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Abstract

In this analytical note, we provide a comprehensive assessment of the complex structural adjustment facing the Canadian economy following the commodity price decline since mid-2014. We quantify separately the impacts coming from the commodity sector restructuring and the broader effect of significantly lower terms of trade. Based on our analysis, the impact on the Canadian economy will occur in three phases. By the end of phase 3, in 2020, the level of Canadian GDP will be 2 per cent lower due to the commodity price decline than it otherwise would have been had commodity prices stayed at the mid-2014 level. At this point, the commodity sector is expected to play a smaller role in the Canadian economy.

JEL classification: E17, E27, E52, J2, Q00
Bank classification: Business fluctuations and cycles; Exchange rates; Labour markets; Potential output; Recent economic and financial developments

Résumé

Dans cette note analytique, nous apportons une évaluation exhaustive de l'ajustement structurel complexe de l'économie canadienne suite à la chute des prix des produits de base amorcée à la mi-2014. Nous estimons séparément les répercussions de la restructuration observée dans le secteur des produits de base ainsi que l'effet plus général de la baisse des termes de l'échange. Selon notre analyse, l'impact sur l'économie canadienne aura trois phases. À la fin de la troisième phase, en 2020, le niveau du PIB du Canada sera inférieur de 2 % au niveau qui aurait été atteint si les prix des produits de base étaient restés comme au 2e trimestre de 2014. En 2020, le secteur des produits de base devrait occuper une place moins importante dans l'économie canadienne.

Classification JEL : E17, E27, E52, J2, Q00
Classification de la Banque : Cycles et fluctuations économiques; Taux de change; Marchés du travail; Production potentielle; Évolution économique et financière récente

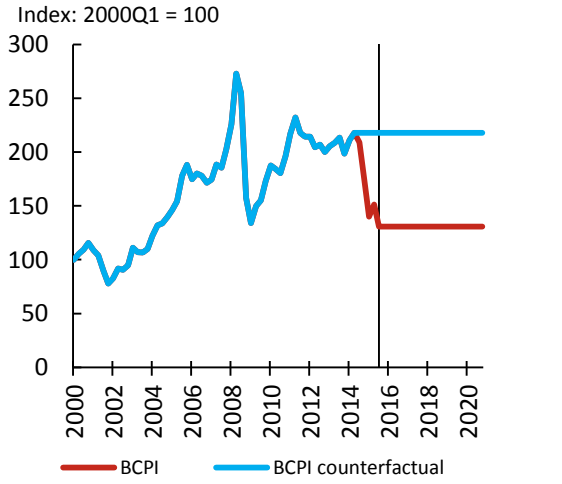
Section 1 | Introduction

Since their historically high levels in mid-2014, commodity prices – measured by the Bank of Canada commodity price index (BCPI) – have declined by 42 per cent (Figure 1), with the West Texas Intermediate (WTI) crude oil price decreasing by about 55 per cent between mid-2014 and 2015Q3 and the Bank of Canada non-energy (BCNE) commodity price index dropping by 14 per cent over the same period.[1] This has triggered a still-ongoing process of restructuring in the commodity sector. Given the important contribution of the commodity sector in Canada, these developments will have a broader impact on the economy.[2] In this analytical note, we provide a comprehensive assessment of the complex structural adjustment to the commodity price decline since mid-2014, under the assumption that commodity prices remain roughly flat for the next five years.[3] Our analysis uses the Bank's Terms-of-Trade Economic Model (ToTEM)[4] to identify the phases in the adjustment and the effects on Canada's GDP and its various components. We also quantify the impact on potential output using the integrated framework.[5]

There are many sources of uncertainty around our estimates. While long-term forecasts are highly uncertain by their very nature, at the current juncture uncertainty around the assumption for commodity prices is especially elevated. In addition, the challenge of identifying the combination of cyclical and structural effects following the commodity price decline is important to bear in mind. Nevertheless, the analysis presented here provides a useful framework to analyze the complex adjustment that the economy will undergo. Keeping in mind these caveats, our findings are as follows:

