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# CANADA

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INTERNATIONAL MONETARY FUND

# CANADA

## SELECTED ISSUES

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Approved By
**Western Hemisphere Department**

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# THE UNCONVENTIONAL ENERGY BOOM IN NORTH AMERICA: MACROECONOMIC IMPLICATIONS AND CHALLENGES FOR CANADA[1]

## A. Introduction

**1. The ongoing boom in oil and natural gas production is dramatically reshaping the energy landscape in North America**. Over one-fifths of the world's total crude oil and one-quarter of the world's natural gas are produced in North America (Table). Canada—the 6th largest oil producer and the third largest natural gas producer —accounts for about 4¾ percent of the world's total production of oil, and a similar share of the world's total natural gas. By most estimates, Canada's share in the world's oil production is projected to increase to about 5½ percent by 2040. The shares of the U.S. and Mexico in the world's energy (especially, crude oil) production are, however, projected to decline over time.

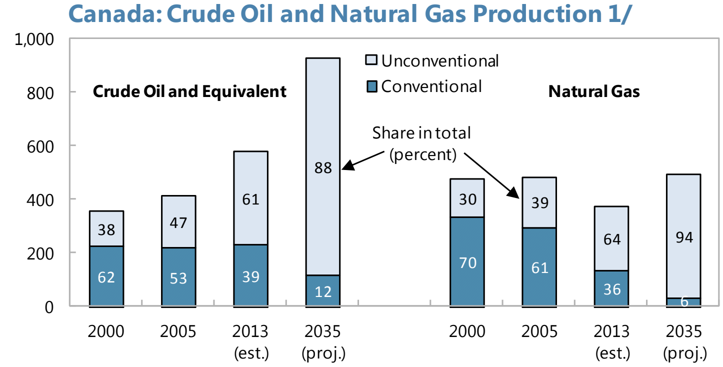
**Shares in Total World Oil and Natural Gas Production**
(Percent, unless otherwise indicated)

| | Crude Oil and Liquid Fuels | | | Natural Gas | | |
|---|---|---|---|---|---|---|
| | 2013 1/ | 2020 | 2040 | 2012 | 2020 | 2040 |
| Canada | 4.7 | 5.3 | 5.4 | 4.6 | 4.1 | 4.1 |
| United States | 13.4 | 13.2 | 10.2 | 19.8 | 19.9 | 17.7 |
| Mexico | 3.2 | 2.0 | 1.8 | 1.4 | 1.2 | 1.9 |
| *Memo:* World 2/ | 90.0 | 96.6 | 115.0 | 121.3 | 132.7 | 186.8 |

Sources: U.S. Energy Information Administration; and IEA (2013).
1/ Jan-Sept 2013.
2/ Million barrels per day for oil; trillion cubic feet for natural gas.

**2. To a large extent this boom reflects the rapid increase of unconventional energy production over the last decade**. While the share of the energy sector in Canada's GDP (by industry) has remained around 10 percent over the last decade, unconventional oil and gas output recorded the highest growth among all the industries in Canada (60 percent, cumulative between 2007 and 2013) and offset the decline in conventional energy output.[2] Unconventional energy has

**Canada: Crude Oil and Natural Gas Production 1/**



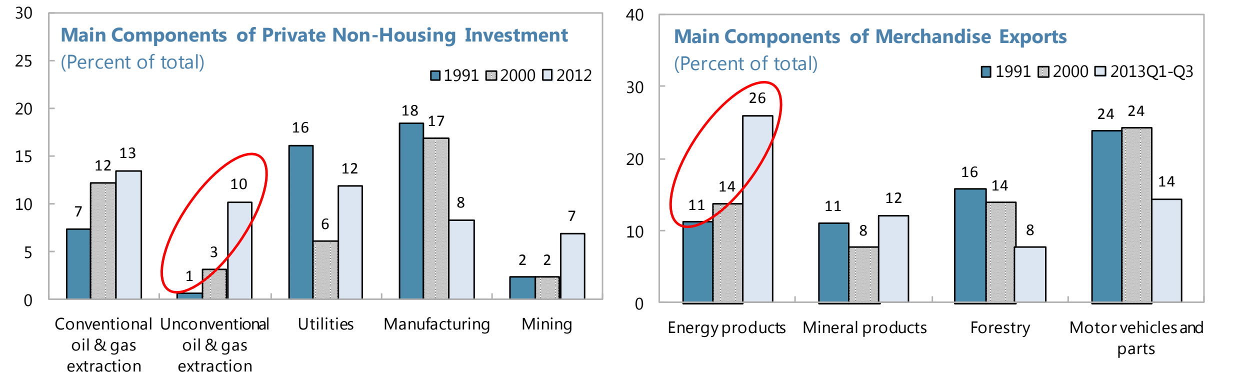

Source: National Energy Board (2013).
1/ Thousand and million cubic meters per day for crude oil and natural gas, respectively.

[1] Prepared by L. Lusinyan (WHD), D. Muir (RES), J. Reynaud (WHD), and S. Patra (Southern Methodist University). The authors are grateful to Andreas Trau and Ziad Ghanem from Statistics Canada for helpful assistance with Input-Output tables, and to the staff of Department of Finance Canada and Bank of Canada for helpful comments. A more detailed version of this paper will be published as an IMF Working Paper.

