Does Canada Have the Dutch Disease?

Shane Bahmann and Matthew Campo

Abstract

This paper evaluates the presence of Dutch Disease in the Canadian economy arising through shocks to oil prices. The analysis consists of two parts: a short-run analysis of employment changes through deindustrialization and a long-run analysis of the impact on manufacturing total factor productivity (TFP). We find that in the short run, Canada is experiencing deindustrialization that is due partly to Dutch Disease and partly to structural change, consistent across most developed OECD countries. The long-run analysis shows that natural resource shocks have a negative effect on manufacturing TFP in turn damaging the competitiveness of the manufacturing sector. Overall, Dutch Disease is a very complex issue that is closely related to structural change. As a result, recent trends in the Canadian economy cannot be entirely attributed to Dutch Disease. Instead, there is a combination of many factors.

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Introduction

The economic phenomenon in which there exists an apparent relationship between natural resource exploitation and the deterioration of manufacturing or agricultural sectors, commonly referred to as the "Dutch Disease," has spawned a vast body of literature. This relationship became apparent following discovery of natural gas deposits in the North Sea region of the Netherlands in 1959 (*The Economist*, 1977). This discovery of natural gas increased revenues in the resource extraction sector and led to the appreciation of the Dutch Guilder. The appreciation of the Guilder resulted in a decrease in comparative advantage and initiated a process of deindustrialization, which occurs as the result of contracting employment levels in the manufacturing sector. Today, the term "Dutch Disease" is used as a general term to describe the economic changes observed in the Netherlands. That is, the Dutch Disease occurs when a country experiences a positive wealth shock, or 'boom', such as resource discovery or resource price shocks, that appreciates a country's currency. As a result, employment begins to shift away from other economic sectors, such as the manufacturing sector, and toward the booming natural resource sector. In turn, this employment shift leads to an overall decrease in productivity of the non-booming sector due largely to the effect of workers being unable to build upon learning-by-doing skills. In the long run, as the initial wealth shock begins to taper and the supply of natural resources begins to decrease, employment begins to shift back to the sectors in which it originated. At this point, the economic sector that experiences productivity losses becomes less competitive and now operates on a much smaller scale and as a result, the economy is left in a worse position relative to its starting point. This is due to the fact that resource wealth can create temporary gains but the long-run loss in productivity may outweigh the benefits of the initial wealth shock.

Much interest is derived from the observation that growth of resource-abundant countries is typically slower than less resource-abundant countries and the discrepancy is commonly attributed to the existence of natural resources (Sachs and Warner, 2001). This is intriguing. Associating resource wealth with negative effects appears counter-intuitive, as any type of wealth should seemingly be beneficial. In Canada, expansions in oil production and the related employment levels concurrent with higher world oil prices, an appreciating Canadian dollar, and a decrease in manufacturing employment levels has often been attributed to the Dutch Disease. Recently, there has been much debate over the existence of the condition within Canada and whether the observed changes can be attributed to structural change or Dutch Disease.

This paper will analyze the short-run effects on employment and long-run effects on total factor productivity in the Canadian economy primarily as a result of oil price shocks. Given the time frame of our analysis, we will not consider natural resource discovery as a mechanism of Dutch Disease. This is primarily due to significant discoveries of oil in Canada, which occurred much earlier in the 20th century. Instead, our research will focus on modern (late-20th century onward) oil price fluctuations as a potential mechanism of Dutch disease in Canada. In the short run, we aim to identify the presence of employment shifts from the lagging manufacturing sector to the booming natural resource sector and employment shifts from the manufacturing sector to the non-traded services sector, hereafter referred to as direct and indirect deindustrialization, respectively. Over time, as the initial wealth shock dissipates, finite natural resources become less cost-effective to extract and there may be a transition of employment back to the manufacturing sector. If productivity in manufacturing does not increase with this transition, or if productivity takes many periods to return to high levels, then we may state that Dutch Disease effects are present and have a negative impact on the economy. This serves as a basis to analyze any long-run productivity effects and assess whether those effects are permanent. We hypothesize that in the short run the Canadian economy is experiencing deindustrialization. Additionally, in the long run there will be a productivity decrease that is consistent with Dutch Disease. Based on the results of this analysis, judgment can be made with regard to the current state of the Canadian economy and the relevance of the disease. Our analysis will conclude that only part of the theoretical model for Dutch Disease holds within Canada and the changes observed are consistent with both portions of the Dutch Disease theory and structural trends that are common among nearly all OECD countries.

The structure and organization of this paper is as follows. Section I presents a review of relevant literature associated with our research objectives, including the core theoretical model that motivates our hypothesis. Section II will present our estimation methodology and provide a justification for the choice of variables. Section III will describe data used and sources. Section IV present empirical results and discussion. Finally, Section V will consist of a conclusion as well as identification of possible areas of further research.

I. Dutch Disease and Literature Review

I. A. Theoretical Model

There are numerous studies that have been undertaken within the Dutch Disease literature. In fact, much of the research performed on the 'disease' has been isolated to developing countries, and despite research focusing on developed countries such as Russia, Norway, and the UK, evidence from Canada on a national level is scarce. These papers are primarily founded upon the "core model" set forth by Corden (1984) [See Appendix 1]. Corden presented the theoretical model that provides the essential knowledge required to study the base mechanisms of this economic phenomenon. The initial effects of a resource discovery induce a shift in labour, seen through employment shares in the lagging and booming sector. The employment shift from the lagging to the booming sector is defined as direct deindustrialization, which does not require the real exchange rate to fluctuate and is not affected by the non-traded sector. Similarly, indirect deindustrialization is defined as the shift of employment from the lagging sector to a non-traded sector as a result of the boom, which increases the opportunity cost of workers in lagging sectors as they can earn higher wages in the non-traded and booming sectors. For the purposes of this paper, we will consider manufacturing as the lagging sector, industries related to natural resource extraction as the booming sector, and the service industry will comprise the non-tradable sector. These will be used to identify short-run deindustrialization through an evaluation of employment levels.

In addition, the core model highlights long-run effects as a result of this deindustrialization in relation to Dutch Disease. Specifically, the long-run effect is that the booming sector competes for scarce factor inputs with the lagging sector, which diminishes productivity and size of the lagging sector. This broad theoretical prediction is extended by Balassa (1964) and Samuelson (1964) who study the effect that productivity has on real exchange rates. The relationship between productivity and exchange rates is commonly referred to as the Balassa-Samuelson effect, which states that a decline of international competitiveness can be compensated by profits to natural resource exports. However, in the long run natural resource extraction is unsustainable due to scarcity of natural resources. As a result, once these natural resources are no longer available for export, and the country begins to shift emphasis back to manufacturing as a primary economic activity, the manufacturing sector will not be competitive enough due to productivity losses and because of this, the country will become a net importer, thus lowering real GDP. This theoretical prediction only holds if deindustrialization slows the growth in total factor productivity (TFP) for manufacturing and TFP is slow to recover. Lower levels of TFP have the potential to damage the comparative advantage for Canadian manufacturers and as a result international trade will decrease, as countries would not find it mutually beneficial to trade with Canadians. This effect on TFP begins in the short run. However, it has long-run implications for trade. For this reason our paper will refer to the TFP effects as a long-run analysis. Overall, this extreme effect can cause a permanent economic contraction and the resource blessing evidently has the potential to become a curse. This has provided an opportunity for empirical research to measure the contraction of lagging sectors and long-run effects in relation to productivity.