- Over the next five years, the economy is expected to be affected by two distinct forces: (i) a restructuring of the commodity sector, with investment and labour flowing to other sectors of the economy, and (ii) broader real income effects leading to lower household spending.
- The economy will adjust to these forces in three phases over the next five years. Herein we quantify the contribution of each effect in isolation.
- Relative to a counterfactual in which commodity prices stay at their mid-2014 levels, the commodity price shocks cause GDP to be 1.4 per cent lower by 2016Q2 (Phase 1), and 2 per cent lower by the end of 2020

Figure 1: The Bank of Canada Commodity Price Index, 2000–20



[1] Throughout the text, we use data up to November 2015, inclusively, unless noted otherwise. Thus we do not take into account the most recent decline in commodity prices.
[2] For instance, the medium-term impact of lower commodity prices has been examined previously in various Bank of Canada *Monetary Policy Reports*.
[3] See the Appendix to the January 2015 *Monetary Policy Report* for an analysis of the medium-term impact of the decline in oil prices.
[4] See Dorich et al. (2013).
[5] See Pichette et al. (2015).

(Phase 3). At this point we expect the share of commodities in the economy to decline toward the pre-boom levels that prevailed in 2002.

Section 2 | Three Phases of the Structural Adjustment

Figure 1 plots the evolution and assumption for the BCPI over 2000–20 (red line),[6] along with the counterfactual path where commodity prices stay at their 2014Q2 level (blue line). In our simulations, we use the difference between these current and counterfactual paths to quantify the size of the commodity price shock, and then use this shock in our simulations to assess the various channels of the structural adjustment triggered by the commodity price decline. Thus, the control scenario in our analysis is the case where commodity prices remain at mid-2014 levels. Most of our analysis focuses on deviations from this control case. Therefore, when we say that an outcome is "lower" we mean that it is lower than in the control case, not that it is lower in absolute terms. Also note that our simulations incorporate a monetary policy response to the commodity price shock: the overnight rate is lowered by 50 basis points over 2015, matching the actual policy changes observed in 2015, and remains constant in 2016.[7]

Lower commodity prices affect the Canadian economy through several interrelated channels:

- Lower profits at commodity-producing firms lead them to significantly curtail investment and reduce labour. Households, including those not in oil-producing regions, reduce spending as the value of financial assets linked to the resource sector falls. As a consequence, industries dependent on household spending reduce investment.
- The effect of a slowing commodity sector is felt through lower interprovincial trade, which affects sales and spending in other sectors of the economy.
- The reduced value of commodity exports, together with lower foreign direct and portfolio investment in the Canadian resource sector, leads to a lower Canadian dollar (CAD). While the lower CAD stimulates exports and hence investment by firms in the non-commodity industries, it makes imported consumer and investment goods, as well as imported inputs into production, more expensive.
- Due to weaker domestic demand, there is more slack in the economy; consequently, monetary policy-makers lower the key policy interest rate.
- The positive impact of lower commodity prices used as inputs in production, including production of consumption goods, provides a small offset to the overall negative impact on the Canadian economy. In addition, the impact of lower commodity prices on foreign demand is embedded in the profile of non-Canadian non-commodity exports.

[6] The Bank's forecast for the BCPI up to 2020 is roughly flat, since we assume that oil prices and the BCNE commodity price index should stay at their current levels, given global factors offsetting each other. See the Bank's October 2015 *Monetary Policy Report* for more details about these assumptions.