[2] Most of Canada's unconventional oil is derived from oil sand, which contains a heavy form of crude known as bitumen, and is generally extracted using surface mining or *in situ* (steam-assisted gravity drainage) techniques at greater depths. Unconventional natural gas mainly includes tight and shale gas.

attracted an increasing share of Canada's overall investment, while energy products have become the largest item in Canada's total goods exports (Figure 1).[3]

**Figure 1. Canada: The Role of Energy Sector in Investment and Exports**

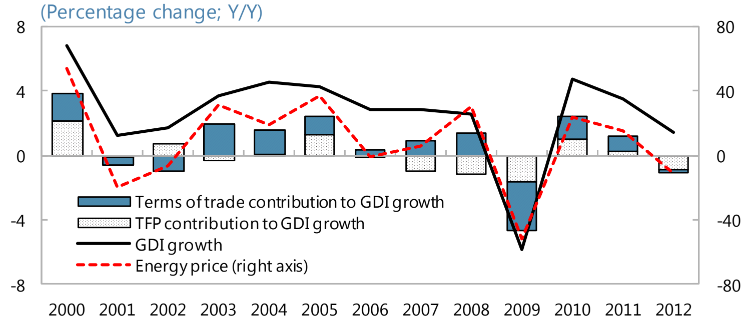



Sources: Statistics Canada; and IMF staff calculations.

**3. Canada has so far benefited from the boom in unconventional energy production.** Higher energy prices contributed to the real appreciation of the Canadian dollar since early 2000s, which has intensified Canada's competitiveness challenges in non-energy sectors, particularly in manufacturing (IMF, 2013a; Bank of Canada, 2012). But the terms of trade improvement from higher energy prices has accounted for about one quarter of the annual average growth of gross domestic income in Canada over the last decade, more than offsetting the negative contribution from total factor productivity (Chart). And while the energy sector's direct contribution to total employment and GDP growth has been relatively small over this period, the overall contribution to the Canadian economy is likely to be larger once we account for its positive spillovers to other industries (such as those that supply goods and services to the energy sector).[4]

**Canada: Gross Domestic Income (GDI), Terms of Trade, Productivity (TFP), and Energy Price**

(Percentage change; Y/Y)




Sources: Statistics Canada; Bank of Canada; and IMF staff estimates.

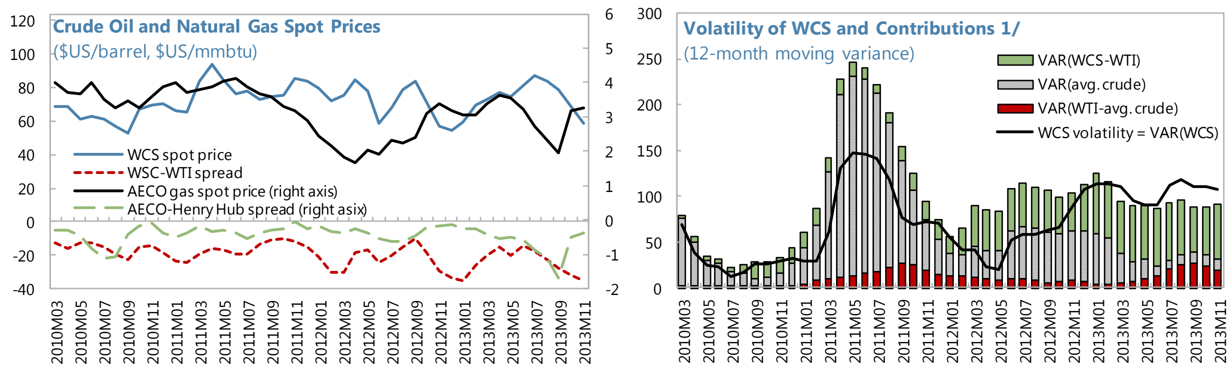
**4. Still, the geographical concentration of Canada's unconventional energy production and transportation bottlenecks have posed significant challenges**. As the U.S. production of

[3] Foreign investment has been a key contributor to oil sands development, representing about one-third of total investment in the sector in 2009–11 (Conference Board of Canada, 2012).

[4] The energy sector accounts for only 0.1 percentage points of the average (2¼ percent) annual GDP growth over the last decade. Also, employment in the energy sector increased by less than 13,000 over 2007–12, against a total 752,000 jobs created over the same period in Canada.

unconventional gas surged since mid-2000s, Canada's production and exports of natural gas have significantly declined. While Canada's oil exports have fared better, gaining a substantial market share in the U.S., greater competition for limited pipeline and refinery capacity in North America has led to a large and volatile discount on the price of Canadian oil (Figure 2).[5] In addition, Canada's internal market remains segmented, as refineries in eastern Canada are not connected with pipelines to western Canada (where the production of unconventional energy is concentrated) and import much of their crude oil at the higher global (Brent) price. This has not only a direct negative impact on Canada's energy trade balance, but potentially also an indirect one as it limits the competitive boost that Canadian manufacturing firms could derive from accessing a cheaper, domestic source of energy.

**Figure 2. Crude Oil and Natural Gas: Prices, Discounts, and Volatility**




Sources: Bloomberg; and IMF staff calculations.
1/ Decomposition of the WCS variance (VAR) into VAR of average crude oil price, VAR of the spread between WCS and WTI, VAR of the spread between WTI and average crude oil price. The respective covariance terms are not showed.

5. **Going forward, the unconventional energy sector can contribute further to Canada's economic activity, especially if the infrastructure capacity is extended**. We assess the economic gains to Canada from the unconventional energy boom by estimating its spillovers to other industries and its broader macroeconomic implications under different assumptions about market access of Canada's energy products. While the spillovers to other sectors of the economy are found to be significant, strengthening the domestic supply-chain would make them larger in the future. For the general equilibrium model, we construct long-term baseline projections for Canada's energy production based on historical trends and taking into account infrastructure constraints. Comparing an upside energy scenario (where energy production increases in the context of unrestricted market access) to a downside scenario (where exports capacity remains limited), suggests that the potential

[5] Heavy crude oil from western Canada's oil sands has always been sold at a discount relative to the price of crude oil produced in the U.S. reflecting its lower quality (almost all unconventional crude oil is heavy oil, which is more expensive to refine) and transportation costs. However, the gap between the Western Canadian Select (WCS) and the West Texas Intermediate (WTI) has increased in recent years, reaching an historical high of $35 per barrel by end-2012 and again in November 2013.

gains from a full market access of Canada's energy products could be about 2 percent of GDP over a ten year horizon.