I. B. Empirical Research

The theoretical literature has created a strong framework that is able to support empirical research relating to Dutch Disease. A majority of this research aims to validate theoretical conclusions made by Corden and Neary (1982), Balassa (1964) and Samuelson (1964) at various scales. Cross-country comparisons, single country, regional, and specific symptom analysis are the most commonly used approaches within the empirical literature to substantiate the Dutch Disease hypothesis. These studies will prove to be important to our own research, as they will provide valuable insight into the statistical methods and data required to answer our research question.

The basis of our research will focus on Canada at the national level. Using data from the United States, Raveh (2013) shows that jurisdictions have the ability to use institutions and low mobility costs to mitigate the impact of Dutch disease. This issue is often referred to as the 'Alberta effect,' and occurs when a province can use low tax levels to create an attractive business environment. However, the impact of the disease would still exist on a national scale due to the loss of manufacturing in other provinces. This abstraction allows us to judge the gains or losses to the Canadian economy as a whole, rather than identifying provincial winners and losers.

The prevalence of deindustrialization does not have any positive or negative implications associated; instead it serves as an indicator as to whether the initial stages of Dutch Disease are present in the economy. Matsen and Torvik (2005) show that the disease is only damaging if manufacturing generates learning-by-doing (LBD). LBD is non-transferable across industries and has a direct relation to output in an industry. Theoretically, LBD is included in the total factor probability (TFP) aspect of calculating output, where $Y=AL^{\alpha}K^{1-\alpha}$ (A=TFP, L=Labour, K=Capital). This paper will focus on the impact of deindustrialization on TFP or equivalently, multifactor productivity (MFP).

II. Methodology

II. A. Short-Run (Employment) Methodology

The short run analysis will be structured upon methodology used in Rudd (1996), in which the dependent variable is the lagging sector. For developed countries, this is most often the manufacturing sector. This dependent variable is expressed as a function of the spending effect as well as the resource movement effect, which are the two effects responsible for the disease. Within the model, Rudd (1996) uses the contribution of manufacturing to non-oil GDP. However, the empirical research aims to determine the extent to which Dutch Disease is responsible for the contraction within the lagging sector. The regression is set up as follows:

Manufacturing = f (spending effect, resource movement effect)

With respect to manufacturing industries, the resource movement and spending effects are equivalent to direct and indirect deindustrialization respectively. Our empirical analysis has been centered on employment levels rather than contribution of a sector to non-oil GDP. This is because our short run analysis aims to identify the presence of Dutch Disease rather than the implications of it; labour is an input to all sectors, meaning that regressing employment levels will allow us to identify if the effect of deindustrialization is present. As a result, the dependent variable, manufacturing employment levels, will be expressed as a function of natural resource employment and service sector employment levels:

Manufacturing = f (natural resource employment, services employment) (1)

It is important to note that employment levels can only grow for an industry at the expense of another industry. In particular, this analysis of employment levels is careful to include only employment levels for three sectors associated with Dutch Disease. This is to avoid issues of the total employment being modeled in our regressions. If total employment were included this would produce results that are purely mathematical in nature, as employment leaving one industry must increase employment in another. For this reason, the following regressions have intentionally avoided the employment levels of all other industries, other than manufacturing, natural resources, and services, as control variables.

To evaluate the short-run effects of Dutch Disease in Canada we will determine if the Canadian economy is experiencing deindustrialization. To do this we will use the following linear regression:

$$\text{Manufacturing Employment} = \beta_0 + \beta_1 \text{(Natural Resource Employment)} + \beta_2 \text{(Services Employment)} + \ldots + u \quad (2)$$

Both direct and indirect deindustrialization causes employment in the natural resource sector to increase and manufacturing to decrease. We will test the hypothesis that natural resources employment has no effect on manufacturing employment (H0: $\beta1 = 0$), against the alternative hypothesis that natural resource employment has a negative effect on manufacturing employment (H0: $\beta1 < 0$). This will provide a clear indication of direct deindustrialization. Moving forward, it must be recognized that direct deindustrialization draws employment away from services (in the same way it draws employment from manufacturing) and indirect deindustrialization draws employment into services, which creates an ambiguous effect as illustrated in Table 1. For this reason, we will test the hypothesis that services employment has no effect on manufacturing employment (H0' : $\beta 2 = 0$) against the two-sided alternative hypothesis that services employment has a relationship with manufacturing employment (H1' : $\beta 2 \neq 0$) for indirect deindustrialization. From this we will be able to state that the indirect deindustrialization effect dominates if $\beta2 < 0$, or that direct deindustrialization dominates if $\beta2 > 0$. If this holds, then we will be able to conclude that Canada is experiencing deindustrialization.

Table 1: Expected Regression Coefficients

	Manufacturing	Natural Resources	Services
Direct Deindustrialization	Negative	Positive	Negative
Indirect Deindustrialization	Negative	Positive	Positive
Total	**Negative**	**Positive**	**Ambiguous**

In building our model, additional variables that have been included are oil prices, Canadian-US exchange rates and manufacturing imports (consisting of fabricated materials and end products). The reasoning for these variables is drawn directly from Corden's model of Dutch Disease in which the price of oil causes the boom in natural resources and the appreciating exchange rate causes the demand for manufacturing imports to increase. These variables are key components of the theoretical framework and as a result essential to our regression analysis. If these variables are excluded it increases the probability of an omitted variable bias which can lead to incorrect inferences.

Recession and expansion dummies have also been included as control variables. Hall (2005) identifies recession and expansion dummy variables as important factors when analyzing employment fluctuations. In our analysis, these variables are used to ensure employment fluctuations related to business cycles are not misinterpreted as Dutch Disease effects. In a recession, we would expect to see employment levels in natural resource sectors, manufacturing, and services to all decrease and in an expansionary period the opposite would hold. Finally, wages in the economy have been also included because wages are also highly correlated with labour productivity, which has a direct impact on the demand for manufacturing inputs, specifically labour. Using these variables, we will carry out our regression analysis over several steps. This will allow us to identify and discuss the effects that each group of variables has on manufacturing employment and allow us to draw conclusions on the prevalence of Dutch Disease in the economy.

II. B. Long Run (TFP) Methodology

Once the presence of deindustrialization has been established, we can then study the long-term effects of Dutch Disease on productivity. Models used by Iscan (2013) and Baldwin and Gu (2003) have been used to motivate a regression framework for our long-run analysis. Iscan (2013) highlights that the use of manufacturing TFP to study Dutch Disease is optimal due to the elimination of possible endogeneity issues related to labour productivity and structural change in a long-run analysis. Baldwin and Gu (2003) determine the effects of export participation on the productivity of manufacturers, with manufacturing TFP as the dependent variable and expressing it as a function of dummies for exporters, new exporters, or previous exporters. As the aim of Baldwin and Gu (2003) was to determine the effects of export participation on manufacturing TFP, the regressions used in our paper will differ slightly.

Our analysis will determine the effects of mining output on manufacturing TFP; therefore mining output will be used as an independent variable rather than an exporting dummy:

$$\textit{Manufacturing TFP} = f\,(\textit{Mining Output})$$

Our initial regression will use manufacturing TFP as the dependent variable and current mining output and lagged mining output as the independent variables:

$$\textit{Manufacturing TFP}_t = \beta_0 + \beta_1\,(\textit{Mining Output})_t + \beta_2\,(\textit{Mining Output})_{t-1} + \ldots + u \quad (4)$$

We will test the hypothesis that lagged mining output has no effect on manufacturing TFP (H0: β2 = 0) against the alternative hypothesis that lagged mining output has a negative effect on TFP (H1: β2 < 0). If we reject the null hypothesis, then mining output will have a negative relationship with manufacturing TFP in the long run.

