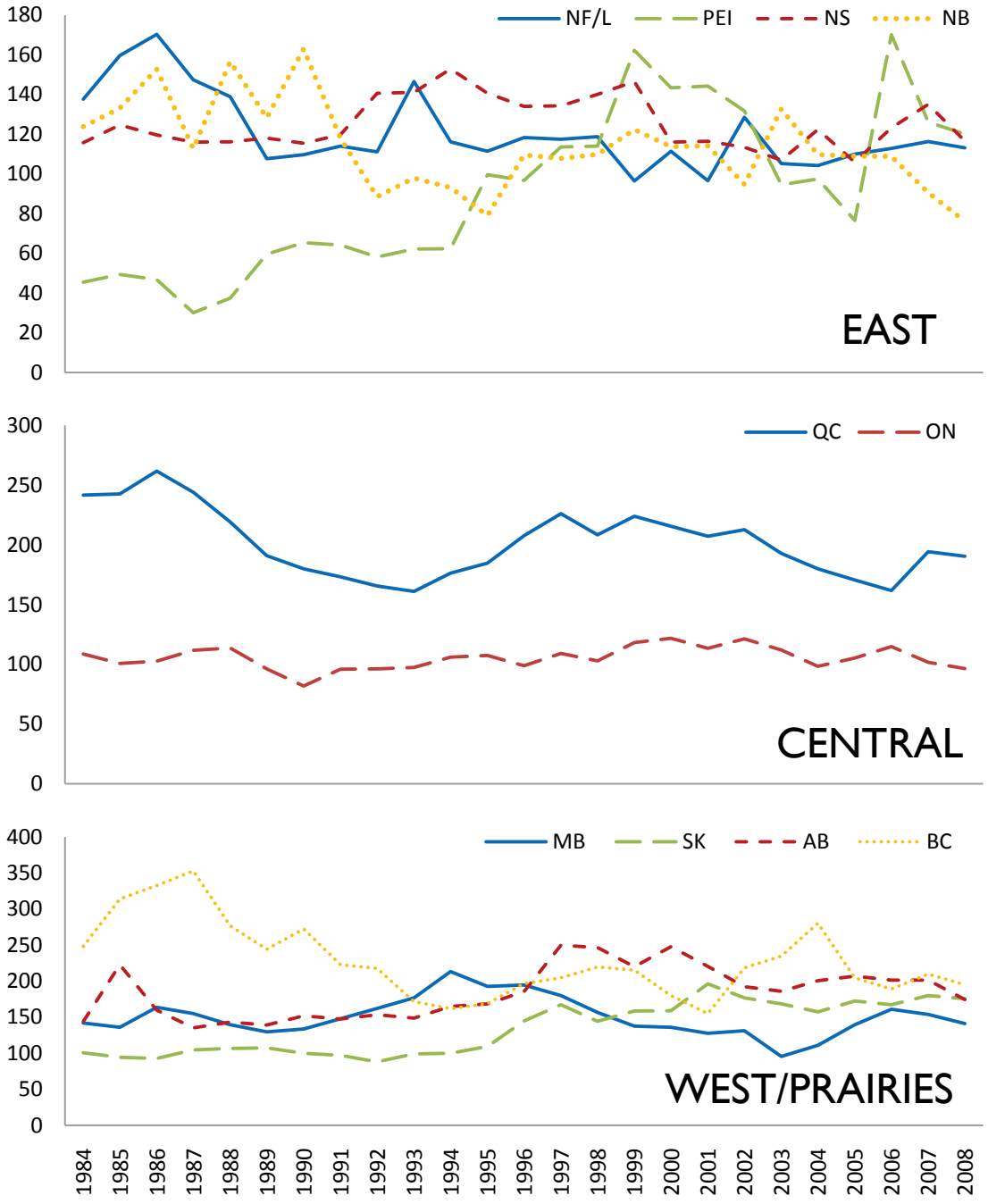


TABLE 4

LABOR PRODUCTIVITY GROWTH AND PMR INDEX GROWTH FOR ENERGY, 1984-2008

(Percentage)

	NF/L	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Labor productivity growth - Energy	-17.8	163.7	0.7	-38.4	-21.2	-11.1	-0.6	74.6	21.4	-21.4
PMR - Energy	-10.3	75.0	-56.5	-73.3	-39.0	-55.6	-5.1	-22.2	-66.7	-42.7
Labor productivity growth - Electricity					-30.1	-11.7	-11.5		-5.1	-25.5
PMR - Electricity	-10.3	75.0	-78.3	-63.6	-43.5	-73.3	-9.3	-18.6	-89.7	-46.5
Labor productivity growth – Natural Gas					223.5	-3.5	56.7		92.0	2.0
PMR - Natural gas					-33.3	-33.3	0.0	-25.4	-33.3	-38.5

Nonetheless, in Section 5 we perform a statistical analysis to see whether any connection between the two variables can be established.

4.4 RETAIL

Prior to 1985, Sunday closing was regulated by the federal government under the *Lord's Day Act* which forced all stores across the country – with a few exceptions – to stop their activities in order to observe the Christian Sabbath. Prior to the invalidation of the act in 1985 by the Supreme Court of Canada, many critics had been addressed towards the law which was considered infringing the *Canadian Charter of Rights and Freedoms* guarantee of freedom of religion.

Nevertheless, the Court stated that legislating a day of rest for non-religious purposes was acceptable. Following this decision, the provincial authorities were granted the right to regulate store opening hours on their territories and many of them prohibited Sunday shopping in order to protect workers and ensure a secular weekly day of rest. Eventually, pressure from retail businesses forced many provincial governments to abolish the weekly day of rest. This deregulation process led to the delegation to municipalities of the power to allow, or prohibit, the opening of retail establishments on Sundays. British Columbia was the first to do so, followed by Alberta (1984), Saskatchewan (1984), Ontario (1989), Manitoba (1993) and New Brunswick (2004).

However, Manitoba, New Brunswick, Nova Scotia and Prince Edward Island still have statutory Sunday closing provisions. Following the abolition of the federal *Lord's Day Act*, the three Maritime Provinces in 1985 and Manitoba in 1987 adopted new laws to ensure that retail businesses remained closed on Sundays. However, Manitoba and New Brunswick have relaxed

these restrictions over time by allowing shops to open on a number of Sundays during the year (mainly around Christmas time).