## B. Assessing Indirect Spillovers from Canada's Energy Sector

**6. To assess the size of the knock-on effects of Canada's energy sector to other industries, we first identify the industries which are most closely linked to the energy sector**. We ranked the industries based on their linkages to the oil and gas extraction sector using Statistics Canada's Input-Output tables for 2009 including 90 sectors. We distinguish between *backward linkages*, with sectors whose goods and services are used as intermediate inputs to oil and gas extraction, and *forward linkages*, with sectors that use oil and gas as inputs to their own production.[6] Sectors with the closest backward linkages with the oil and gas sector included engineering, finance, insurance, IT, administrative, other professional services, and electric utilities, with the top ten sectors accounting for over three-quarters of the total inputs used in the energy sector. Among forward linkages, petroleum and coal product manufacturing stands out (70 percent of their inputs comes from oil and gas sector), with chemical and agricultural manufacturing and electric utilities also using a relatively great share of oil and gas in their production function. Finally, when looking at the sectors that directly contribute to investment (as opposed to intermediate inputs) in the oil and gas sector, engineering construction is found to be the sector with the strongest link to the energy sector.

**7. The boom of unconventional energy production has had some notable spillovers on other Canadian industries**. Using the above-discussed ranking and applying it to more detailed sectoral GDP data show that sectors more closely linked to unconventional oil extraction activities have generally experienced above-average output growth between 2007 and 2013 (especially engineering and construction services, natural gas distribution, and pipeline transportation of crude oil) (Figure 3).[7] This is especially the case for sectors with stronger backward linkages to the energy sector. Adding the direct contribution to growth of the unconventional oil and gas sector to that of the most closely related industries suggests that the overall impact of the energy sector is significant (close to one-third of cumulative GDP growth over 2007–13).[8] As in the case of output growth, sectors most closely linked to unconventional oil extraction tended to experience both higher than industry-average employment and wage increases.

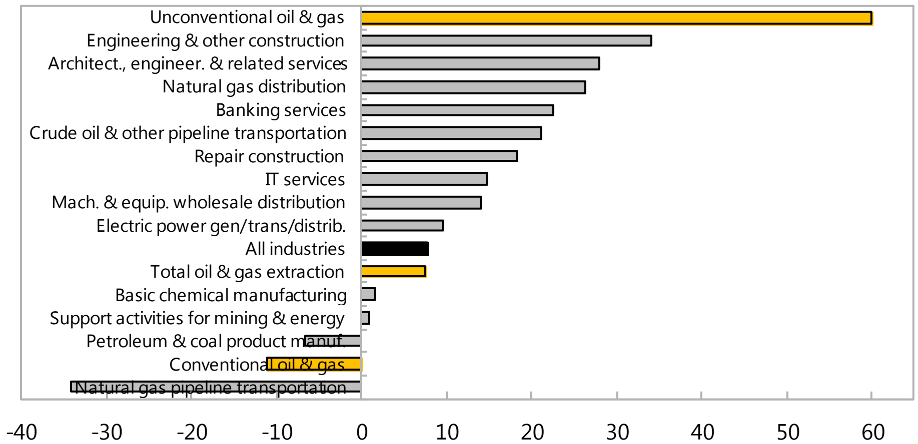
[6] See Appendix 1 for a further discussion of the Input-Output tables and related analysis.

[7] The ranking is applied directly if industry categories in the Input-Output tables and the GDP by industry (based on North American Industry Classification System) dataset match. But the sectoral breakdown from the Input-Output tables does not allow distinguishing between linkages with oil and gas sub-sectors or between conventional and unconventional oil and gas sub-sectors. Thus, in the cases when there are sub-sectors not included in the ranking but judged to be related to unconventional oil production, we use the sub-sectors instead. For example, in Figure 3, instead of reporting Pipeline transportation, we separate Crude oil and other pipeline transportation and Pipeline transportation of natural gas.

[8] This, however, may overstate the overall impact of the energy sector since the entire contribution (as opposed to the share of growth attributable to unconventional energy sector only) of the related industries is included.

**Figure 3. Canada: Output in Energy and Related (Selected) Industries**

(Percentage change 2007–13; GDP at basic prices, chained 2007 dollars)

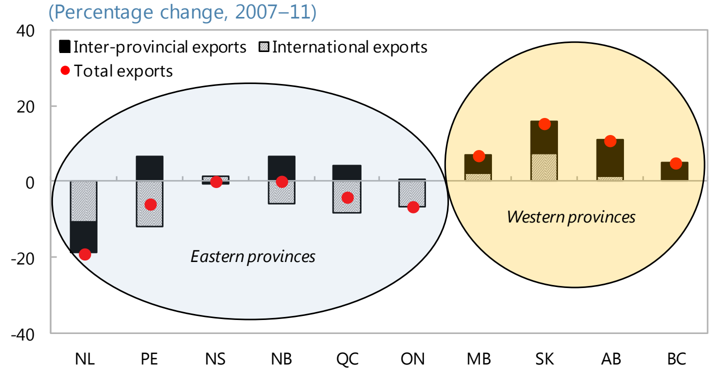



Sources: Statistics Canada; and IMF staff estimates.

**8. While unconventional energy resources are concentrated in Canada's western provinces, the positive effects have been felt across the country, including through trade and fiscal channels**. Some of the international trade lost in recent years has been replaced with greater inter-provincial trade (Chart). In particular, eastern provinces (particularly Québec) seem to have at least partly offset the decline of their international exports of manufacturing products with greater inter-provincial exports to western, resource-rich, provinces. Furthermore, fiscal transfers, including equalization payments have been an important channel of the geographical spillovers from the energy sector, growing more rapidly for the eastern provinces since mid-2000s, especially for Ontario and Québec (Bank of Canada, 2013).[9]

**Canada: Contributions to Real Provincial Exports Growth**

(Percentage change, 2007–11)




Sources: Statistics Canada; and IMF staff calculations.