As this long-run analysis will focus on the effects of past mining output, lagged variables will also be used to test the results over a longer time period. We have tested several time periods of mining output in relation to manufacturing TFP to determine which time period has the most significant lag effect [See Appendix 3]. For our analysis, we will use a lag of eight periods (years) to assess the lagged mining output effects on manufacturing TFP. Additional control variables that will be included are: the cost of labour, the cost of capital, and capital to labour ratio. Baldwin and Gu (2003) illustrate that the productivity of labour and capital are represented by the costs in the manufacturing sector, because of this, changes in each may control for variations in TFP that did not arise as a result of mining output. Finally, the capital-to-labour ratio has been chosen to account for the variation in TFP that arises from varying allocations of resources to capital and labour levels. This is justified by the analysis undertaken by Baldwin and Gu (2003).

III. Data

Our analysis focuses on results from two data sets. This is necessary as the second set provides published levels of TFP. Although TFP values can be calculated using the first data set, values of capital and labour do not exist on a quarterly basis, and the available data would reduce the number of observations to an undesirable level. Additionally, data for labour inputs and output do exist from the first data set, however; the values from CANSIM table 383-0022 are preferred from a consistency perspective as opposed to manipulating the data repeatedly. Detailed definitions, numerical interpretations, and sources of data used are available in the supplementary material section.

III. A Data Set 1

The first data set consists primarily of quarterly Canadian economic variables from the first quarter of 1981 to the third quarter of 2013. This equates to a total of 131 data points for variable categories such as productivity measures, real gross domestic product, resource prices, and employment levels by industry. These have been compiled into a single data set using various data tables derived from Statistics Canada's CANSIM database with the exception of crude oil price data, which is sourced from the United States Energy Information Administration. This data set will be used to analyze short-run labour movements in connection with the Dutch Disease.

Employment levels by North American Industry Classification System (NAICS) and total Canadian employment are derived from CANSIM table 282-0088. This table presents monthly survey estimates of employment by industry measured in thousands of people. We used a basic calculation to average the monthly data to create quarterly observations. To isolate for labour share by NAICS, we have divided specific industrial classifications by all industry employment to determine the proportion of employees employed by a specific sector. For example, manufacturing employment share is calculated by dividing employment in the manufacturing sector by employment in all industries. Although these shares are not used in the regressions they do motivate research into Dutch Disease in Canada, and can be seen in Appendix 2.

Oil price data were collected from the United States Energy Information Administration quarterly publications. The West Texas Intermediate (WTI), which is traded from Cushing, Oklahoma serves as a commonly accepted benchmark of oil spot prices. Due to the proximity and influence of this market to Canadian consumers it is reasonable to assume that the prices in this market have a significant influence on not only Canadian oil prices but also the entire economy.

Monthly *foreign exchange rate* data for Canadian cents per United States dollar have been taken from CANSIM table 176-0049. These exchange rates are significant as the United States is a major export trading partner for Canada (Industry Canada, 2013). Inclusion of this variable may help control for any possible fluctuations in the economies of major Canadian trading partners that may impact our analysis. However, any regressions using exchange rates will be looked at through an uncertain lens as they are influenced by a variety of volatile factors. By using a simple average, we have translated this monthly data into quarterly points.

Dummy variables for *recession and expansion* have been derived from an analysis of real GDP growth between quarters calculated from CANSIM Table 379-0007. The recession and expansion dummy variables allow us to control for business cycle effects within our model. A recession is defined as two consecutive quarters of negative real GDP growth. There are four recessions within our analysis timeframe: Q3-1981 to Q4-1982, Q3-1986 to Q4-1986, Q2-1990 to Q1-1991, and Q4-2008 to Q3-2009. An expansion is the portion of a business cycle, which is defined as the period between post-recession recovery and next peak in real GDP growth. There are four periods of expansion within our analysis: Q1-1984 to Q4-1985, Q1-1987 to Q2-1988, Q1-1994 to Q1-1995, and Q4-2010 to Q1-2011. By definition, recessions are timeframes in which there exists at least two consecutive quarters of negative economic growth.

Productivity data and related variables such as labour compensation (*wage*), were collected from CANSIM table 383-0008, which is indexed on a seasonally adjusted quarterly basis setting the base year 2007 as 100. These data are collected using a variety of mandatory surveys and then adjusted for consistency with annual accounts. *Manufacturing imports* were obtained from CANSIM table 228-0002 and are measured in millions of Canadian dollars. The values used were from the balance of payments accounts, and is a combination of section 4 and section 5 imports: fabricated materials, and end products both inedible. In the regression these variables will be tested independently as end products are expected to compete with domestic manufactured goods. Fabricated material imports can be used as inputs and may be positively related to domestic manufacturing. Thus, the result for manufacturing imports may only show the combined results and not be accurate in depicting the whole relationship.

III. B. Data Set 2

The second data set consists of yearly data from 1977 to 2008, resulting in 32 observations. The majority of this set of data is comprised of values from CANSIM table 383-0022. It contains data on real gross output for mining (*mining output*), and *cost of capital* (both in millions of Canadian dollars). As well, labour compensation (*wages*); capital and labour inputs (capital/labour = *capital-to-labour ratio*) and TFP/MFP (all of which 2002 is the base year = 100) for each of the three industries are included in the table. *Manufacturing TFP* is published under the title Multifactor productivity, which serves as a measure of evaluating the changes in output per unit of combined inputs. As a majority of these data are supplied only in yearly sets, the numbers of data points are limited. However, it is fundamental in our long-run analysis of productivity impacts.

IV. Empirical Results and Explanation

The following section includes the empirical results of our research using each data set to evaluate the effects of Dutch Disease within the Canadian economy. Summary statistics for each data set, detailed definitions, and numerical interpretations of each variable can be found in the supplementary materials section.

IV. A. Short Run Deindustrialization

Table 2 reports our short-run regression results. Column (i) represents initial regressions outlining employment levels without any control variables. The results at this stage are consistent with our hypothesis that deindustrialization is present. It shows the expected effects from the natural resource sector that deindustrialization is present, while the coefficient for service employment suggests that the direct deindustrialization effect is greater than the indirect effect. These initial results motivate further analysis. Since Column (i) yields low R^2 values, this means that the variables used explain only a small part of deindustrialization; therefore, more variable must be included to account for mechanisms that are actively a part of Disease. Our regression in Column (ii) expands upon our initial regression by including oil prices and the exchange rates. With the addition of these variables, changes in employment levels remain consistent with deindustrialization. The inclusion of oil price and exchange rate variables drastically boost the R^2 value from 0.16 to 0.39. Dutch Disease theory suggests that increases in both oil prices and exchange rates should have a negative effect on manufacturing employment. However at this point, our results are inconsistent with the theory due to the fact that both oil prices and exchange rates are reported to have a positive coefficient.