FIGURE 12

EVOLUTION OF THE RETAIL DISTRIBUTION INDEX, 1984-2008

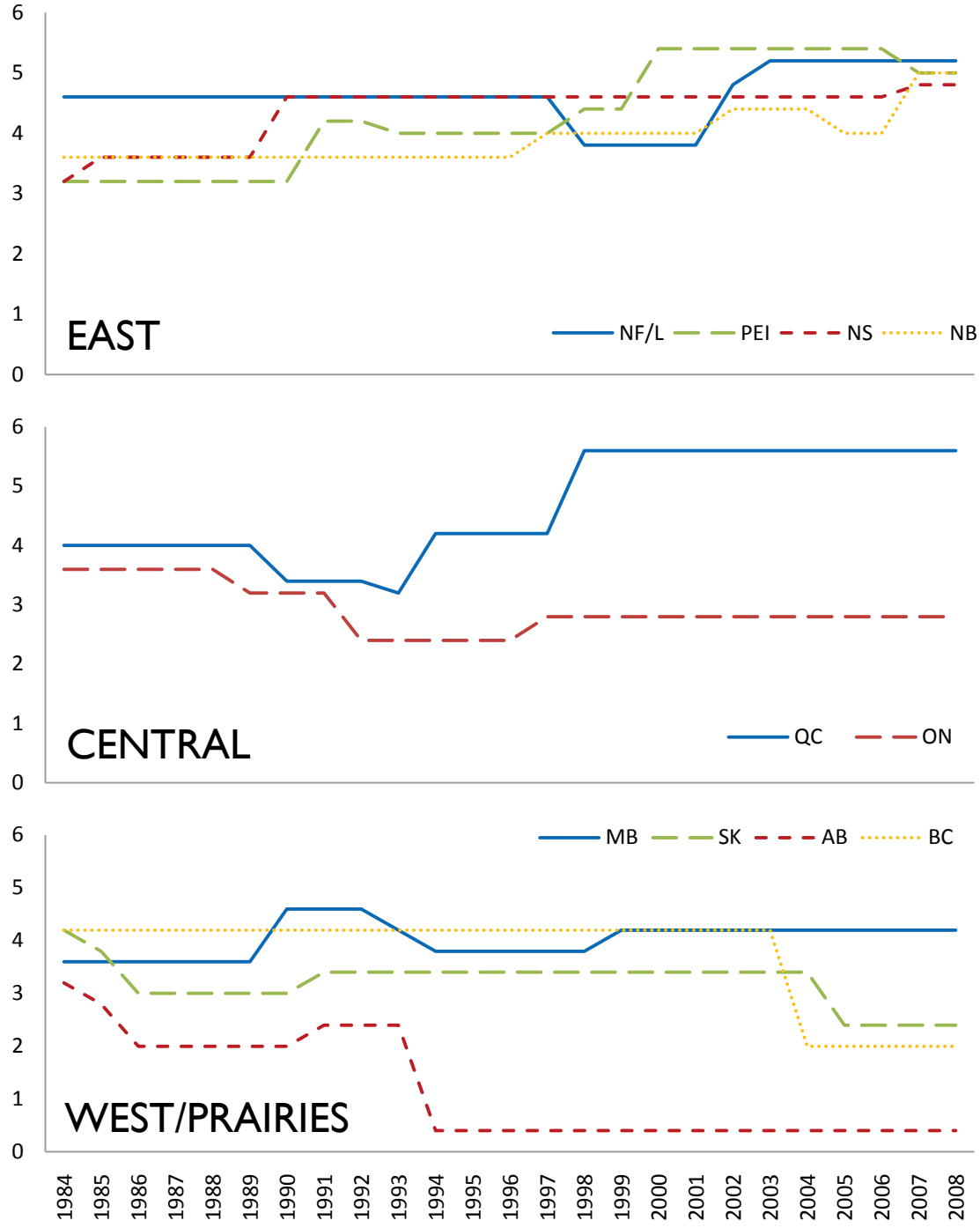


Figure 12 shows the evolution of the retail distribution PMR index. It appears that, in contrast with the energy sector, the provinces did not all move in the same direction in terms of regulation. From Figure 13 we can see that a group of six provinces increased the level of regulatory oversight for retail distribution (Newfoundland/Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Québec and Manitoba). Many of these provinces saw their regulation index rise following the introduction of price controls over gasoline products (Québec, Newfoundland/Labrador, Nova Scotia, and New Brunswick). In some other cases, the introduction of price controls for alcoholic beverages in order to avoid abusive consumption was the reason of the rise of the index (Manitoba).

On the other hand, four provinces have reduced the regulatory burden (Alberta, Ontario, British Columbia, and Saskatchewan). These provinces have eliminated restrictions over store opening hours and some of them have liberalized – at least in part – the sale of alcoholic products.

Québec is one of the most restrictive provinces in regards to retail regulation. Indeed, in 1969 the government introduced a regulation limiting opening hours on week days. For example a commercial establishment cannot be open later than 21:00 on weekdays. This regulation is specific to Québec as no other provinces have such regulation in effect. The province is also one of the five jurisdictions in Canada to control gasoline prices, the others being the four Atlantic Provinces.