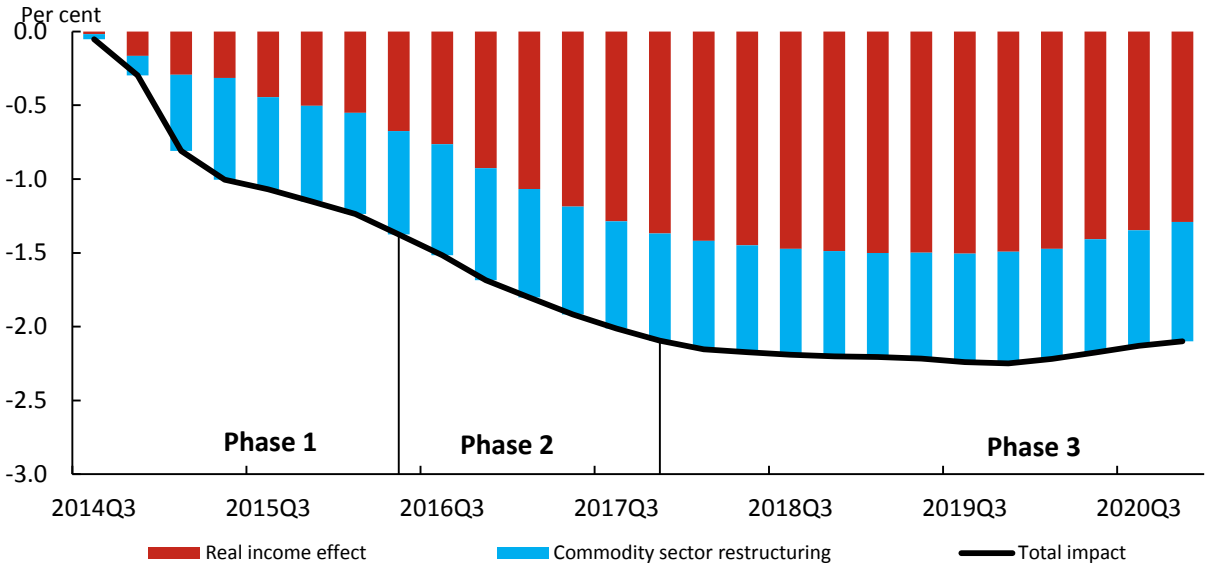
[7] Note that, after 2016, the monetary policy rate increases more slowly relative to the control scenario where commodity prices stay at their mid-2014 levels.

To frame our discussion, we narrow down these interrelated channels into two distinct effects, which are equally important but differ in their breadth of impact and timing: (i) the impact of lower factor demand in the commodity sector, and (ii) the broader effect of lower terms of trade.[8]

- The impact of lower factor demand is concentrated in the commodity sector, with offsets in the broader economy due to the monetary policy response, weaker exchange rate and somewhat lower factor prices for other industries.
- The broader economic impact of lower wealth and real domestic incomes due to declining commodity prices will lead to gradually lower household spending on consumption and housing, as well as investment in the non-resource industries compared to the scenario where commodity prices stay at mid-2014 levels.

The two effects – commodity sector restructuring and the broader real income effects – are significantly different in timing and magnitude, as well as the breadth of their impact on GDP.[9] In the scenario presented below we isolate the impact on the overall economy from each of these two effects.

Figure 2: Impact on the Level of Output from the Commodity Price Decline Relative to the Counterfactual Scenario of Commodity Prices Staying at 2014Q2 Levels*



*Note: The impact of the commodity price decline is estimated relative to the counterfactual scenario of commodity prices staying at their 2014Q2 levels through 2020, not in absolute terms. For example, Figure 2 shows that at the end of 2020, the level of output is 2 per cent lower relative to that counterfactual scenario.

The economy will adjust to these forces in three phases (Figure 2):

[8] The two impacts correspond to the resource movement and spending effects identified in the literature on economic adjustment to booms/busts in commodity prices. See, for example, Spatafora and Warner (1995).

[9] We quantify the pure real income effect by keeping the commodity sector inputs – capital and labour – fixed in an alternative simulation. The difference between the full impact of lower commodity prices and the real income effect is the restructuring effect.

- In **Phase 1**, which lasts until mid-2016, the impact of the resource sector restructuring dominates, mostly due to significantly lower investment in the commodity sector. The impact on the broader economy increases more gradually, since the impact of lower real incomes takes time to materialize. The level impact of the commodity sector restructuring effect grows until mid-2016, after which it peaks and stays roughly constant.
- In **Phase 2**, between mid-2016 and the end of 2017, the impact of lower real incomes becomes more important, reaching a peak in 2017Q4. The impact of the restructuring recedes slightly thereafter. The positive impact of the lower CAD and interest rates continues to grow in this phase, giving non-commodity exports a significant boost.
- In **Phase 3,** the economy reaches its equilibrium, consistent with potential output that is 2 per cent lower than the control case, since drastically lower investment reduces the Canadian economy's buildup of productive capacity. By the end of 2020, we expect the share of commodities in the economy to decline toward the pre-boom levels of 2002. The ratio of exports to nominal GDP is lower due to the decrease in relative export prices, and the share of investment is much lower due to the decline in real investment in the commodity sector.