It is important to note that if employment fluctuations are explained by business cycles then the Canadian economy is not suffering from Dutch Disease. Instead, these employment shifts can be explained by structural change. In order to account for this it is important that the expansion and recession dummies are included. In column (iii), after incorporating these variables, the R^2 value shows that business cycles do not fully explain the fluctuations in manufacturing employment. However, they do explain some portion of the employment shifts. It is interesting that the coefficients on natural resource and service employment levels are now both positive, which is not consistent with our hypothesis. Although this regression may not be consistent with our hypothesis, it is consistent with the assumption that economic expansions will increase overall employment in the economy, whereas recessions will decrease overall employment in the economy. Column (iv) builds upon the previous analysis by including wage and manufacturing import information. This regression is motivated by the idea that increases in wage capture some of the effect of deindustrialization as the opportunity cost of workers in the lagging sector is increasing. They can earn higher wages in the non-traded and booming sector. At this point, increasing wages have a significant negative effect on manufacturing employment. This is likely a result of higher wages in either natural resource or services sectors causing employment to shift away from manufacturing jobs. The manufacturing imports variable is included to confirm that a decrease in

Table 2: Short-run Deindustrialization (Manufacturing Employment as Dependent Variable)

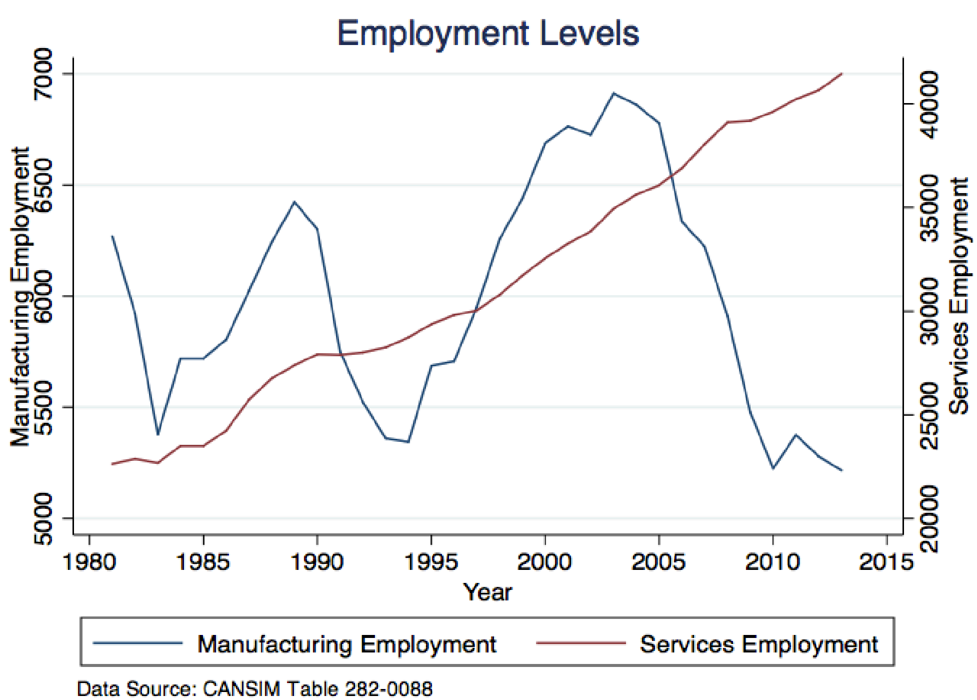
Short-run Deindustrialization (Manufacturing Employment as dependent variable)	**Manufacturing Employment (i)**	**Manufacturing Employment (ii)**	**Manufacturing Employment (iii)**	**Manufacturing Employment (iv)**	**Manufacturing Employment (v)**
Variable	Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)	Coefficient (T-statistic)
Natural Resource Employment	-2.807842*** (-4.97)	-0.0722622 (-0.07)	0.0159752 (0.02)	-0.8766789 (0.69)	-0.4898486 (0.77)
Service Employment	0.014085* (1.75)	0.0195506 (0.92)	0.0093657 (0.43)	0.6397152*** (0.06)	0.6249233*** (0.07)
Oil Prices	-	0.489996 (0.10)	1.186523 (0.24)	-6.673648** (3.17)	-4.825894 (3.54)
Exchange Rate (USD)	-	21.98652*** (4.31)	21.71107*** (4.27)	-4.476569 (5.16)	-4.36565 (5.15)
Expansion Dummy	-	-	-289.5744** (-2.17)	-310.7125*** (83.85)	-292.4973** (85.19)
Recession Dummy	-	-	-153.7555 (-1.05)	-48.23033 (101.38)	-41.7348 (101.37)
Wage	-	-	-	-190.3409*** (14.91)	-185.4725*** (15.48)
Manufacturing Imports (All)				0.0288125*** (0.01)	-
Manufacturing Imports (Fabricated)	-	-	-	-	-0.0105902 (0.03)
Manufacturing Imports (End)	-	-	-	-	0.0406183** (0.01)
Observations	131	110	110	106	106
Constant	8124.411*** (17.18)	2658.726** (2.02)	2968.888** (2.28)	-7.010714 (1584.867)	-293.3205 (1601.56)
R^2	0.1623	0.3911	0.4209	0.78	0.78

Significant at 90% level *
Significant at 95% level **
Significant at 99% level ***

manufacturing employment is coupled with an increase in imports of manufactured goods. This regression yields an R^2 value much higher than previous regressions. The null hypotheses of natural resource employment and service sector employment (H_0: $\beta_1 = 0$ and H_0': $\beta_2 = 0$) are both rejected with 95% confidence, with services sector employment (H_0') being rejected at a 99% confidence level. Column (v) further breaks down manufacturing imports into sub categories: fabricated goods and end goods. Fabricated goods include wood, textiles, chemicals, plastics, and rubber materials, while end goods include items such as engines, drilling and mining equipment, industrial machinery, apparel, and motor vehicles. From our results we observe that fabricated imports have a negative impact on manufacturing employment whereas the import of end goods have a positive effect on manufacturing employment. A possible explanation for these counterintuitive results can be attributed to structural change. When the exchange rate rises, manufacturing employment decreases but it is cheaper to import materials. When the exchange rate drops manufacturing employment increases and more end goods are imported as many industries use these imports, such as machines, for their own manufacturing.

The notion that the direct effect is greater than the indirect effect of deindustrialization is supported by Figure 1 below. There is potentially an effect of indirect deindustrialization in the later periods of the chart, however; it is not clear that there exists strong evidence from indirect deindustrialization. If this were the case services employment would show increases where manufacturing employment shows decreases.

Figure 1: Service Sector and Manufacturing Sector Employment Levels



In discussing our empirical results, the coefficient for manufacturing imports would indicate that there is a positive relationship with domestic manufacturing employment. This is interesting, however, the variable includes imported fabricated materials, not just end materials. Domestic manufacturing requires labour input as well as material inputs, so this finding is not unrealistic. The negative coefficients associated with oil prices and the exchange rates are also consistent with Corden's model of Dutch Disease, as both increase and manufacturing employment decreases. This regression is evidence that Dutch Disease is present in the economy. However, Dutch Disease does not fully explain this short-run deindustrialization. For example, the large negative coefficient for the expansion dummy variable provides evidence of deindustrialization that is strictly due to business cycle fluctuations. The significance of this is that we are able to prove that Canada does not suffer exclusively from deindustrialization caused by Dutch Disease. Instead, we are able to observe that employment shifts are due in part to resource price booms and exchange rate fluctuations as well as business cycle effects. It also shows that without an in-depth examination, the Dutch Disease can easily be mistaken for structural changes.

With multiple variables and various effects working simultaneously, the complexity in diagnosing a specific country with the Dutch Disease is highlighted. In Canada, it is possible to identify the Dutch Disease-related deindustrialization as a mechanism that operates through resource price shocks and exchange rate fluctuations, but only accounts for a small portion of deindustrialization as there are many other factors such as structural change and technological advances that are also responsible for deindustrialization.