FIGURE 13

RETAIL DISTRIBUTION INDEX IN 1984 AND 2008

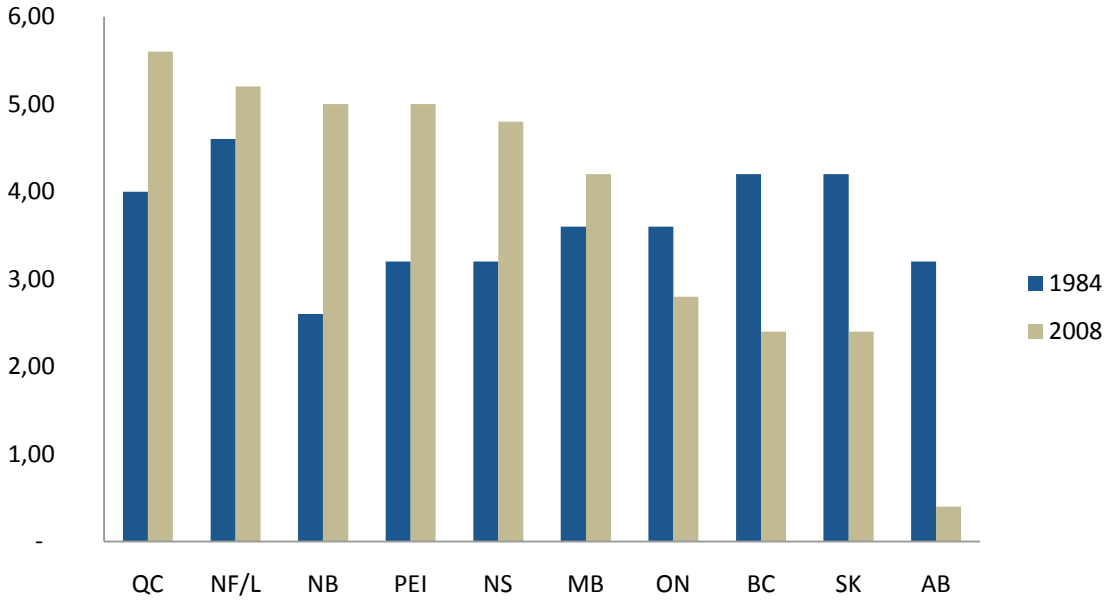
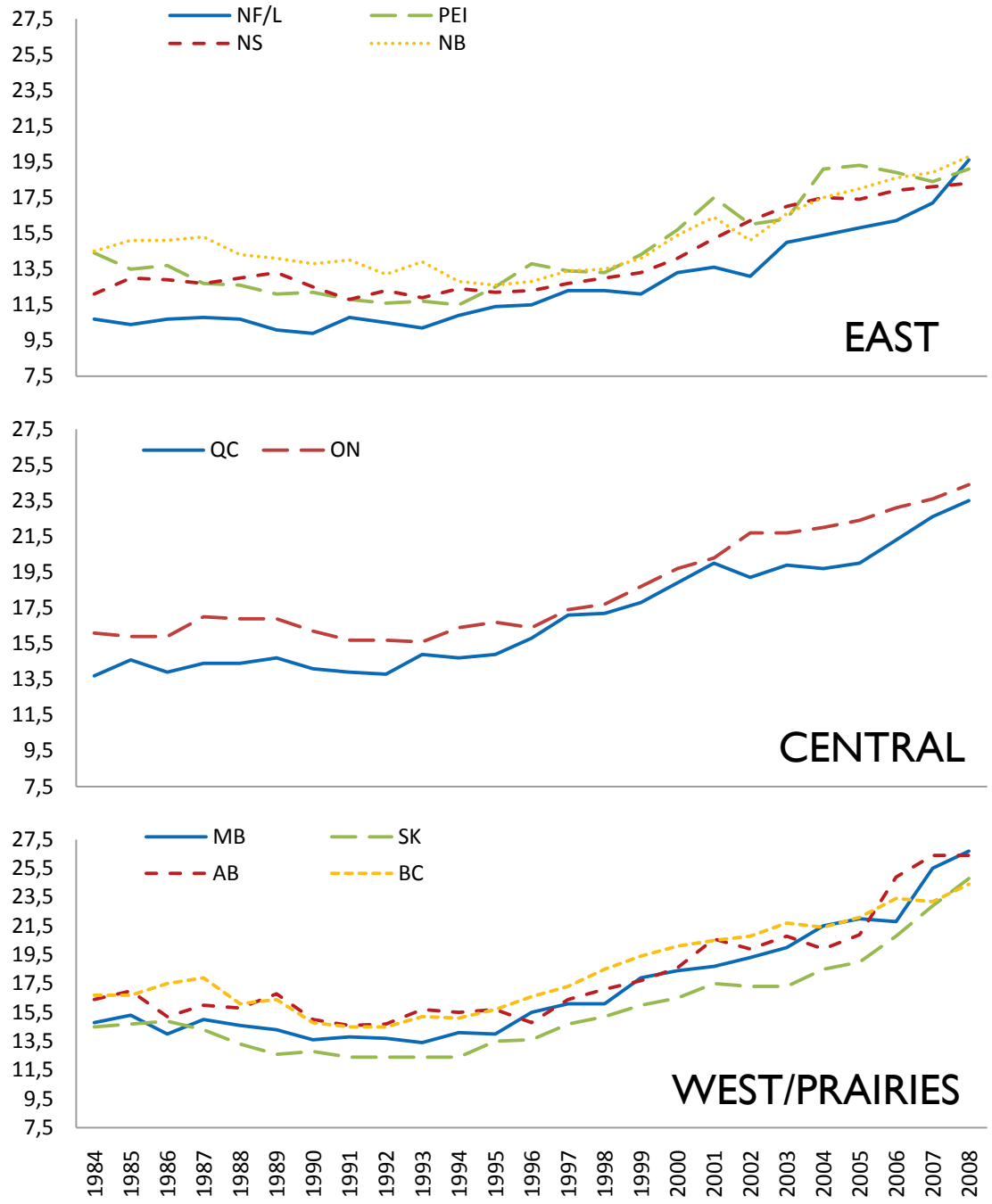


FIGURE 14

EVOLUTION OF LABOR PRODUCTIVITY, RETAIL DISTRIBUTION, 1984-2008

(Dollars per hour)



From Figure 14, it is clear that labor productivity in retail has been upward trending since 1984. It is also very difficult to associate the variation in regulation to the evolution of labor

productivity since every province saw their productivity increase during this period. However, individually some provinces have interesting patterns. For example, Newfoundland which regulated the most its retail industry in the past 25 years has also been the province with the biggest growth in labor productivity for the industry. On the other hand, British Columbia shows the opposite. The province has one of the most liberalized retail markets, and one of the strongest decreases in the PMR index, but experienced poor labor productivity growth since 1984.

It seems that no general relation seems to take place between regulation and productivity in the retail sector as shown in Table 5. Clearly, the figures say nothing about any apparent link between these two variables. Some of the most restrictive provinces have presented the best productivity growth performance (for example, Newfoundland/Labrador or Manitoba). The following empirical analysis will help us uncover whether such a link exists or not.

TABLE 5

LABOR PRODUCTIVITY GROWTH AND PMR INDEX GROWTH FOR RETAIL, 1984-2008

(Percentage)

	NF/L	PEI	NS	NB	QC	ON	MB	SK	AB	BC
Labor productivity growth	83.2	32.6	51.2	36.6	71.5	51.6	80.4	71.0	61.0	46.1
PMR growth	13.0	56.3	50.0	38.9	40.0	-22.2	16.7	-42.9	-87.5	-52.4

5. ANALYSIS AND RESULTS

From the previous section, we have an idea of the general trends in PMR and productivity in each industry in each province. In this section, we perform a full statistical analysis of this relationship. More specifically, we are interested in testing the effect of regulation on productivity in each of the three industries we study across the ten provinces.

EMPIRICAL APPROACH

Our empirical approach uses the differences in regulation across provinces and time in order to identify the effect of regulation on productivity. Our main empirical model is given by

$$(1) \qquad PROD_{pit} = \beta_1 PROD_{pit-1} + \beta_2 REG_{pit} + \beta_{3p} TREND_t + \delta_p + \tau_t + \varepsilon_{pt}$$

where δ_p and τ_t are vectors of province and time effects, respectively. $TREND_t$ is a time trend specific to province p. $PROD_{pit}$ is the level of labor productivity in province *p,* industry *i,* and time *t*. $PROD_{pit-1}$ is the lagged level of labor productivity and REG_{pit} is the level of the regulation index. Thus, the coefficient β_2 captures the effect of the level of regulation on productivity. We use a dynamic panel data method since we expect a province's productivity level to be quite persistent over time. Apart from this benchmark specification, we also estimate the equation using lagged regulation as well as both lagged and contemporary level in order to account for the possible delay before a change in regulation affects the level of productivity.

The fixed-effect approach allows us to account for unobserved heterogeneity. δ_p allows for arbitrary correlation between the unobservable province effect and the observed explanatory variables – namely regulation. Identification of the effect of regulation relies solely on variation over time within provinces.

While this approach allows us to account for unobserved heterogeneity, given our dynamic panel data structure, it suffers from an endogeneity problem. In our context, this problem arises for two reasons. First, since (1) is inherently dynamic, the lagged level of productivity will by construction be correlated with lagged values of ε_{pt}. Second, regulation may also be endogenous. Unobserved factors that directly influence productivity may also affect the decision to regulate/deregulate.

Methods proposed by Arellano and Bond (1991) are often used to address these issues. These methods involve using lagged values of the dependent variable and lagged values of the endogenous right-hand-side variables as instruments. These represent valid instruments when the error terms are serially uncorrelated. We also present results using these methods, but it should be noted that they are mostly designed for panels with large cross sections and relatively short time series. We have a small cross section (just the ten provinces), but a relatively long time series (twenty-five years). In contrast, the least square dummy variable estimator with fixed-effect performs well for panels with long time series, and this is our main specification.