**9. A more formal Input-Output analysis of linkages also shows that inter-sectoral spillovers have been important** (Appendix 1). Having quantified backward and forward linkages between the energy sector and other sectors (at the national, provincial, and international levels), we use Input-Output models to calculate the multiplicative effect of an exogenous change in the final

[9] Labor mobility serves as another channel of inter-provincial spillovers, with the number of inter-provincial employees in Alberta nearly doubling between 2003 and 2010 (Laporte and others, 2013).

demand for energy. These multiplier effects (Appendix Table A3 and Table A4) suggest that each dollar invested in Canada's energy sector increases Canada's GDP by ninety cents (a greater impact compared to manufacturing).[10] While the energy sector and Alberta benefit the most, about one-quarter of the overall GDP increase comes from other sectors. There are also important positive spillovers to the Canadian economy from greater U.S. investment in the U.S. energy sector, reflecting the relatively large share of energy and manufacturing inputs that the U.S. energy sector imports from Canada.

**10. There is room for larger spillovers going forward**. The Input-Output tables used in our analysis are based on the 2009 data, and may underestimate the potential spillovers from the energy sector. Greater inter-provincial trade in recent years may reflect stronger linkages between Canada's energy and other sectors, and between western and eastern provinces, than implied by the estimated multipliers. Increasing the multipliers, we can simulate the potential impact of higher oil production if these linkages were to increase (i.e., if the energy sector in western provinces were to use more goods and services from industries in eastern provinces, and/or industries/refineries in eastern provinces were to use more western Canadian oil). For example, in a scenario where the linkages between Alberta's energy and Ontario's manufacturing sectors strengthen to match the magnitude of inter-industry linkages within Alberta, a positive shock to oil production in Alberta would have a positive impact on Ontario's GDP which is three times larger than estimated based on the 2009 data (see Appendix 1).

## C. Assessing Broader Economic Effects from Canada's Energy Sector

**11. To assess the broader macroeconomic effects from Canada's growing energy production we use a general equilibrium model**. This allows us to go beyond inter-sectoral linkages and consider the impact of an increase of energy production on household consumption and business investment, oil prices (domestic and global), Canada's exchange rate, and external balance. To do so, we use the IMF's Global Economy Model (GEM), which is described in Appendix 2. We construct an illustrative baseline scenario for Canada's energy production based on historical and projected trends and taking into account infrastructure constraints. We then simulate the macroeconomic impact of a shock in energy production in two scenarios: (i) a "global market" scenario where there is no capacity constraint and Canada's energy products can access global markets; and (ii) a "segmented market" scenario, where higher energy production can initially be absorbed by available export infrastructure assumed in our baseline, but eventually declines relative to the baseline as infrastructure capacity remains largely unchanged. Although the model includes different levels of energy production and could potentially allow differentiating energy prices at consumer level, it is, however, structured such that there is only one relevant global oil price for

[10] In Input-Output models, output multiplier, for example, for the energy sector, is defined as the total value of production in all sectors of the economy that is necessary to satisfy a dollar's worth of final demand (e.g., additional investment or exports) for the energy sector's output.

production and there is no differentiation between different types of energy products. Given the stylized nature of the model, simulation results should be considered only as illustrative.

**12. Long-term forecasts of energy production are typically supply-driven, and thus rest on two main assumptions**.[11] The first is that the infrastructure required to bring Canada's energy production to markets will be built. The second is that all crude oil produced in Canada will find its demand. There is some uncertainty, however, on both assumptions:

- *Infrastructure:* Increased reliance on rail transportation, greater capacity of the U.S. refineries that process Canadian heavy crude oil,[12]and the reversal of pipeline flows,[13] have all contributed to relieving capacity constraints recently and may continue to do so in the near term. However, more pipeline capacity will be needed in the future to accommodate the increased production of Canadian oil. While there are a number of projects underway which add pipeline capacity almost equivalent to Canada's current oil production (about 3 million barrels per day), the approval of some of these projects faces significant resistance.[14]
- *Demand*: Assuming only a modest increase in the domestic use of heavy crude oil and limited diversification to non US export markets, bringing the growing supply of Canada's crude oil to markets implies that Canada's share of U.S. oil import would increase from the current 30 percent to almost 70 percent by 2035 (Figure 4).[15] Prospects for Canada's natural gas exports to the U.S. are even less clear: while the increased demand for natural gas in Canada (largely, for oil sands and power generation) is expected to reduce the net available exports of gas, the U.S. is projected to become a net exporter of natural gas after 2020 (Figure 4). Some see a case for an energy exchange in the future between the U.S. and Canada, whereby Canadian oil could be exchanged with U.S. natural gas (CERI, 2011b).

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[11] For example, NEB (2011), NEB (2013), and CERI (2013).

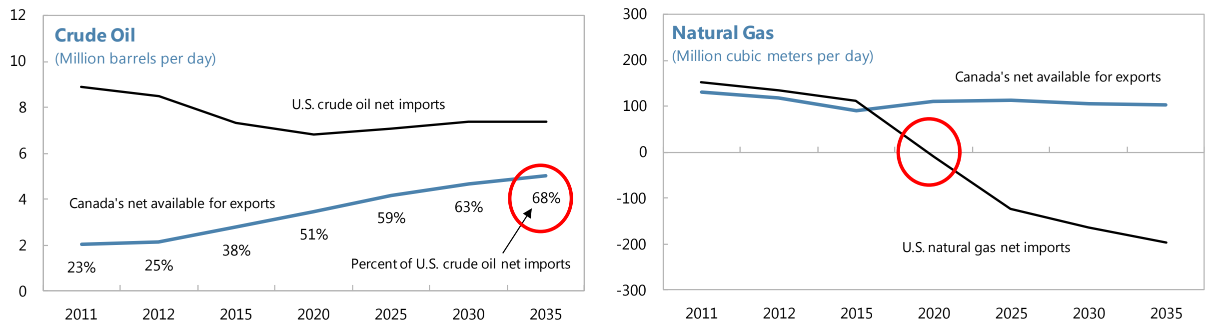
[12] This especially refers to BP's major Whiting refinery in Indiana.