Figure 2 supports the conclusion that the observed decreases in manufacturing employment cannot be entirely attributed to Dutch Disease. It is clear that manufacturing employment appears to be cyclical regardless of the behavior of real GDP over the entire timeframe of our analysis. Since oil prices and exchange rates impact manufacturing employment in ways consistent with Dutch Disease, it is important to investigate the long-run productivity effects.

IV. B. Long Run Productivity Impacts

It should be recognized that the implications of the disease varies with the responsiveness of TFP to output of the mining sector. If past levels of mining output show significant relationships to manufacturing TFP, then manufacturing will take a longer period of time to regain the productivity lost from the Dutch Disease. This means that the productivity levels will be below the level it would be at if employment had not shifted as a result of the Dutch disease, and thus hurting the competitiveness of Canada's manufacturers and the Canadian economy. Figure 3 above illustrates the trends of mining output and manufacturing TFP. It is clear that TFP in manufacturing hinders once mining output experiences a boom. This is clear support for the use of lagged mining output as a variable in the regressions. Appendix 3 also provides an empirical justification for our choice of lagged variable. We have regressed several periods of mining output to

Figure 2: Manufacturing Sector Employment Levels and Real GDP

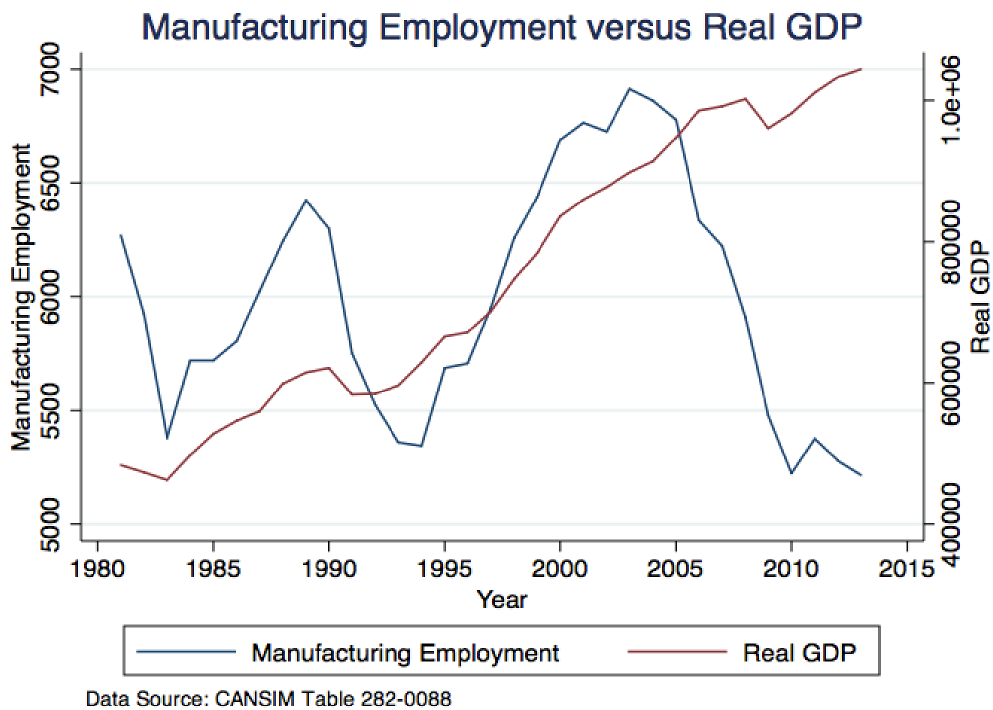
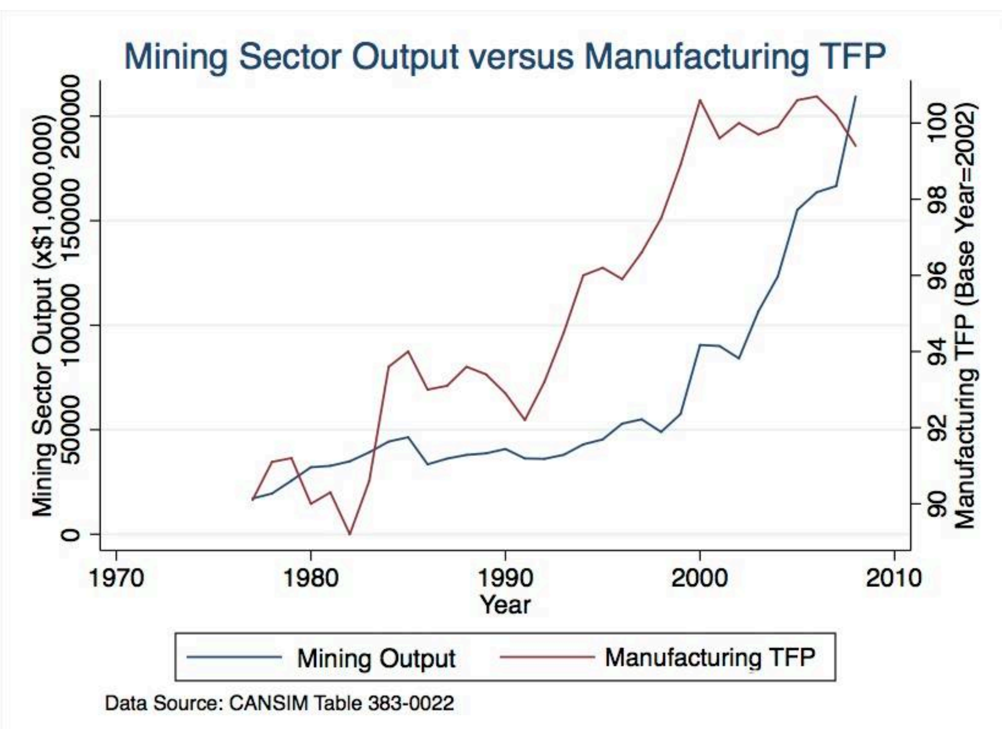


Figure 3: Mining Sector Output and Manufacturing TFP



determine which period contains the most significant lag. As a result, we have selected an eight-year lag (n=8), in our analysis of manufacturing TFP.

The initial regression in Table 3 below, column (i), showing solely the effect of contemporary mining output and mining output eight years in the past provides interesting results. The coefficients imply that contemporary mining output has a significant positive effect on manufacturing TFP but the long run effect is insignificant. The regression in column (ii) shows similar results with a much better fit. The R^2 value is high, and the coefficients on mining outputs are significant. From this regression we are able to reject the hypothesis that mining output has no effect on manufacturing TFP ($H_0 = 0$) and state that mining output has a significant negative impact on manufacturing TFP eight years in the future. It is also interesting that mining output still has a positive relationship with contemporary manufacturing TFP. A possible explanation is that higher incomes in the economy from resource extraction are circulated among domestic businesses, including to manufacturers who spend this on increasing productivity. It is important to note that wages and labour productivity share a very high positive correlation. As a result, the wage variable will also be used to capture labour productivity effects. Finally, with such a high R^2 value it is extremely likely that the coefficient for mining output lagged will not change with the addition of more relevant variables.