TABLE 6

EFFECT OF PMR ON PRODUCTIVITY, FE AND A-B ESTIMATION USING REGULATION INDEX

	Fixed effects			Arellano-Bond		
	(1)	(2)	(3)	(4)	(5)	(6)
A. ELECTRICITY						
REG_t	-11.025**		-12.328*	-11.834***		-12.883***
	(0.028)		(0.087)	(0.000)		(0.002)
REG_{t-1}		-4.356	2.415		-5.030*	1.964
		(0.277)	(0.711)		(0.077)	(0.681)
$PROD_{t-1}$	.513***	.558***	.521***	.505***	.551***	.512***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# of periods	24	24	24	24	24	24
# of provinces	5	5	5	5	5	5
Sargan test					97.734 (0.163)	
AR2 test					.398 (0.691)	
B. NATURAL GAS						
REG_t	-0.909		4.469	-0.909		4.520
	(0.962)		(0.864)	(0.949)		(0.810)
REG_{t-1}		-5.654	-8.270		-5.748	-8.413
		(0.287)	(0.489)		(0.140)	(0.288)
$PROD_{t-1}$	.512**	.510**	.512**	.512***	.510***	.512***
	(0.024)	(0.028)	(0.034)	(0.000)	(0.000)	(0.000)
# of periods	24	24	24	24	24	24
# of provinces	5	5	5	5	5	5
Sargan test					96.860 (0.179)	
AR2 test					-.993 (0.321)	
C. UTILITIES						
REG_t	-4.208		-7.399***	-4.972*		-7.397***
	(0.231)		(0.008)	(0.075)		(0.000)
REG_{t-1}		-0.623	4.430*		-0.852	3.384*
		(0.845)	(0.098)		(0.748)	(0.060)
$PROD_{t-1}$	.566***	.590***	.568***	.569***	.589***	.570***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# of periods	24	24	24	24	24	24
# of provinces	9	9	9	9	9	9
Sargan test					182.533 (0.166)	
AR2 test					.620 (0.536)	
D. RETAIL						
REG_t	0.150		0.125	0.196		0.173
	(0.318)		(0.467)	(0.112)		(0.234)
REG_{t-1}		0.125	0.035		0.163	0.031
		(0.326)	(0.779)		(0.167)	(0.767)
$PROD_{t-1}$	.540***	.535***	.538***	.525***	.525***	.523***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# of periods	24	24	24	24	24	24
# of provinces	10	10	10	10	10	10
Sargan test					202.369 (0.181)	
AR2 test					-1.518 (0.129)	

Notes: p-values corrected with Huber-White robust standard errors clustered on provinces reported in parenthesis (fixed effects). *p-values* corrected with Arellano-Bond robust VCE standard errors reported in parenthesis (Arellano-Bond).
Sargan test is a test of over-identifying restrictions (*p-value* reported in parenthesis). AR2 test is for second-order serial correlation of residuals from the first difference equation (*p-value* reported in parenthesis).
The instrument set includes lagged values of the dependent variable dated *t*-2, *t*-3 and earlier and regulation index dated *t*-2 and earlier.
*, **, *** significant at 10, 5 and 1% respectively.

As mentioned previously, in the case of natural gas and electricity, the estimations were performed on the five largest Canadian provinces, namely Québec, Ontario, Manitoba, Alberta, and British Columbia, since productivity measures for these industries are confidential and unpublished for the other provinces.

Table 6 reports the results of the estimation using aggregate PMR index for the three industries, plus for electricity and natural gas combined (since doing so allows us to look at the full set of provinces).[9] First of all, the coefficient for lag productivity is positive and significant in all the regressions performed, meaning that the level of productivity is persistent over time.[10]

In the electricity sector, the results in column 1 show that a lower score in the regulation index is correlated with higher productivity level. In other words, the results suggest that regulation and labor productivity are linked negatively and significantly for the electricity sector. This link is robust to different specifications (different estimation procedures and regulation indices) including the Arellano-Bond estimator. More concretely, a one unit decrease in the index is associated with an increase in productivity of $11.03/hour in the electricity sector. If we trust that the dynamic panel data methods have successfully controlled for endogeneity problems, we can interpret this relationship as being causal. In the case of the Arellano-Bond estimator, a one unit decrease in the regulation index will increase productivity by $11.83/hour. In other words, a one unit decrease in the regulation index raises productivity by more than 5 %. This finding is of particular interest since many provinces still maintain heavy regulation and are reluctant to liberalize this industry.

As a robustness check the alternative productivity measure mentioned above, the ratio between kilowatts produced and hours worked, is used to validate the relationship between regulation and productivity in the electricity sector. The results in table 7 indicate that the choice of productivity measure is not a decisive factor in the identification of a link between the two variables. While the estimation using regular fixed-effects estimation produces coefficients for regulation that are not significant, they are of the expected sign (negative). Moreover, when using the Arellano and Bond estimator, the results are significant and of the same sign as with the standard productivity measure. More precisely, we find that lowering the regulation index by one unit, increases productivity by more than 0.12 kilowatt/hours worked. When considering that the average productivity in the industry is 4.68 kilowatts produced/hours worked, a one unit decrease in the regulation index raises productivity by more than 2 %. While the results using both measures of productivity for the electricity industry are not exactly similar, they are qualitatively comparable.

[9] The values of the Sargan and AR2 test confirm that our specification is valid. The Sargan test of over-identifying restrictions indicates that the hypothesis of absence of correlation between instruments and residuals cannot be rejected. In the same manner, the AR2 test for second-order serial correlation of residuals from the first difference equation does not reject the null hypothesis of absence of correlation.

[10] Detailed results of estimations are available in appendix 1.

TABLE 7

EFFECT OF PMR ON PRODUCTIVITY (kWh/HOUR) IN THE ELECTRICITY SECTOR, FE AND A-B ESTIMATION USING REGULATION INDEX

	Fixed effects			Arellano-Bond		
	(1)	(2)	(3)	(4)	(5)	(6)
REG_t	-.105		-.273	-.122*		-.284*
	(0.216)		(0.236)	(0.062)		(0.072)
REG_{t-1}		.120			.106	.269
		(0.530)			(0.426)	(0.236)
$PROD_{t-1}$	.422***	.463***	.426**	.415***	.458***	.420***
	(0.008)	(0.006)	(0.014)	(0.000)	(0.000)	(0.000)
# of periods	24	24	24	24	24	24
# of provinces	5	5	5	5	5	5
Sargan test					94.629 (0.223)	
AR2 test					.574 (0.566)	

Turning to natural gas, we find no significant relationship between regulation and productivity regardless of specification. When natural gas is combined with electricity to form the Energy regulation index and when we use the productivity measure for Utilities, we find a negative link only when both the present and lagged values of the regulation index are included in the specification.[11] Given the results for electricity and natural gas alone, it is possible that the results for energy as a whole are mostly generated by the electricity sector. But it could be that in the five provinces for which we do not have industry-specific information, there is an effect of regulation on productivity in the natural gas sector.