[13] As in the cases of the Seaway pipeline from Cushing (Oklahoma) to the Gulf Coast, and of Enbridge Line 9 to carry crude oil from Sarnia (in southwestern Ontario) to refineries in eastern Canada.

[14] Major projects under consideration include TransCanada's Energy East project (to switch one or more existing gas pipelines that run from Alberta to Québec into crude service); Enbridge's Northern Gateway project (to transport heavy oil sands west to British Columbia's port of Kitimat and to markets mainly in Asia); Alberta Clipper Expansion to reach existing markets in Midwest and Ontario; Kinder Morgan Trans Mountain Expansion to West Coast; and Keystone XL's southern leg (from Cushing—major refinery in Oklahoma—to the Gulf Coast, to help alleviate congestion at the refinery).

[15] This is based on the U.S. EIA 2013 Annual Energy Outlook projections of the U.S. crude oil net imports (reference case) and NEB (2011) reference case projections of Canadian crude oil net available for exports.

**Figure 4. Canada and the United States: Exports and Imports of Crude Oil and Natural Gas**




Sources: NEB; and EIA.

**13. Our baseline scenario incorporates a more moderate increase in energy production compared to consensus**. We assume that oil production will increase over the next decade at a rate of about 3 percent per year, in line with the average over the period of 2001–11. This is a lower increase than in the central scenario of most forecasts, where Canada's crude oil production is expected to almost double by 2035, reaching about 6 million barrels per day (Figure 5), as we factor in some capacity constraints going forward. The projected baseline crude oil production would require about ¾ percent of GDP investment on average per year over the next decade.[16] For natural gas, while most forecasts foresee an increase in production by 20–30 percent by 2035,[17] we follow CAPP (2013) constrained market scenario over the medium term, assuming that the pick-up of energy production in the U.S. (IMF, 2013b)[18] will reduce the demand for Canada's gas, before Canada's gas production rebounds after 2020 as infrastructure constraints start to ease.

**14. We use the NEB (2011) reference case as the Global Market (upside) scenario to simulate the impact of higher energy production**. In particular, this supply-driven scenario assumes that there will be sufficient infrastructure to bring Canada's oil and gas (including LNG) to export and domestic markets, and that markets will continue to be able to absorb Canadian exports. By 2020, total energy production in the global market scenario would be about 20 percent higher than in our illustrative baseline. The NEB reference case projections assume that a gradual increase in crude oil prices would promote active growth in oil sands (especially, in *situ* projects which have lower entry cost) and the completion of infrastructure projects that are already well advanced in

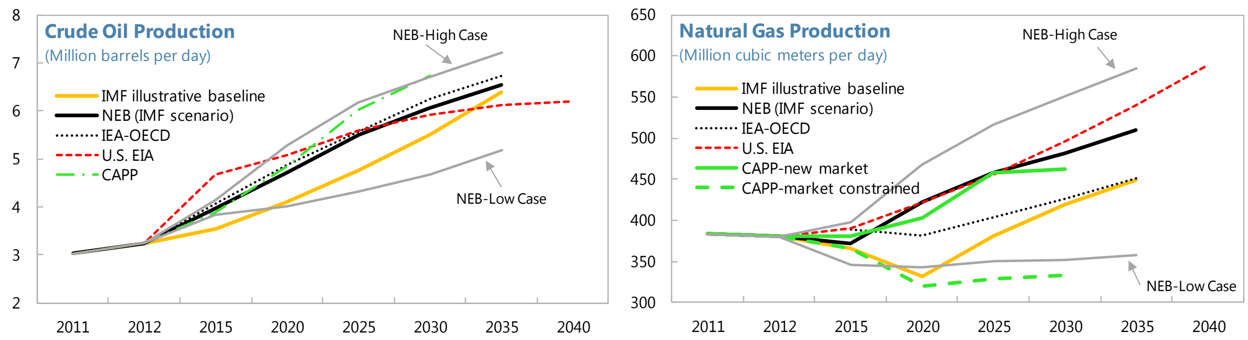
[16] This estimate is obtained using CERI (2013) detailed projections of capital investment required to start and sustain oil sands production, but adjusted for our baseline projection of crude oil production. The required investment would be slightly higher, by 0.1 percent of GDP, in the upside (global market) scenario with the increased oil production. The estimates are close to the annual average of about 0.8 percent of GDP investment in unconventional energy sector over the period of 2000–12.

[17] This modest increase in natural gas production needs to be seen in the context of a significant decline in the production since the early 2000s: indeed, only after 2030, Canada's natural gas production would return to the levels recorded in 2002 (around 500 million $m^3$ per day).

[18] The U.S. baseline scenario results in the reduction in the U.S. net energy trade deficit by 0.9 percentage points of GDP during 2012–25.

their construction/planning will suffice to accommodate the greater production in the next few years, while the currently proposed new projects will be implemented over the longer term.[19] Natural gas production is expected to continue to decline in the near term but will increase over the longer-term, as rising gas prices and prospects of LNG exports would promote higher drilling activity.

**Figure 5. Canada: Crude Oil and Natural Gas—Projected Production**




Sources: NEB; IEA; U.S. EIA; CAPP; and IMF staff estimates.

**15. Higher energy production in the Global Market scenario would boost Canada's real GDP by 2 percent by 2020** (Appendix 2, Figure A1).[20] The permanent increase of energy supply by one of the largest oil and gas producer in the world would put downward pressure on the price of energy, both domestically and globally (the U.S. dollar price of energy would fall 2 percent within a decade). With goods cheaper because of lower production costs, the Canadian dollar stronger in real terms, and a positive wealth effect (as the value of energy production will increases despite the fall in the global energy prices) private consumption would increase. Firms would begin to expand their productive capacity, and increase their demand for labor and capital. As Canada's energy exports increase, its net energy balance would improve by one percentage point of GDP within a decade. However, the current account would be slightly negative, reflecting larger deterioration in the non-energy balance driven by higher imports demand from households and firms.