This long-run analysis highlights that manufacturing TFP is damaged as a result of a resource price shock. This damage occurs in lagging periods and there is evidence that output from the natural resources sector has a negative effect on manufacturing TFP. The overall effect of this is that in the long run, manufacturing TFP is lower than its potential had it not been affected by a resource price shock. Once again, this may not be entirely due to the Dutch Disease. A factor that might explain part of this observation includes the globalizing nature of business. Although globalization does not geographically bring people closer it reduces communication, transportation, and travel times. As a result, the effects of declining manufacturing TFP may be exacerbated in developed countries since developing countries are able to produce manufactured goods with much lower costs and as a result sell these goods to a wider range of markets at lower prices, thus reducing the demand of manufactured goods from resource abundant countries. With this new competition, investment activities may decline in the manufacturing sector as manufacturers seek to lower costs in order to maximize profits and as a result this is able to explain some of the TFP decline. In Canada, this may be a sign that there has been a loss in competitive advantage to lower-cost producers, which can be problematic far into the future if resources begin to run out and there exists a manufacturing sector that is unable to support new employment. Overall, this decrease in manufacturing TFP is a cause for concern due to the fact that over time it can result in significant losses in manufacturing output. It may be extreme to assume that the manufacturing sector can be lost entirely, but as it declines, it reduces diversification within the economy and a larger proportion of people will become susceptible to shocks in the natural resource and services sector.

Table 3: Long-Run TFP Analysis (Manufacturing TFP as Dependent Variable)

	Manufacturing TFP (i)	**Manufacturing TFP (ii)**
Variables	Coefficient (t-statistic)	Coefficient (t-statistic)
Mining Output+	59.80*** (4.40)	17.00*** (5.28)
Mining Output Lag 8 years+	-55.10 (-1.14)	-51.80*** (17.40)
Cost of Capital+	-	75.10*** (13.60)
Wages	-	0.2722893** (0.1293446)
Capital-Labour Ratio	-	1.629774 (3.350582)
Observations	24	24
Constant	94.41764*** (70.61)	65.38336*** (9.658342)
R^2	0.64	0.98

Significant at 90% level *
Significant at 95% level **
Significant at 99% level ***

+Scaled Values (multiplied by 1,000,000)

V. Conclusion

This paper performed a detailed analysis of the short-run and long run effect of Dutch Disease within Canada. In Canada, Dutch Disease is defined as the apparent relationship between an increase in natural resource extraction and a following decrease in the manufacturing sector. The mechanism in which this operates is a resource price shock that causes extraction in the natural resources sector to increase that which appreciates a country's currency and in turn results in an uncompetitive manufacturing sector. As the supply of finite resources decrease, the economy is left in a worse off position as they are left with a weak manufacturing sector and few natural resources. In

Canada, we have found that this is a very complex issue. However, there is significant evidence that the Dutch Disease exists. It is important to understand that the observed changes related to Dutch Disease are closely related to structural and technological changes such that the symptoms of Dutch Disease only account for a small portion of change within the Canadian economy. Additionally, the long-run analysis supports the hypothesis that the deindustrialization is having a harmful effect on the productivity of Canadian manufacturers. It is very likely that these negative effects on manufacturing will harm the competitiveness of Canadian manufacturers, although that depends on the productivity of foreign manufacturers and such statements would require further research.

It should also be noted that growth in employment is rare among OECD countries (Bernard, 2009), and a corollary is that it must be admitted that the observed deindustrialization in Canada may result from a form of 'natural' deindustrialization that arises as countries develop. Interesting findings may arise from comparing the trends in Canadian manufacturing to those of other OECD countries in future research. Additional mention should be made of the exchange rate. The exchange rates are impacted by many factors in addition to the demand and supply for imports. Examples of these are any activities that may change the value of the United States dollar. Its position as a global currency adds extra volatility to the variable and relationships with manufacturing employment may arise from unobserved factors.

Despite these points, the findings of this paper show trends which are consistent with Dutch disease and find a negative relationship between similar trends and TFP in the long term. Regardless of whether Dutch disease is the causing factor behind these findings or not, the outlook for productivity in Canada's manufacturing sector is not favorable and the situation is made no better by the economic emphasis on the natural resource sector.

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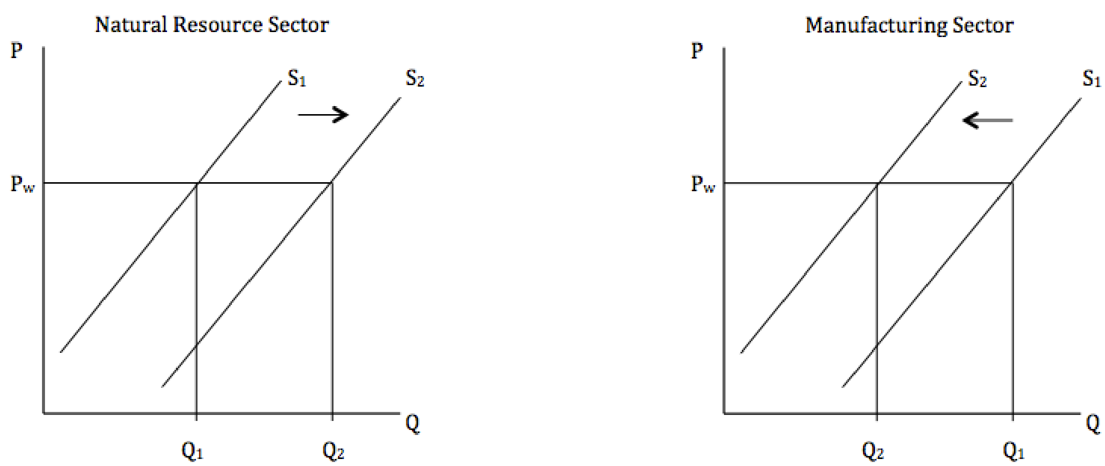
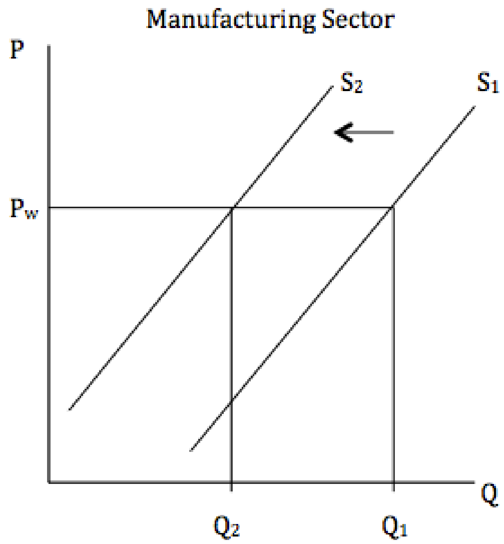
Appendices

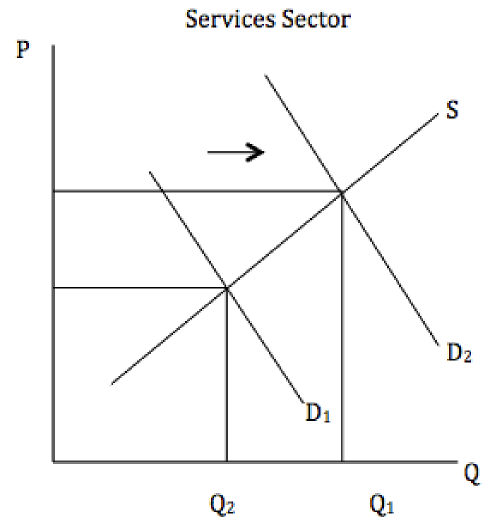
Appendix 1: Graphical Representation of Corden Model

A price boom in the natural resource sector causes the profits to increase within that sector. As a result of the increase in profits, the marginal product of labour increases and this translates into a wage increase in that sector. Labour supply moves from manufacturing and services (impact on services is not depicted) to the natural resource sector. This shift in labour is called the *Resource Movement Effect*, or *Direct Deindustrialization*:



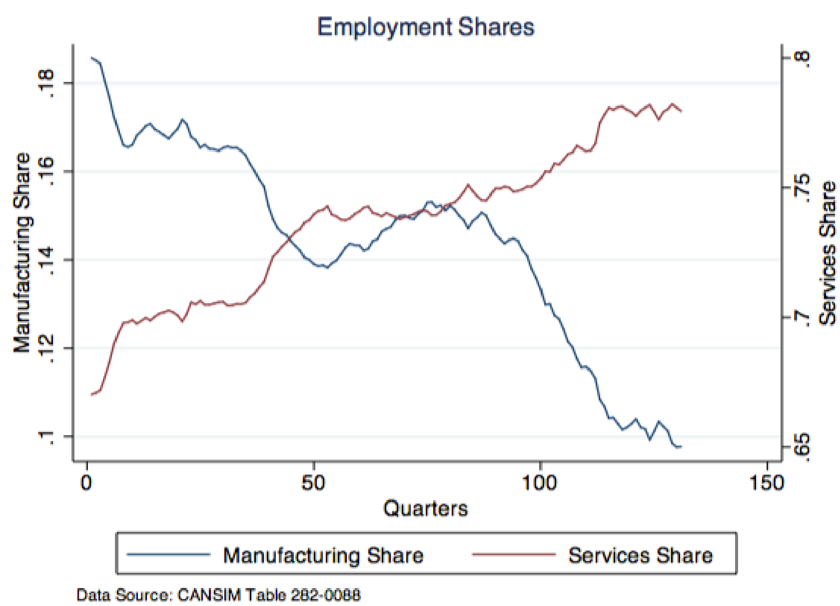
Additionally, the increase in wages to labour in the natural resource sector causes higher incomes for consumers in the economy. This income is spent on non-traded goods; in this case services. The extra income increases the demand for services, resulting in higher prices and quantities demanded of services, and the service sector also has an increase in profits. This results in higher marginal product of labour, and increase wages in the services sector. Labour also transitions out of manufacturing and into the services sector. This effect is called the *Spending Effect*, or *Indirect Deindustrialization*:

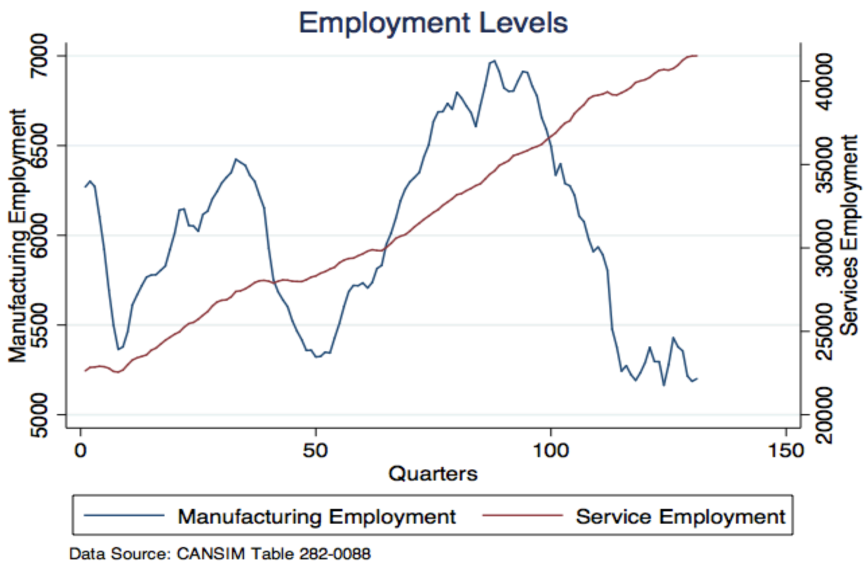




Appendix 2: Additional Deindustrialization Evidence

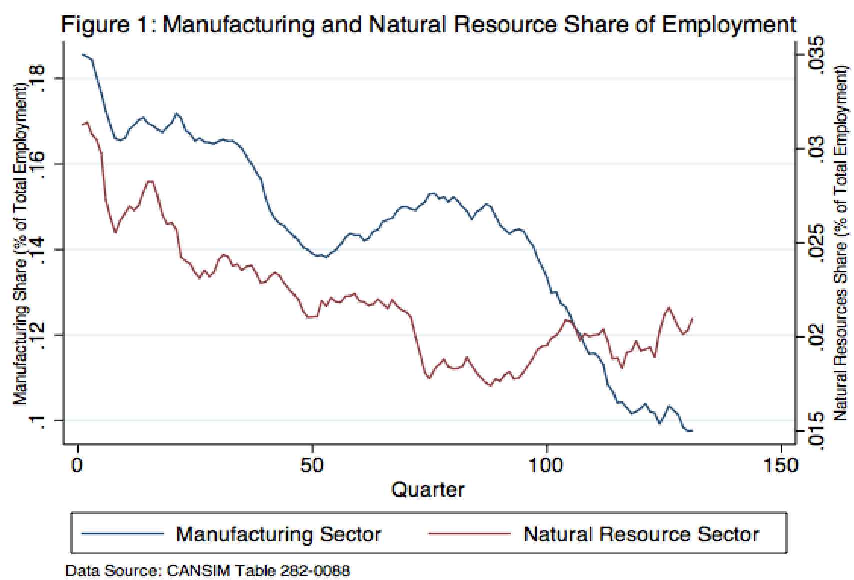
'Indirect Deindustrialiation'

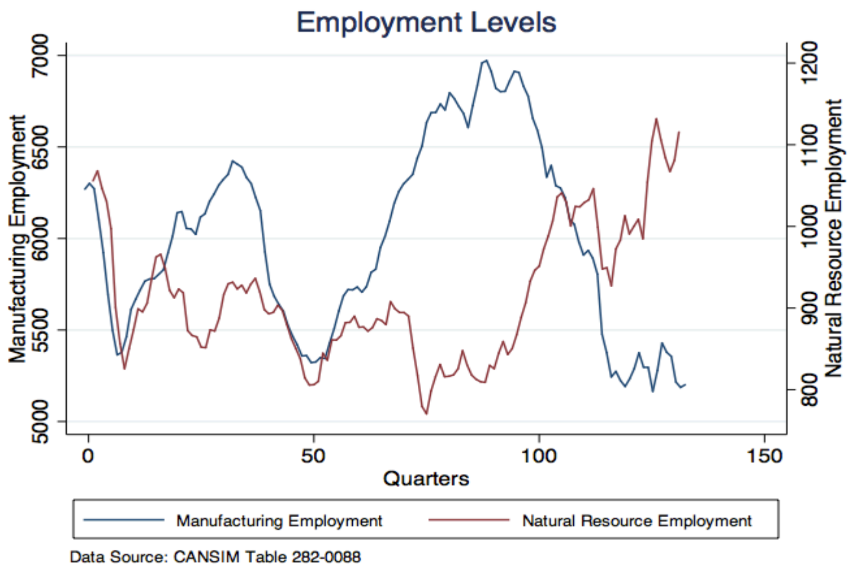




The graph depicting employment shares as an excellent example of indirect deindustrialization. Although the axes have different scales, a loss of manufacturing employment share is concurrent with a gain in service share of employment. Despite this, the employment levels chart does not depict the same story, it is much more likely that the deindustrialization from the first graph is structural, the loss of manufacturing employment in the later quarters may be related to the gain in service employment, however; such conclusions would be speculation.