Finally, in retail trade the results show an absence of link between the regulation and the level of productivity for the industry. This is not surprising given what we saw in the previous section: productivity in all provinces has been improving, while regulation has increased in some and decreased in others. In this sector, our PMR variables are not exhaustive and so may not reflect adequately the complete picture of the regulatory environment in the provinces. For example, our index does not include pricing regulation for food products (for example, milk, eggs, etc.). Ideally, we would have productivity measures for each of the specific industries for which we have collected PMR variables, namely alcohol retailing and gasoline. With this information we might have expected to find more evidence of a link between regulation and productivity.

More generally, there may just be insufficient variation in the regulation index for retail and for natural gas to identify an effect. One thing we have done to try to address this is to repeat the

[11] For confidentiality reasons, we couldn't estimate the effect of regulation in the energy sector directly on the labor productivity of this industry. In fact, Statistics Canada does not publish data on labor productivity for the energy sector and does only so for the Utilities which comprise the electricity industry, the natural gas distribution industry and water supply and sewage industry.

estimation using three year blocks of data. The results were very similar to the ones presented above and so we excluded them from the report.

Also, it is possible that specific regulations actually work in opposite direction and may counteract each other so that when aggregating into an index it is impossible to identify the link between regulation and productivity in a general sense while precise reforms have the potential to enhance or reduce productivity. This suggests that studying the disaggregated effects of various regulations might be worthwhile.

6. CONCLUSION

The main contribution of this report is to build measures of regulatory activity in a number of key industries in each province over the entire period of liberalization. This measure was constructed by examining in detail the acts and their revisions over the past thirty years.

Our measure characterizes the liberalization process in both the electricity and natural gas industries and illustrates that there was variation in the timing of deregulation across provinces. In the retail sector, there is interesting and important heterogeneity in the evolution of the level of regulatory activity across provinces. In some, the level of regulatory activity decreased enormously, while in others it actually increased.

We have then linked this measure with a measure of labor productivity in an attempt to determine whether there is a relationship between the two. Our results suggest that there is an important link between regulation and productivity in the electricity sector. In the natural gas and retail sectors, we find no evidence of such a link, but this could be due to data limitations.

In future work we intend to look more carefully at the role of the individual factors that make up the indices and to study the effect of these on productivity. Of course, here again the data requirements are quite stringent and so, this analysis must be done with care.

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APPENDIX 1

RESULTS OF THE ESTIMATION USING FIXED EFFECT AND ARELLANO-BOND ESTIMATOR, ELECTRICITY (DOLLARS/HOURS WORKED)

(*p-value* in parenthesis)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
1987	-14.840	-13.867	-14.668	-15.009	-14.012	-14.866
	(0.629)	(0.664)	(0.638)	(0.496)	(0.542)	(0.504)
1988	-26.455	-23.339	-25.902	-26.994	-23.802	-26.538
	(0.564)	(0.625)	(0.577)	(0.410)	(0.489)	(0.422)
1989	-24.129	-18.416	-23.115	-25.118	-19.266	-24.280
	(0.702)	(0.781)	(0.716)	(0.581)	(0.689)	(0.595)
1990	4.353	12.266	5.757	2.983	11.089	4.143
	(0.959)	(0.892)	(0.946)	(0.961)	(0.867)	(0.947)
1991	-20.493	-11.763	-18.943	-22.004	-13.061	-20.724
	(0.839)	(0.911)	(0.852)	(0.765)	(0.865)	(0.778)
1992	6.069	17.313	8.065	4.123	15.641	5.772
	(0.959)	(0.891)	(0.946)	(0.962)	(0.865)	(0.947)
1993	-7.786	4.522	-5.601	-9.915	2.692	-8.111
	(0.954)	(0.975)	(0.967)	(0.921)	(0.979)	(0.935)
1994	24.240	38.692	26.805	21.739	36.543	23.858
	(0.873)	(0.809)	(0.861)	(0.844)	(0.753)	(0.829)
1995	22.130	37.210	24.807	19.521	34.968	21.732
	(0.897)	(0.836)	(0.885)	(0.875)	(0.789)	(0.861)
1996	33.099	55.920	35.273	29.783	53.471	31.594
	(0.853)	(0.777)	(0.844)	(0.819)	(0.709)	(0.808)
1997	32.440	60.536	35.352	28.462	57.564	30.882
	(0.879)	(0.788)	(0.870)	(0.855)	(0.725)	(0.844)
1998	32.222	58.756	36.847	28.044	55.192	31.859
	(0.890)	(0.812)	(0.875)	(0.869)	(0.759)	(0.851)
1999	13.179	47.906	17.303	8.243	44.107	11.660
	(0.953)	(0.842)	(0.939)	(0.960)	(0.801)	(0.944)
2000	19.482	53.938	25.471	14.140	49.387	19.080
	(0.941)	(0.846)	(0.923)	(0.941)	(0.808)	(0.921)
2001	9.445	47.732	15.540	3.633	42.899	8.666
	(0.972)	(0.867)	(0.953)	(0.985)	(0.837)	(0.964)
2002	29.381	73.908	35.756	22.825	68.613	28.095
	(0.915)	(0.804)	(0.898)	(0.910)	(0.752)	(0.889)
2003	28.117	74.038	35.445	21.218	68.300	27.268
	(0.926)	(0.822)	(0.908)	(0.924)	(0.776)	(0.903)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2		1	2	
2004	**54.068**	**100.585**	**62.140**	**46.915**	**94.495**	**53.573**
	(0.868)	(0.775)	(0.850)	(0.843)	(0.712)	(0.822)
2005	34.047	81.119	42.218	26.798	74.946	33.538
	(0.920)	(0.823)	(0.901)	(0.914)	(0.776)	(0.892)
2006	41.906	92.242	50.33	34.202	85.747	41.153
	(0.904)	(0.806)	(0.886)	(0.893)	(0.754)	(0.872)
2007	52.965	105.645	61.798	44.89	98.834	52.179
	(0.884)	(0.788)	(0.866)	(0.866)	(0.730)	(0.844)
2008	39.804	93.334	49.107	31.506	86.264	39.180
	(0.916)	(0.818)	(0.897)	(0.909)	(0.770)	(0.887)
Alberta TREND	-5.309	-6.382	-5.506	-5.097	-6.198	-5.261
	(0.763)	(0.732)	(0.757)	(0.689)	(0.646)	(0.680)
British Columbia TREND	-7.456	-9.033	-7.759	-7.387	-8.973	-7.635
	(0.668)	(0.627)	(0.659)	(0.554)	(0.500)	(0.542)
Manitoba TREND	-5.023	-7.304	-5.397	-4.418	-6.786	-4.730
	(0.769)	(0.692)	(0.755)	(0.723)	(0.612)	(0.704)
Ontario TREND	-5.344	-6.310	-5.535	-5.312	-6.281	-5.467
	(0.761)	(0.735)	(0.755)	(0.676)	(0.641)	(0.668)
Québec TREND	-5.477	-6.920	-5.713	-5.124	-6.619	-5.321
	(0.753)	(0.709)	(0.745)	(0.683)	(0.621)	(0.673)
Constant	205.781**	163.199**	198.606**			
	(0.018)	(0.027)	(0.021)			