**16. We then use the GEM model to simulate the Segmented Market scenario, where infrastructure bottlenecks persist**. We assume that export infrastructure capacities will remain largely unchanged over time and all new (relative to the baseline) energy production would remain

[19] Projections for Canada's crude oil supply have been revised up in NEB (2013) by about 5 percent on average per year over 2013–35 reflecting higher heavy crude oil supply as oil sands operators foresee better long-term market opportunities from heavy oil than from synthetic light oil. However, natural gas production is expected to be lower relative to the NEB (2011) projections.

[20] In what follows, we assume that households and firms do not fully anticipate the prospects for greater future energy production. If households were to anticipate the increase in future wealth, consumption would increase much faster. Similarly, if firms were to immediately internalize the permanent reduction of energy prices, their capital spending would increase earlier.

in Canada. This scenario depends on the ability of the Canadian economy to absorb the additional supply of energy. Since the increase in energy supply is expected to come mostly from oil sands, it cannot be easily absorbed domestically but over time some substitution of Canada's oil imports with domestic supply would take place. In particular, we assume that in the absence of new infrastructure or market access, gross exports of crude oil would grow at a very low rate relative to the Global Market scenario (0.6 percent per year vs. 3 percent), and by mid-2020s oil imports would be replaced with domestic supply. For natural gas production, we follow CAPP (2013) constrained market scenario until 2020 (Figure 5) and assume it remains at the level of gas consumption afterwards. Any intermediate case, where infrastructure would be built in Canada and/or the U.S. to support the increase in Canadian energy production would follow a path starting from the Segmented Market scenario and converging to the Global Market scenario in the long run.

**17. In the Segmented Market scenario, Canada's real GDP would be ½ percent lower than in the baseline by 2020** (Appendix 2, Figure A2). The output loss would increase to 2 percent in the long run. Assuming that agents do not immediately anticipate the more negative prospects for energy production caused by the infrastructure constraints, they would consume and invest more as they expect energy production to increase. This would support real GDP growth initially while Canada's trade and current account would remain largely unchanged as the impact of stronger Canadian dollar is offset by slightly higher net energy balance in the near/medium term.[21] Longer-run results for the unanticipated and anticipated cases would converge, with Canada's GDP, private consumption, investment, and oil balance worse off than in the baseline.

## D. Conclusions

**18. The unconventional energy boom has had significant positive effects on Canada's economic activity and has the potential to contribute even more in the future with the appropriate extension of infrastructure capacity**. Our findings suggest that while limited exports capacity would result in output losses over the medium term, the potential output gains from a full market access of Canada's energy products could reach about 2 percent of GDP over a ten year horizon. Actions can be taken on a number of fronts to resolve transportation constraints and address domestic market segmentation. These include diversifying international export markets for Canadian energy products, which would require building pipeline and export infrastructure to facilitate access to non-U.S. markets. Energy integration between Canada's western and eastern provinces can be strengthened further, and recent initiatives in this direction are welcome. More generally, there appears to be an important scope to increase inter-industry linkages across Canada that would lead to wider sharing of benefits from the energy sector.

[21] The anticipated scenario generates a somewhat lower real GDP over the medium term. As agents perceive the upcoming fall in energy production (relative to the baseline scenario), they reduce consumption and investment, the current account improves (also owing to the real exchange rate depreciation) while the net energy balance worsens over time and approaches zero in the long run.

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# Appendix 1. Input-Output Analysis

**We use an Input-Output model to quantify inter-industry linkages between energy and other sectors within Canada and between Canada and the United States**.[22] Input-Output (I-O) analysis shows how industries are linked together through supplying inputs for the output of an economy. I-O tables include an inter-industry transactions table, where the rows describe the distribution of a producer's output throughout the economy, while the columns describe the composition of inputs required by a particular industry to produce its output. I-O tables include also Final Demand columns which record the sales by each sector to final markets for their production, including gross private domestic investment, personal and government consumption expenditure, inventories, and international exports and imports. The data used in our analysis are for the year 2009, and the sectoral mapping for Canada and the U.S. is reported in Appendix Tables A1 and A2, respectively.

**Input-Output analysis allows assessing short-term impacts on all industries/regions resulting from an increase in the final demand from one or more industries/regions**. The impacts can be direct (spending on goods, services, labor within a given industry/region *j* to meet the higher demand), indirect impacts (on suppliers of goods and services who also require additional inputs for their own production to meet the additional demand from industry/region j), and induced impacts (resulting from household spending of labor and other income earned either directly or indirectly from the oil and natural gas industry's spending). In this paper, we focus on direct and indirect impacts (Type I multiplies).

**Table A3 and A4 report the estimated GDP multipliers at the country and provincial levels, respectively**.[23] Table A3 shows that a $1 investment in Canada's energy sector would increase Canada's GDP by $0.89. While three-quarters of the increase in GDP would remain within the energy sector, for each dollar invested in the energy sector, manufacturing and other sectors would gain $0.03 and $0.17, respectively. The U.S. GDP will go up by $0.03, including through the positive impact on manufacturing. Spillovers to the energy sector from investing in the manufacturing sector would be larger but the overall impact on Canada's GDP would be smaller given lower intra-manufacturing multiplier (0.42) which reflects relatively less interconnected sector as opposed to intra-energy multiplier (0.69). The multipliers reported in Table A4 can be used to explore the

[22] Input-Output models have increasingly been used in recent years to quantify the impact of energy sector—see for example, CERI (2011a,b) for Alberta's oil sands, Deloitte (2013) for TransCanada Energy East Project, and PWC (2011) for the U.S. oil and natural gas industry. However, I-O models have some important limitations, as these are static and based on restricting assumptions, such as fixed I-O coefficients and the lack of adjustment in response to shocks which change prices. For a detailed discussion of I-O analysis, see for example, Miller and Blair (2009).