In the next section, we give details on the adjustment during the three phases.

Section 3 | Details of the Adjustment

Phase 1

The first phase is dominated by the resource sector restructuring due to a significant and front-loaded decline in investment, as firms dramatically curtail business investment and employment amid collapsing profits. By the end of Phase 1 in mid-2016, we estimate that the impact of the commodity price decline on the level of GDP will be about 1.4 per cent, with both effects (restructuring of commodity sectors and lower incomes) contributing about equally.

The impetus for the restructuring in the commodity sector is a dramatic fall in actual and expected profits. Operating profits in the sector decreased substantially in 2015, especially for the oil and gas producers. For example, the average yearly operating profits between 2011 and 2014 in the oil and gas industry were 14.5 billion dollars, while this dropped to an average of -3.2 billion dollars (annualized) in 2015. This swing in oil and gas profits represents about 1 per cent of nominal GDP.[10] In addition to its impact on investment plans and hiring decisions in the sector, we expect that a prolonged drag on aggregate profits will affect wealth and income over the next two phases.

The data observed so far corroborate our view on the impact of the commodity shock to business investment. As expected, total business investment registered double-digit declines in 2015Q1–Q2, with a further decline in

[10] This estimate is based on data from Statistics Canada's Quarterly Survey of Financial Statements, Table 187-0001. The drop in profits in the oil and gas sector between 2015 and the average of 2011–14 is thus 17.7 billion dollars, which represents about 1 per cent of the average nominal GDP between 2011 and 2015.

2015Q3 (-19.9, -11.1 and -6.0 seasonally adjusted annual rates for 2015Q1–Q3). Underlying this weakness has been a dramatic fall in investment in the oil and gas sector, in particular in engineering structures (Table 1).[11,12]

- Overall, we estimate that the level of total business investment is 15 per cent weaker by the end of this first phase of adjustment relative to the counterfactual with commodity prices at their 2014Q2 levels. For the commodity sector, we estimate that the level of investment is about 36 per cent weaker than if commodity prices had not declined by mid-2016.

Table 1: Business Investment Cumulative Decline, per cent

	Total	Engineering Structures
2014Q2–2015Q3	-8%	-13%

Sources: Statistics Canada and Bank of Canada calculations

The labour market in the commodity sector suffers significantly in the first phase of the adjustment; indeed, the commodity sector and the economies of oil-producing provinces have been particularly depressed since the onset of the decline in commodity prices. For instance, between August 2014 and 2015, employment in the commodity sector has contracted by 9.8 per cent; within that sector, the mining, quarrying, oil and gas subsector was particularly hard-hit. Total hours (employment times average hours per worker) contracted even more, as average weekly hours worked also decreased slightly (Table 2).

Table 2: Labour Input Breakdown by Sector since Commodity Price Decline

Change, per cent (Aug14-Sep15)	Canada	Commodities	Mining, Oil, Gas
Total hours	0.5	-10.1	-12.0
Total employment	0.8	-9.9	-11.9
Avg. hours per week	-0.3	-0.3	-0.1
Total nominal earnings	1.8	-15.0	-16.8

Notes: 3-month moving averages of seasonally-adjusted data. Source: Survey of Employment, Payroll and Hours (SEPH), Table 281-0048. Latest data available: September 2015. The commodity sector includes forestry and logging (113) and support activities to forestry (1153); and mining, quarrying, and oil and gas extraction (21). The agriculture and fishing industries are not covered by the SEPH.

However, a contraction in the commodity sector is unlikely to have a significant *direct* impact on the Canadian labour market because, as of 2014, the commodity sector comprised only about 1.8 and 2.2 per cent of total employment and total labour hours, respectively. Consequently, the labour market downturn in the commodity

[11] Business investment includes investment in non-residential structures, machinery and equipment, intellectual property products and investment by non-profit institutions serving households, thus excluding residential structure investment, CANSIM Table 380-0064.