APPENDIX 1 (CONTINUED)

RESULTS OF THE ESTIMATION USING FIXED EFFECT AND ARELLANO-BOND ESTIMATOR, ELECTRICITY (KILOWATTS/HOURS WORKED)

(*p-value* in parenthesis)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
1987	0.968	1.023	0.974	0.959	1.017	0.965
	(0.529)	(0.520)	(0.525)	(0.267)	(0.367)	(0.371)
1988	1.609	1.702	1.618	1.593	1.692	1.604
	(0.379)	(0.369)	(0.372)	(0.229)	(0.194)	(0.197)
1989	2.914	3.053	2.928	2.891	3.038	2.907
	(0.326)	(0.322)	(0.321)	(0.110)	(0.147)	(0.144)
1990	3.073	3.233	3.090	3.047	3.215	3.065
	(0.322)	(0.318)	(0.316)	(0.183)	(0.143)	(0.140)
1991	4.810	5.027	4.833	4.774*	5.003*	4.799*
	(0.263)	(0.263)	(0.258)	(0.087)	(0.095)	(0.089)
1992	5.320	5.545	5.343	5.283	5.520*	5.308*
	(0.258)	(0.259)	(0.254)	(0.107)	(0.091)	(0.085)
1993	6.562	6.825	6.589	6.518*	6.796*	6.548*
	(0.234)	(0.237)	(0.230)	(0.084)	(0.074)	(0.067)
1994	7.619	7.901	7.648	7.572*	7.870*	7.603*
	(0.244)	(0.247)	(0.240)	(0.076)	(0.081)	(0.074)
1995	8.441	8.744	8.472	8.391*	8.711*	8.425*
	(0.246)	(0.250)	(0.243)	(0.078)	(0.083)	(0.076)
1996	9.793	10.187	9.730	9.728*	10.150*	9.672*
	(0.251)	(0.250)	(0.247)	(0.064)	(0.083)	(0.080)
1997	10.475	11.012	10.468	10.397*	10.967*	10.396*
	(0.254)	(0.251)	(0.250)	(0.071)	(0.084)	(0.082)
1998	10.874	11.515	11.044	10.792*	11.459*	10.962*
	(0.262)	(0.260)	(0.258)	(0.084)	(0.092)	(0.088)
1999	11.645	12.400	11.719	11.544*	12.338*	11.623*
	(0.255)	(0.248)	(0.251)	(0.088)	(0.083)	(0.083)
2000	12.835	13.704	13.079	12.727*	13.629*	12.972*
	(0.260)	(0.255)	(0.254)	(0.080)	(0.088)	(0.086)
2001	13.476	14.388	13.693	13.361*	14.310*	13.580*
	(0.267)	(0.261)	(0.261)	(0.085)	(0.093)	(0.092)
2002	14.556	15.571	14.754	14.427*	15.487	14.629
	(0.285)	(0.276)	(0.280)	(0.081)	(0.106)	(0.107)
2003	15.663	16.776	15.948	15.527*	16.683	15.814
	(0.286)	(0.278)	(0.276)	(0.076)	(0.107)	(0.104)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
2004	15.602	16.758	15.945	15.462*	16.661*	15.805*
	(0.267)	(0.262)	(0.262)	(0.095)	(0.094)	(0.092)
2005	17.377	18.599	17.727	17.227*	18.495*	17.577*
	(0.265)	(0.261)	(0.260)	(0.078)	(0.093)	(0.090)
2006	17.823	19.065	18.157	17.669*	18.960*	18.004*
	(0.270)	(0.266)	(0.264)	(0.085)	(0.097)	(0.094)
2007	18.762	20.068	19.111	18.600*	19.957	18.950*
	(0.276)	(0.273)	(0.272)	(0.084)	(0.103)	(0.100)
2008	19.678	21.029	20.058	19.510*	20.913*	19.891*
	(0.268)	(0.265)	(0.263)	(0.083)	(0.096)	(0.093)
Alberta TREND	-0.881	-0.895	-0.875	-0.878*	-0.894*	-0.873*
	(0.264)	(0.264)	(0.259)	(0.079)	(0.095)	(0.089)
British Columbia TREND	-0.985	-1.023	-0.995	-0.982**	-1.021*	-0.993*
	(0.229)	(0.230)	(0.226)	(0.048)	(0.068)	(0.063)
Manitoba TREND	-0.920	-0.976	-0.935	-0.906*	-0.965*	-0.921*
	(0.254)	(0.252)	(0.250)	(0.070)	(0.085)	(0.083)
Ontario TREND	-0.908	-0.921	-0.903	-0.907*	-0.920*	-0.902*
	(0.254)	(0.255)	(0.249)	(0.069)	(0.088)	(0.081)
Québec TREND	-0.907	-0.937	-0.909	-0.902*	-0.934*	-0.904*
	(0.256)	(0.256)	(0.251)	(0.070)	(0.088)	(0.083)
Constant	5.983**	4.631**	5.378**			
	(0.042)	(0.029)	(0.030)			

APPENDIX 1 (CONTINUED)