[23] Gross output multipliers (not reported here), are larger than GDP multipliers because they do not correct for double-counting of intermediate inputs. Our estimates of Input-Output multiplies are broadly in line with those found in other studies, but are expected to be smaller than Type II multipliers which include induced effects. Differences may also reflect different sectoral and regional aggregations and time period used in other studies. For a detailed discussion of the methodology and the data used in this paper, see Patra (2013).

potential economic impact of and inter-provincial/international spillovers from higher oil production in Canada and the U.S. We discuss two such illustrative scenarios below:

- **Higher crude oil production in Alberta**. A one percent of (national) GDP investment in the energy sector in Alberta will boost Canada's GDP by 0.9 percent, of which 0.82 percent of GDP will be in Alberta itself. This would translate into over 4 percent increase in Alberta's GDP (Alberta's share in national GDP is about 20 percent, and its GDP has been growing at an average real rate of 4¾ per year percent in 2010–12). The impact on, for example, Ontario's total GDP in this scenario would amount to only about 0.04 percent of national GDP or 0.1 percent of Ontario's GDP, suggesting limited spillovers. The overall GDP multiplier for Canada from oil sands investment in Alberta is somewhat higher in CERI (2011a)—1.01, but likely reflects the fact that this multiplier includes also the induced effects. Furthermore, CERI (2011a) finds a much stronger spillover to the U.S. (20 percent vs. only 2 percent in our case).

- **Higher energy production in the U.S.** A one percent of GDP exogenous increase in the final demand from the U.S. energy sector will increase the U.S. GDP by 0.94 percent of GDP, while Canada's GDP would go up by 0.14 percent or about 1¼ percent of Canada's GDP. Thus, developments in the U.S. energy sector impact Canada much more than the other way round. This may reflect the fact that the share of Canadian energy sector's imports from the U.S. is relatively small, so the spillover effect on the U.S. from the increased investment in Canada is not substantial. On the other hand, since the U.S. energy sector imports much energy and manufacturing from Canada, an increased investment/production in the U.S. has a larger impact on Canada.

| Table A1. Sectoral Mapping: Canadian Provinces | |
|---|---|
| Energy | Mining, quarrying, and oil and gas extraction (NAICS 21) |
| Manufacturing | Utilities& Manufacturing (NAICS 22, 31, 32, 33) |
| Agriculture | Crop and animal production, Forestry and logging,<br>Fishing hunting and Trapping, Support activities for agriculture and forestry (NAICS 11) |
| Other | Residential construction<br>Non-residential building construction<br>Engineering construction<br>Repair construction<br>Other activities of the construction industry<br>Wholesale trade<br>Retail trade<br>Transportation and warehousing<br>Information and cultural industries<br>Finance, insurance, real estate, rental and leasing and holding companies<br>Owner occupied dwellings<br>Professional, scientific and technical services<br>Administrative and support, waste management and remediation services<br>Educational services<br>Health care and social assistance<br>Arts, entertainment and recreation<br>Accommodation and food services<br>Other services (except public administration)<br>Non-profit institutions serving households<br>Government education services<br>Government health services<br>Other federal government services<br>Other provincial and territorial government services<br>Other municipal government services<br>Other aboriginal government services<br>(NAICS 23, 42, 44, 45, 48, 49, 51, 52, 53, 54, 56, 61, 62, 71, 72, 81, 92) |

| Table A2. Sectoral Mapping: United States | |
|---|---|
| Energy | Mining |
| Manufacturing | Utilities & Manufacturing |
| Agriculture | Agriculture, forestry, fishing, and hunting |
| Other | Construction<br>Wholesale trade<br>Retail trade<br>Transportation and warehousing<br>Information<br>Finance, insurance, real estate, rental, and leasing<br>Professional and business services<br>Educational services, health care, and social assistance<br>Arts, entertainment, recreation accommodation, and food services<br>Other services, except government<br>Government<br>Scrap, used and secondhand goods<br>Noncomparable imports and rest-of-the-world adjustment |

**Table A3. Estimated GDP Multipliers: Canada and the U.S. Input-Output Model, 2009**

| From \ To | | Canada | | | | United States | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Energy | Manuf. | Agric. | Other | Energy | Manuf. | Agric. | Other |
| Canada | Energy | 0.69 | 0.06 | 0.02 | 0.01 | 0.05 | 0.01 | 0.00 | 0.00 |
| | Manuf. | 0.03 | 0.42 | 0.12 | 0.04 | 0.04 | 0.01 | 0.01 | 0.00 |
| | Agric. | 0.00 | 0.02 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Other | 0.17 | 0.17 | 0.25 | 0.85 | 0.05 | 0.01 | 0.00 | 0.00 |
| United States | Energy | 0.00 | 0.01 | 0.01 | 0.00 | 0.67 | 0.04 | 0.01 | 0.00 |
| | Manuf. | 0.01 | 0.06 | 0.04 | 0.02 | 0.06 | 0.53 | 0.12 | 0.04 |
| | Agric. | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.51 | 0.00 |
| | Other | 0.01 | 0.04 | 0.02 | 0.01 | 0.21 | 0.24 | 0.25 | 0.90 |
| Canada - Total | | 0.89 | 0.68 | 0.79 | 0.90 | 0.14 | 0.02 | 0.02 | 0.00 |
| United States - Total | | 0.03 | 0.11 | 0.07 | 0.04 | 0.94 | 0.83 | 0.90 | 0.95 |

Source: IMF staff estimates.