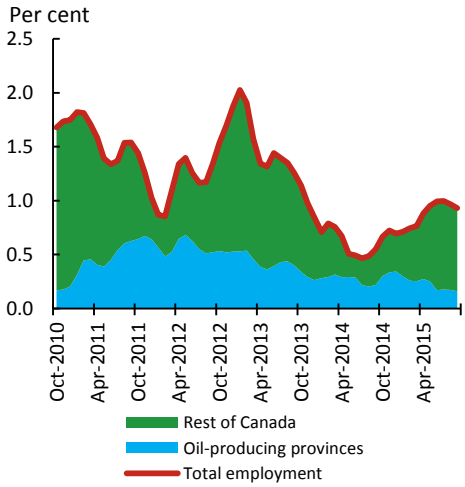
[12] We expect oil and gas investment to fall by 38 per cent in 2015 and 25 per cent in 2016.

sector has not been felt at the national level so far, where employment and total hours have not declined (Table 2).[13]

Even if the size of the labour market in the commodity sector is fairly small, its *indirect* impacts on the Canadian economy are likely to be more important for two reasons.

First, the oil and gas sector has spillovers in the oil-rich provinces:[14] employment in other industries benefited from the investment boom of the past decade.[15] For instance, between 2011 and 2014, the oil-rich provinces accounted for 39 per cent of employment growth in Canada (Figure 3), as the rest of the country experienced low employment growth.[16] Going forward, we expect total employment growth to remain low and to be driven mainly outside the oil-rich provinces, particularly in sectors benefiting from a lower CAD.

Figure 3: Contribution to Employment Growth



Second, average earnings and average hours are relatively high in the commodity sector, especially in mining, quarrying, and oil and gas extraction. Consequently, a fall in employment and/or hours in the commodity sector would impact aggregate earnings more significantly. For instance, earnings in the commodity sector represent about 3.8 per cent of aggregate earnings, while the oil-producing provinces comprise 21 per cent of national aggregate earnings:[17]

- Between August 2014 and 2015, aggregate nominal earnings in the commodity sector fell by 14.4 per cent, while in mining, quarrying, and oil and gas extraction those earnings fell by about 16 per cent (Table 2).[18] This was felt in the oil-producing provinces, where aggregate earnings fell over the same period. As the rest of the country benefited from the shift in economic activity from the lower CAD and the 50 basis point decrease in the overnight rate, aggregate earnings at the national level increased by about 2 per cent (Table 2).
- We estimate that the commodity price shock, in isolation, will reduce aggregate earnings by 2 per cent by the end of Phase 1; this fall in aggregate earnings represents roughly 1.2 per cent of nominal GDP. This drag on aggregate earnings will likely persist in the next phases, negatively affecting incomes.

[13] The commodity price shock has also yet to be felt at the country level in terms of unemployment: the Canadian unemployment rate has hovered around 7 per cent since late 2013, and the labour market indicator has improved relative to the first half of 2014.
[14] Alberta, Saskatchewan, and Newfoundland and Labrador.
[15] For example, according to the Labour Force Survey, the oil-producing provinces' share of Canadian employment grew by more than 2 percentage points since the beginning of the oil boom (early 2000s), and it now stands at 17.4 per cent. The picture is similar for total hours, which grew from about 16 per cent in 2000 to a high of 18.7 per cent in 2014.
[16] Source: Labour Force Survey.
[17] These numbers are based on same data as in Table 2, i.e. Survey of Employment, Payroll and Hours (SEPH).
[18] Of the 16.8 per cent decline in aggregate nominal earnings in the mining, quarrying, and oil and gas sector, employment and average weekly earnings accounted for -11.6 and -5.2 percentage points, respectively.