'Direct Deindustrialization'





Over the entire time period of employment shares it is difficult to establish a connection between manufacturing and natural resource employment. However, following from approximately 2005 (n=100) it is clear that natural resources experience a boom in employment, while the manufacturing sector shows a quick drop in employment levels. Unlike the evidence of *Indirect Deindustrialization*, the graph of employment levels supports this as well. The decrease in manufacturing employment occurs within a very close time period of natural resource employment increasing.

Appendix 3: Lag Analysis (Long Run)

Column (i) shows the relationship of mining output and manufacturing TFP for 10 lags and a t^2 variable was chosen as the mining output shows an exponential trend. In this column it is clear that the eighth lag is significant, and is even significant in Columns (ii) and (iii) both showing high R^2 values. Although the contemporary mining output is not significant in any of these regressions, it was still chosen as a variable in the long run empirical analysis in order to separate the long run and short run effects on TFP. The t^2 value was not included, as the manufacturing TFP did not show a specific trend.

	I	**II**	**III**	**IV**
	Coefficient *(T-statistic)*	Coefficient *(T-statistic)*	Coefficient *(T-statistic)*	Coefficient *(T-statistic)*
Mining Output	-5.33e-06 *(-0.18)*	0.0000113 *(0.18)*	-	-5.98e-07 *(-0.07)*
L1.	-0.0000346 *(-1.30)*	-	-	-
L2.	4.66e-06 *(0.17)*	-	-	-
L3.	0.0000174 *(0.58)*	-	-	-
L4.	0.0000328 *(1.01)*	-	-	-
L5.	0.0000373 *(1.78)*	-	-	-
L6.	-4.66e-06 *(-0.10)*	-	-	-
L7.	-0.0000542 (-1.34)	-	-	-
L8.	-0.0000786* (-2.15)	-0.0001119*** *(-5.91)*	-.000098*** *(-5.51)*	-
L9.	-0.0000685 *(-1.56)*	-	-	-
L10.	0.0000161 (-0.38)	-	-	-
t^2	.0001683*** *(4.89)*	.0001285*** *(11.29)*	.0001408*** *(15.47)*	0.0000969*** *(9.22)*
Constant	-568.4308*** (-4.16)	-411.631*** *(-9.81)*	-460.3503*** *(-12.89)*	-289.6022*** *(-7.01)*
R^2	0.9844	0.9513	0.9444	.90511
Obs.	22	24	24	32

*Significant at 90% level **
*Significant at 95% level ***
*Significant at 99% level ****

Supplementary Material: Summary Statistics and Variable Definitions

1) Data Set #1: Short-Run Variable Statistics

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Manufacturing Employment	131	6000.308	521.9276	5164.4	6971.5
Natural Resource Employment	131	914.84	82.27	770.40	1131.70
Oil Price	110	39.76	29.03	12.94	123.95
CAD-USD Exchange rate	131	126.55	16.15	96.76	159.44
Service Employment	131	31502.99	5779.81	22557.40	41517.00
Manufacturing Imports	126	52897.39	26474.43	12932.5	97119.8
Manufacturing Imports (Fabricated)	126	12940.09	7399.585	2897.8	28318.9
Manufacturing Imports (End)	126	39957.3	19244.74	9771.8	69139.8
Wage	130	73.46079	22.73256	34.628	116.099
Recession (Dummy Variable)	131	0.122137	0.328701	0	1
Expansion (Dummy Variable)	131	0.160305	0.368297	0	1

*Natural resource sector employment includes mining, fishing, forestry, quarrying, oil, and gas.
*Observations are measured quarterly from 1981 to 2013.

1) Data Set #2: Long-Run Variable Statistics

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Manufacturing TFP	32	95.24375	3.783746	89.2	100.7
Mining Output	32	65051.94	48806.64	17126.2	209435.5
Cost of Capital	32	47575.48	25270.5	11354.7	90972.5
Wages	32	94.29062	5.621523	85.5	103.4
Capital-Labour Ratio	32	0.887731 1	0.1353433	0.6513762	1.149123

*Observations are measured yearly from 1977 to 2008.

3) Variable Definitions

Variable	Source	Definition and Numerical Interpretation.
Natural Resource Employment	CANSIM Table 282-0088	This sector comprises establishments primarily engaged in extracting naturally occurring minerals (NAICS 21). [Numerical interpretation is persons x 1,000].
Manufacturing Employment	CANSIM Table 282-0088	This sector comprises establishments primarily engaged in the physical or chemical transformation of materials or substances into new products (NAICS 31-33). [Numerical interpretation is persons x 1,000]
Service Employment	CANSIM Table 282-0088	This sector comprises establishments primarily engaged in service activities identified in NAICS 41 to NAICS 91. This includes activities such as banking, professional services and educational services (NAICS 41-91). [Numerical interpretation is persons x 1,000].
Oil Prices	United States Department of Energy Information	West Texas Intermediate (WTI) – A crude stream produced in Texas and southern Oklahoma which serves as a reference or "marker" for pricing a number of other crude streams and which is traded in the domestic spot market at Cushing, Oklahoma. [Numerical interpretation is US$ per barrel].
CAD-USD Exchange rate	CANSIM Table 176-0049	Value of Canadian currency for purposes of conversion to United States Dollar. [Numerical interpretation is Canadian cents per United States Dollar]
Manufacturing	CANSIM Table	Summation of sections 4 and 5 from the Balance of Payments

Imports	228-0002	reported imports: fabricated materials inedible, and end products, inedible.
Manufacturing Imports (Fabricated)	CANSIM Table 228-0002	Section 4 inedible fabricated materials. Includes several groups such as wood, textiles, chemicals, plastics, and rubber materials. [Numerical interpretation is quarterly dollars x 1,000,000]
Manufacturing Imports (End)	CANSIM Table 228-0002	Section 5 inedible end products. Includes several groups such as engines, drilling and mining equipment, industrial machinery, apparel, and motor vehicles. [Numerical interpretation is quarterly dollars x 1,000,000]
Wage (Hourly Compensation for all jobs)	CANSIM Table 383-0008	The ratio between total compensation for all jobs, and the number of hours worked. The term "hourly compensation" is often used to refer to the total compensation per hour worked. [Index, 2007=100].
Labour Productivity	CANSIM Table 383-0008	A measure of real gross domestic product per hour worked [2007=100].
Recession (Dummy Variable)	See Definition	A recession is defined as two consecutive periods of negative real GDP growth. [Numerical interpretation is 1 if recession, 0 otherwise].
Expansion (Dummy Variable)	See Definition	An expansion is defined as the portion of the business cycle between post-recession recovery and the next business cycle peak. [Numerical interpretation is 1 if expansion, 0 otherwise].
Manufacturing TFP	CANSIM Table 383-0022	Manufacturing total factor productivity based on gross output measures the efficiency with which all inputs including capital, labour and intermediate inputs are used in production. It is the ratio of real gross output to combined units of all inputs (NAICS 31-33) [Numerical interpretation is index, with base year of 2002=100].
Mining Output	CANSIM Table 383-0022	Mining output is comprised of the proportion of gross domestic product at basic prices produced by the natural resources sector (NAICS 21). [Numerical interpretation is dollars x 1,000,000]
Cost of Capital	CANSIM Table 383-0022	The opportunity cost of the funds employed as the result of an investment decision; the rate of return that a business could earn if it chose another investment with equivalent risk. [Numerical interpretation is dollars x 1,000,000].

Capital-Labour Ratio	CANSIM Table 383-0022	Ratio of capital inputs to labour inputs. [Numerical interpretation is capital/labour].
Time (Data Set #2)	N/A	Yearly data from 1977 to 2008.