RESULTS OF THE ESTIMATION USING FIXED EFFECT AND ARELLANO-BOND ESTIMATOR, NATURAL GAS

(*p-value* in parenthesis)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
1987	11.169	9.449	8.685	11.169	9.424	8.646
	(0.839)	(0.866)	(0.881)	(0.780)	(0.818)	(0.838)
1988	-6.734	-10.163	-11.701	-6.734	-10.215	-11.782
	(0.956)	(0.934)	(0.927)	(0.940)	(0.909)	(0.899)
1989	14.651	9.187	5.581	14.651	9.115	5.452
	(0.922)	(0.951)	(0.972)	(0.894)	(0.933)	(0.962)
1990	19.041	13.290	8.356	19.040	13.219	8.214
	(0.927)	(0.948)	(0.969)	(0.900)	(0.929)	(0.958)
1991	23.525	17.681	12.428	23.524	17.614	12.286
	(0.924)	(0.942)	(0.961)	(0.896)	(0.921)	(0.947)
1992	29.753	22.344	15.186	29.752	22.258	15.001
	(0.919)	(0.938)	(0.960)	(0.889)	(0.916)	(0.946)
1993	35.023	27.316	18.840	35.021	27.233	18.643
	(0.916)	(0.933)	(0.957)	(0.886)	(0.909)	(0.941)
1994	43.170	35.165	25.370	43.168	35.085	25.162
	(0.911)	(0.926)	(0.949)	(0.878)	(0.899)	(0.931)
1995	51.398	43.168	32.391	51.396	43.090	32.174
	(0.905)	(0.918)	(0.942)	(0.870)	(0.889)	(0.921)
1996	62.927	53.977	41.676	62.925	53.894	41.435
	(0.896)	(0.908)	(0.933)	(0.858)	(0.875)	(0.909)
1997	112.239	103.006	89.373	112.236	102.924	89.119
	(0.833)	(0.843)	(0.871)	(0.773)	(0.786)	(0.824)
1998	85.047	75.749	61.383	85.045	75.659	61.111
	(0.883)	(0.893)	(0.918)	(0.840)	(0.854)	(0.888)
1999	104.585	93.850	76.448	104.583	93.751	76.131
	(0.868)	(0.879)	(0.906)	(0.820)	(0.834)	(0.872)
2000	130.860	121.611	103.998	130.857	121.541	103.713
	(0.846)	(0.853)	(0.881)	(0.790)	(0.799)	(0.837)
2001	117.230	107.304	88.130	117.228	107.224	87.815
	(0.871)	(0.878)	(0.906)	(0.824)	(0.834)	(0.871)
2002	136.401	126.164	105.682	136.398	126.088	105.358
	(0.858)	(0.865)	(0.893)	(0.807)	(0.816)	(0.854)
2003	107.613	97.098	75.281	107.610	97.023	74.942
	(0.894)	(0.902)	(0.928)	(0.856)	(0.866)	(0.902)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2		1	2	
2004	121.018	110.146	87.061	121.014	110.080	86.719
	(0.888)	(0.895)	(0.921)	(0.847)	(0.857)	(0.892)
2005	125.689	114.504	90.114	125.685	114.444	89.763
	(0.890)	(0.896)	(0.923)	(0.849)	(0.859)	(0.895)
2006	141.551	130.058	104.358	141.547	130.001	103.997
	(0.883)	(0.889)	(0.916)	(0.840)	(0.848)	(0.885)
2007	156.514	144.807	118.115	156.509	144.752	117.744
	(0.875)	(0.881)	(0.908)	(0.830)	(0.838)	(0.875)
2008	156.260	143.852	115.618	156.255	143.789	115.221
	(0.881)	(0.887)	(0.915)	(0.838)	(0.846)	(0.883)
Alberta TREND	-5.943	-5.790	-4.372	-5.942	-5.797	-4.364
	(0.899)	(0.898)	(0.927)	(0.862)	(0.860)	(0.900)
British Columbia TREND	-7.195	-6.992	-5.631	-7.195	-6.999	-5.624
	(0.878)	(0.877)	(0.907)	(0.834)	(0.833)	(0.872)
Manitoba TREND	-6.696	-6.182	-4.943	-6.696	-6.198	-4.948
	(0.885)	(0.891)	(0.918)	(0.844)	(0.851)	(0.887)
Ontario TREND	-7.306	-6.980	-5.696	-7.306	-6.975	-5.675
	(0.876)	(0.878)	(0.906)	(0.831)	(0.833)	(0.871)
Québec TREND	-6.019	-5.742	-4.436	-6.019	-5.730	-4.406
	(0.897)	(0.898)	(0.926)	(0.859)	(0.861)	(0.899)
Constant	66.838	87.060	76.213			
	(0.699)	(0.510)	(0.639)			

APPENDIX 1 (CONTINUED)

RESULTS OF THE ESTIMATION USING FIXED EFFECT AND ARELLANO-BOND ESTIMATOR, UTILITIES

(*p-value* in parenthesis)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
1987	-3.43	-2.779	-3.301	-3.459	-2.801	-3.354
	(0.868)	(0.895)	(0.875)	(0.843)	(0.874)	(0.848)
1988	0.967	2.137	1.881	0.998	2.073	1.712
	(0.978)	(0.953)	(0.958)	(0.973)	(0.945)	(0.954)
1989	-3.726	-2.355	-2.131	-3.572	-2.443	-2.330
	(0.941)	(0.963)	(0.966)	(0.934)	(0.955)	(0.956)
1990	18.420	20.252	20.342	18.718	20.158	20.220
	(0.777)	(0.759)	(0.753)	(0.733)	(0.717)	(0.709)
1991	14.865	16.914	16.877	15.209	16.818	16.784
	(0.851)	(0.833)	(0.830)	(0.819)	(0.803)	(0.799)
1992	25.587	27.856	28.186	26.054	27.742	28.085
	(0.788)	(0.773)	(0.766)	(0.745)	(0.732)	(0.723)
1993	35.141	38.220	37.509	35.590	38.102	37.452
	(0.741)	(0.724)	(0.724)	(0.691)	(0.675)	(0.673)
1994	46.536	49.542	49.937	47.086	49.383	49.741
	(0.705)	(0.692)	(0.684)	(0.649)	(0.637)	(0.627)
1995	48.805	51.861	52.427	49.433	51.701	52.262
	(0.724)	(0.712)	(0.704)	(0.671)	(0.661)	(0.650)
1996	71.194	75.042	74.701	71.810	74.873	74.559
	(0.640)	(0.629)	(0.621)	(0.573)	(0.565)	(0.554)
1997	81.973	86.205	85.906	82.530	85.998	85.606
	(0.638)	(0.627)	(0.622)	(0.572)	(0.562)	(0.555)
1998	76.913	81.242	81.587	77.474	80.995	81.120
	(0.680)	(0.668)	(0.661)	(0.620)	(0.610)	(0.600)
1999	86.320	91.142	91.464	86.935	90.868	90.948
	(0.661)	(0.649)	(0.641)	(0.598)	(0.587)	(0.577)
2000	90.253	95.209	95.999	90.960	94.913	95.437
	(0.676)	(0.665)	(0.656)	(0.616)	(0.606)	(0.595)
2001	92.517	99.219	97.456	93.050	98.915	96.922
	(0.681)	(0.666)	(0.665)	(0.622)	(0.607)	(0.606)
2002	107.672	114.850	114.216	108.234	114.455	113.342
	(0.653)	(0.638)	(0.633)	(0.590)	(0.575)	(0.569)
2003	106.334	113.551	113.580	106.964	113.127	112.612
	(0.678)	(0.663)	(0.657)	(0.619)	(0.604)	(0.597)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2		1	2	
2004	120.602	128.132	128.220	121.330	127.696	127.270
	(0.660)	(0.646)	(0.639)	(0.597)	(0.584)	(0.576)
2005	120.588	129.413	127.626	121.176	128.968	126.68
	(0.672)	(0.655)	(0.653)	(0.612)	(0.595)	(0.593)
2006	132.324	141.248	140.961	133.006	140.728	139.739
	(0.658)	(0.642)	(0.636)	(0.595)	(0.580)	(0.573)
2007	143.210	152.562	151.953	143.918	152.033	150.738
	(0.649)	(0.634)	(0.628)	(0.585)	(0.570)	(0.564)
2008	136.628	145.886	146.094	137.432	145.332	144.807
	(0.676)	(0.661)	(0.654)	(0.616)	(0.601)	(0.594)
Alberta TREND	-6.858	-6.793	-7.092	-7.210	-7.036	-7.390
	(0.644)	(0.652)	(0.633)	(0.561)	(0.576)	(0.549)
British Columbia TREND	-9.220	-9.270	-9.539	-9.059	-8.924	-9.317
	(0.539)	(0.543)	(0.524)	(0.466)	(0.479)	(0.450)
Manitoba TREND	-7.508	-7.894	-7.887	-7.382	-7.924	-7.672
	(0.611)	(0.599)	(0.592)	(0.548)	(0.528)	(0.529)
New Brunswick TREND	-8.687	-8.384	-8.948	-9.105	-8.552	-9.295
	(0.564)	(0.583)	(0.553)	(0.474)	(0.507)	(0.462)
Nova Scotia TREND	-7.763	-7.691	-8.038	-8.116	-8.110	-8.321
	(0.603)	(0.612)	(0.590)	(0.517)	(0.522)	(0.504)
Ontario TREND	-7.403	-7.374	-7.642	-7.560	-7.109	-7.760
	(0.619)	(0.626)	(0.608)	(0.542)	(0.571)	(0.529)
Québec TREND	-7.855	-7.909	-8.116	-8.203	-8.180	-8.402
	(0.598)	(0.602)	(0.586)	(0.516)	(0.524)	(0.503)
Saskatchewan TREND	-5.175	-5.555	-5.517	-4.999	-5.254	-5.283
	(0.723)	(0.709)	(0.705)	(0.684)	(0.675)	(0.664)
Newfoundland/Labrador TREND	-7.771	-8.046	-8.139	-7.554	-7.801	-7.841
	(0.600)	(0.594)	(0.582)	(0.535)	(0.529)	(0.516)
Constant	120.729**	98.985*	114.705*			
	(0.045)	(0.084)	(0.061)			