Given these large adjustments to investment and labour demand in the commodity sector, the effect on the potential output of the economy is material. The main transmission channel of the decline in commodity prices on potential output is through capital formation:

- The impact on trend labour input of a decline in the commodity sector is likely to be small, given the small share of the sector in total labour input. Even if we assume that the entire decline in hours in the mining, quarrying, oil and gas sector was structural, the level of potential output would be at most 0.1 per cent lower by the end of 2015 compared to the control case. Assuming that some workers have already reallocated to other sectors, the impact is likely to be close to 0.
- However, lower investment in the commodity sector will affect capital stock dynamics over the three adjustment phases. Our conclusion is that the fall of investment, triggered by the recent decline in commodity prices, will have a permanent negative impact on the level of potential output, but not its growth.[19]
    - The permanent impact on the level of potential output is due to a much lower amount of new capital created, not the destruction of existing capital. The significant drop of investment in the oil and gas sector as a result of the decline in commodity prices is only partly compensated by higher levels of investment in the rest of the economy.
- Our assessment is that, by 2020, the level of potential output will be 2 per cent lower than it would have been absent the decline in commodity prices, after which the impact on the growth rate of potential will stabilize.

Other effects in Phase 1:

- Relative to the control case, lower investment and labour inputs curtail production of commodities, including those destined for exports. However, higher non-commodity exports provide a gradual offset due to the lower real effective exchange rate.
- The impact on the broader economy and household spending in particular is initially small, given that the consequences of the restructuring in the commodity sector are fairly concentrated and the monetary stimulus of 50 basis points helps mitigate the consequences for the broader economy. However, the impact of lower real incomes gradually builds and becomes the dominant negative force in GDP space after mid-2016.

Phase 2

Between mid-2016 and 2017Q4, the impact of lower real incomes dominates, with the effect on consumption continuing to widen. At the same time, the positive impact of the lower CAD and interest rates continues to grow in this phase, notably giving non-commodity exports a significant boost. On net, by the end of 2017Q4, the level of

[19] Following the commodity price decline, it is expected that the pace of technological progress across the economy will maintain trend total factor productivity growth around its historical average, and that trend labour input will barely be affected. Post-2020, investment will be back at a level that would sustain the historical level of capital deepening, given the new lower steady-state capital stock, leaving no permanent impact on potential output growth.

Canadian GDP is about 2 per cent lower relative to the control case, with almost two-thirds of the impact coming from the lower real incomes effect:

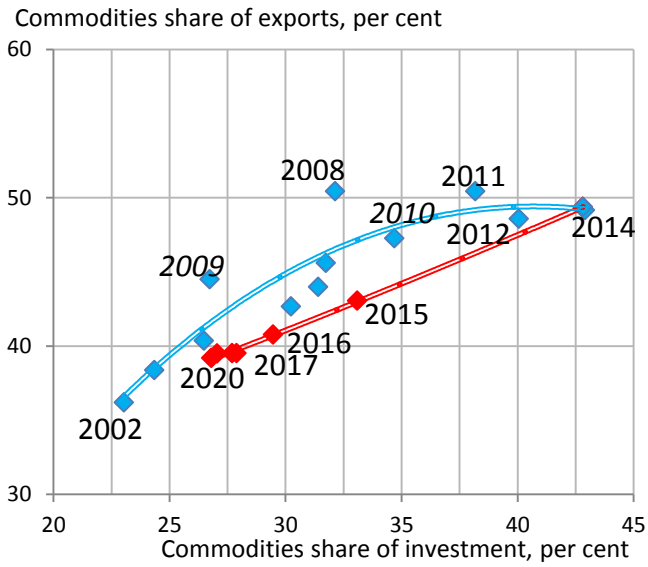
- By 2017Q4, about three-quarters of the adjustment to consumption is completed. Consumption is 1.4 per cent lower than the control case by the end of the phase, compared to the total impact of -2 per cent in 2020, in line with the impact on potential output.
- Commodity exports are almost 6 per cent below the control case in this phase due to declining production as the sector shrinks.
- As in phase 1, there are positive offsets from the lower CAD, which supports non-commodity exports. Specifically, the lower CAD boosts non-commodity exports by almost 4 per cent by the end of the phase.[20] The policy rate cushions the decline of business and household spending.
- Consequently, labour input and investment demanded specifically in the non-commodity export sector expand, drawing on some of the underutilized productive capacity in the resource sector. Nevertheless, we anticipate only modest investment growth in the non-resource commodity sector through 2017. At the end of 2017, total investment remains 14 per cent below the control case, where commodity prices stay at mid-2014 levels.

Finally, the level of potential output is 1.5 per cent lower than the control case at the end of 2017, as the decline in investment leads to a gradual decline in accumulated capital.

Phase 3: The new equilibrium

The final leg of the adjustment occurs between 2017Q4 and 2020Q4 (**Phase 3**), when the economy reaches its equilibrium consistent with the level of potential output that is 2 per cent lower than the control case. By the end of 2020, we expect the share of commodities in the economy to stabilize toward the pre-boom levels of 2002 (see Figure 4 for the evolution of the share of commodities in total exports and total investment).[21] Given that the commodity

Figure 4: Evolution of the Commodities Share of Exports and Investment



[20] Examples of non-commodity exports that are more sensitive to the exchange rate include industrial machinery and equipment, building and packing materials, plastic and rubber, and consumer goods.

[21] Figure 4 shows nominal exports of farm, fishing and intermediate food products; energy products; metal ores and non-metallic minerals; metal and non-metallic mineral products; basic and industrial chemical, plastic and rubber products; forestry products and building and packaging materials relative to total nominal exports (CANSIM Table 380-0070), including data up to 2015Q2. Commodity sector investment share is nominal business investment by agriculture, forestry, fishing, hunting, and mining, oil and gas industries, relative to total nominal business investment (CANSIM Table 031-0005). Note that

sector is highly capital-intensive, the decrease in the commodities share of total investment should reduce the stock of capital at the national level by about 6 per cent, which is consistent with the 2 per cent projected decline in potential.[22]

At the end of Phase 3, while the impact on the growth rates has dissipated, total real exports are expected to stabilize 0.2 per cent below the level that they would have attained without the decline in commodity prices.[23]

On the domestic side, households are expected to gradually adjust to lower wealth and incomes by reducing expenditures on consumption and, to a much lesser extent, housing relative to the control case. Consumption is expected to stabilize in line with potential output (-2 per cent in 2020), reacting to lower levels of permanent income.

As aggregate real expenditure shifts toward non-commodity exports, investment in sectors related to domestic spending and commodities ends lower in Phase 3 compared to the counterfactual scenario:

- In the non-exporting industries, lower demand reduces incentives to invest, while the weaker exchange rate increases the price of investment over the following five years.
- Investment in the commodity sector remains 34 per cent below the control case at the end of Phase 3, with overall investment 10 per cent lower by the end of 2020.
- Finally, consistent with lower consumption and investment, real imports are 3 per cent lower by the end of 2020.

The uncertainty around our estimates is large

Note that the overall effects at the end of the 5-year period depend significantly on our estimate of the effect on potential output, which depends on:

a) our assumption of the persistence of the commodity price decline;

b) possible threshold effects, if persistently low prices trigger further declines in investment in the commodity sector;

c) the extent to which domestic demand – in particular, investment – is affected by lower commodity prices;

d) the extent to which investment related to higher non-commodity exports offsets the fall in commodity-related investment, which underlies our projected impact on productive capital in the long run;

2009–10 nominal shares are affected by the global financial crisis, which led to significant volatility in commodity prices and investment.

[22] The decline in the commodity sector's investment share will have a negative impact on its share of the total capital stock, especially in the oil and gas sector. For example, the oil and gas sector's capital share is very large relative to its labour share (roughly 24 per cent vs. 2 per cent in 2014); given the fall in the investment share of the oil and gas sector, its capital share is projected to decrease by 4 percentage points by 2020.

[23] The initial decline in commodity exports, which are 6 per cent lower than the control case in 2017Q4, is partly offset by the rise in non-commodity exports, boosted by the lower dollar.

e) the assumption that productivity growth is not going to be affected when the composition of the economy reaches an equilibrium that is less commodity-dependent.

In addition, there is uncertainty regarding the impact on various components:

a) non-commodity exports might take longer to respond to the real depreciation due, for instance, to the decline in capacity observed since 2000;

b) commodity exports may be more resilient relative to our scenario, because of the relative stickiness of oil production in the oil sands;

c) the extent to which households are affected by lower profits in the commodity sector will depend on the distribution of firms' ownership in the commodity sector; if firms' profits are concentrated within few households, and given that a significant share of profits in the commodity sector are under foreign control, this would dampen the real income effects of the commodity price shock.

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