APPENDIX 1 (CONTINUED)

RESULTS OF THE ESTIMATION USING FIXED EFFECT AND ARELLANO-BOND ESTIMATOR, RETAIL DISTRIBUTION

(*p-value* in parenthesis)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2	3	4	5	6
1987	0.700	0.737	0.707	0.686	0.737	0.692
	(0.290)	(0.271)	(0.294)	(0.204)	(0.181)	(0.208)
1988	0.476	0.532	0.486	0.454	0.530	0.463
	(0.632)	(0.596)	(0.631)	(0.587)	(0.533)	(0.586)
1989	1.020	1.085	1.030	0.983	1.076	0.992
	(0.463)	(0.440)	(0.464)	(0.396)	(0.362)	(0.397)
1990	0.720	0.830	0.738	0.666	0.817	0.682
	(0.646)	(0.599)	(0.644)	(0.613)	(0.540)	(0.612)
1991	1.219	1.353	1.238	1.137	1.325	1.153
	(0.533)	(0.489)	(0.533)	(0.487)	(0.419)	(0.487)
1992	1.568	1.684	1.580	1.476	1.644	1.486
	(0.499)	(0.470)	(0.500)	(0.446)	(0.400)	(0.446)
1993	2.218	2.351	2.233	2.118	2.309	2.131
	(0.416)	(0.391)	(0.418)	(0.349)	(0.312)	(0.350)
1994	2.535	2.675	2.552	2.434	2.635	2.448
	(0.408)	(0.383)	(0.409)	(0.338)	(0.302)	(0.339)
1995	3.166	3.343	3.190	3.056	3.305	3.077
	(0.341)	(0.319)	(0.344)	(0.264)	(0.234)	(0.267)
1996	3.713	3.909	3.740	3.597	3.870	3.621
	(0.315)	(0.293)	(0.317)	(0.236)	(0.207)	(0.237)
1997	4.600	4.828	4.632	4.476	4.790	4.504
	(0.275)	(0.255)	(0.278)	(0.193)	(0.168)	(0.196)
1998	4.820	5.074	4.855	4.691	5.036	4.722
	(0.282)	(0.262)	(0.285)	(0.200)	(0.175)	(0.203)
1999	5.727	5.993	5.762	5.590	5.951	5.621
	(0.244)	(0.226)	(0.247)	(0.161)	(0.140)	(0.163)
2000	6.592	6.890	6.632	6.451	6.850	6.487
	(0.211)	(0.194)	(0.213)	(0.129)	(0.110)	(0.131)
2001	7.385	7.693	7.425	7.247	7.655*	7.282
	(0.197)	(0.183)	(0.200)	(0.116)	(0.100)	(0.118)
2002	7.016	7.367	7.063	6.875	7.334	6.917
	(0.246)	(0.226)	(0.248)	(0.162)	(0.139)	(0.164)
2003	8.212	8.568	8.257	8.056	8.525	8.096
	(0.202)	(0.186)	(0.205)	(0.121)	(0.103)	(0.123)

	FIXED EFFECTS			ARELLANO-BOND		
	1	2		1	2	
2004	8.789	9.129	8.831	8.644	9.088*	8.681
	(0.188)	(0.175)	(0.190)	(0.107)	(0.094)	(0.109)
2005	9.256	9.623	9.305	9.115	9.593*	9.159
	(0.194)	(0.181)	(0.196)	(0.111)	(0.098)	(0.113)
2006	10.358	10.763	10.415	10.213*	10.739*	10.264*
	(0.179)	(0.167)	(0.182)	(0.098)	(0.086)	(0.100)
2007	11.137	11.576	11.199	10.992*	11.558*	11.048*
	(0.178)	(0.166)	(0.181)	(0.097)	(0.084)	(0.099)
2008	11.962	12.414	12.026	11.821*	12.399*	11.879*
	(0.155)	(0.144)	(0.158)	(0.078)	(0.067)	(0.080)
Alberta TREND	-0.352	-0.369	-0.354	-0.345	-0.368	-0.347
	(0.324)	(0.305)	(0.326)	(0.239)	(0.215)	(0.241)
British Columbia TREND	-0.372	-0.388	-0.375	-0.366	-0.389	-0.369
	(0.297)	(0.284)	(0.300)	(0.212)	(0.193)	(0.215)
Prince Edward Island TREND	-0.402	-0.420	-0.405	-0.388	-0.411	-0.391
	(0.264)	(0.248)	(0.267)	(0.186)	(0.167)	(0.189)
Manitoba TREND	-0.424	-0.441	-0.427	-0.409	-0.433	-0.411
	(0.242)	(0.229)	(0.244)	(0.159)	(0.141)	(0.161)
New Brunswick TREND	-0.344	-0.359	-0.347	-0.350	-0.371	-0.353
	(0.331)	(0.317)	(0.333)	(0.228)	(0.210)	(0.230)
Nova Scotia TREND	-0.335	-0.353	-0.336	-0.331	-0.354	-0.332
	(0.347)	(0.323)	(0.348)	(0.259)	(0.231)	(0.261)
Ontario TREND	-0.270	-0.288	-0.273	-0.260	-0.285	-0.262
	(0.441)	(0.415)	(0.442)	(0.370)	(0.331)	(0.371)
Québec TREND	-0.299	-0.318	-0.301	-0.278	-0.306	-0.279
	(0.398)	(0.372)	(0.400)	(0.340)	(0.300)	(0.341)
Saskatchewan TREND	-0.282	-0.301	-0.283	-0.269	-0.296	-0.269
	(0.426)	(0.394)	(0.427)	(0.358)	(0.312)	(0.359)
Newfoundland/Labrador TREND	-0.322	-0.345	-0.324	-0.301	-0.329	-0.302
	(0.365)	(0.333)	(0.367)	(0.302)	(0.258)	(0.303)
Constant	6.976***	7.162***	6.965***			
	(0.000)	(0.000)	(0.000)			

Note: *, **, *** significant at 10, 5 and 1% respectively.