**Table A4. Estimated GDP Multipliers: Disaggregated Provincial and the U.S. Input-Output Model, 2009**

| From \ To | | Alberta | | | | Ontario | | | | United States | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy | Manuf. | Agric. | Other | Energy | Manuf. | Agric. | Other | Energy | Manuf. | Agric. | Other |
| Alberta | Energy | 0.67 | 0.13 | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 |
| | Manuf. | 0.02 | 0.37 | 0.08 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| | Agric. | 0.00 | 0.02 | 0.31 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Other | 0.13 | 0.13 | 0.20 | 0.12 | 0.01 | 0.02 | 0.01 | 0.01 | 0.03 | 0.00 | 0.00 | 0.00 |
| Ontario | Energy | 0.00 | 0.00 | 0.00 | 0.00 | 0.64 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Manuf. | 0.01 | 0.01 | 0.01 | 0.00 | 0.03 | 0.37 | 0.08 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Agric. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Other | 0.03 | 0.04 | 0.04 | 0.02 | 0.15 | 0.13 | 0.21 | 0.82 | 0.01 | 0.00 | 0.00 | 0.00 |
| Other Canada | Energy | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| | Manuf. | 0.01 | 0.02 | 0.04 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| | Agric. | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Other | 0.02 | 0.06 | 0.08 | 0.05 | 0.02 | 0.04 | 0.04 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 |
| United States | Energy | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.67 | 0.04 | 0.01 | 0.00 |
| | Manuf. | 0.01 | 0.02 | 0.02 | 0.01 | 0.03 | 0.10 | 0.06 | 0.03 | 0.06 | 0.53 | 0.12 | 0.04 |
| | Agric. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.51 | 0.00 |
| | Other | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.06 | 0.04 | 0.02 | 0.21 | 0.24 | 0.25 | 0.90 |
| Canada - Total | | 0.90 | 0.80 | 0.81 | 0.34 | 0.88 | 0.63 | 0.77 | 0.89 | 0.14 | 0.02 | 0.02 | 0.00 |
| United States - Total | | 0.02 | 0.04 | 0.04 | 0.02 | 0.06 | 0.18 | 0.11 | 0.05 | 0.94 | 0.83 | 0.90 | 0.95 |

Source: IMF staff estimates.

# Appendix 2. IMF's Global Economy Model

**The GEM is a micro-founded DSGE model of the new open economy paradigm outlined in Lalonde and Muir (2007) and Pesenti (2008)**. In this analysis, we use a three-region version of the GEM, comprising Canada, the United States, and the Rest of the World, each modeled symmetrically. Firms produce non-tradable and tradable intermediate goods, energy (oil and natural gas), non-energy commodities, and retail fuels. The production of each sector is assumed to be monopolistically competitive, such that each firm is able to set a price above its marginal cost, allowing a markup.

**There are three major agents in the economy—firms, households and the government**. Firms combine intermediate goods to create investment, or combine them with the energy good (retail fuels) to create consumption.[24] Households supply labor and consume final goods (domestic or imported), and are either liquidity-constrained, consuming only from current income, or forward-looking with the ability to save. The government consists of a fiscal and a monetary authority, which follow standard balanced budget and core inflation targeting rules, respectively.

**For each region's external sector, all the bilateral flows of exports and imports of energy, commodities, and tradable intermediate goods are tracked**. Internationally-traded net foreign assets (NFA) are assumed to be denominated in U.S. dollars. External imbalances are bounded by the assumption that regions are targeting a specific NFA-to-GDP ratio. The cost of holding an excess balance of assets puts upward pressure on their bilateral U.S. dollar real exchange rate (which is also determined by a standard uncovered interest rate parity condition), which leads to a decrease in the current account in the short run, eliminating the external imbalances.

**In order to match the persistence observed in the data, the model includes real adjustment costs and nominal rigidities that are allowed to differ across regions**. We assume real adjustment costs in capital, investment, labor, and imports. Along with the presence of the fixed factor of production, real adjustment costs are the key to the speed of adjustment in the production and demand of energy and commodities, as well as the movement in their prices. Finally, nominal rigidities govern the setting of wages and prices of intermediate goods.

**A special emphasis is placed on the energy sector**. Each region has firms that produce energy by combining capital, labor, and crude oil reserves. Energy can be either used as an input (along with a capital-labor bundle and commodities) to produce intermediate goods, traded across regions, or further processed into retail fuels, such as heating fuels and automobile gasoline. The benchmark calibration allows for perfect mobility and substitution of energy across regions, although this can be easily modified when we use a three-region version.

[24] Such arrangement for production of consumption goods allows the identification of both headline consumer price index (CPI) inflation and core CPI inflation which excludes the effect of changes in energy prices.

**We look at three possible outcomes relative to our baseline scenario of 3 percent growth per year in energy production**. Scenarios are distinguished according to the assumptions about export infrastructure capacities:

- **Global Market scenario** where there would be no shortage of export infrastructure from year 1 on and Canada would be able to successfully market and export all extra energy production, as infrastructure grows apace with the expansion of its energy supply.
- **Segmented Market scenario** where export infrastructure capacities will remain largely unchanged over time and most of the new—but lower than in the baseline—energy production would remain in Canada.
- **Gradual Market Access scenario** is an intermediate case where infrastructure will gradually be built, lagging the increase in the energy supply. This case is not explicitly presented in the paper as it is essentially a linear combination of the Global and Segmented Market scenarios.

**We simulate these scenarios in tandem with the scenario of increasing U.S. energy production over the next 12 years as in IMF (2013b)**. Using this base case would have no significant effects on the qualitative outcome, but would minimize some of the quantitative effects. The concurrent increase in U.S. production would lead to stronger price movements from the Canadian production increase, because the real rigidities in the energy sector would be more binding, especially during the first half of the expansion in Canada's energy production.

**The standard version of the GEM easily represents the Global Market scenario**. For the Segmented Market scenario, the lack of infrastructure available for Canadian energy exports to the United States and abroad is proxied by calibrating the price elasticity of demand for imports to be inelastic outside of Canada. Therefore, as Canadian energy production increases, there is a near-prohibitive preference outside of Canada for energy produced in the United States and the rest of the world only. However, without new infrastructure and markets, Canada's increasing energy supply cannot be fully absorbed domestically, and hence, need to be cut.

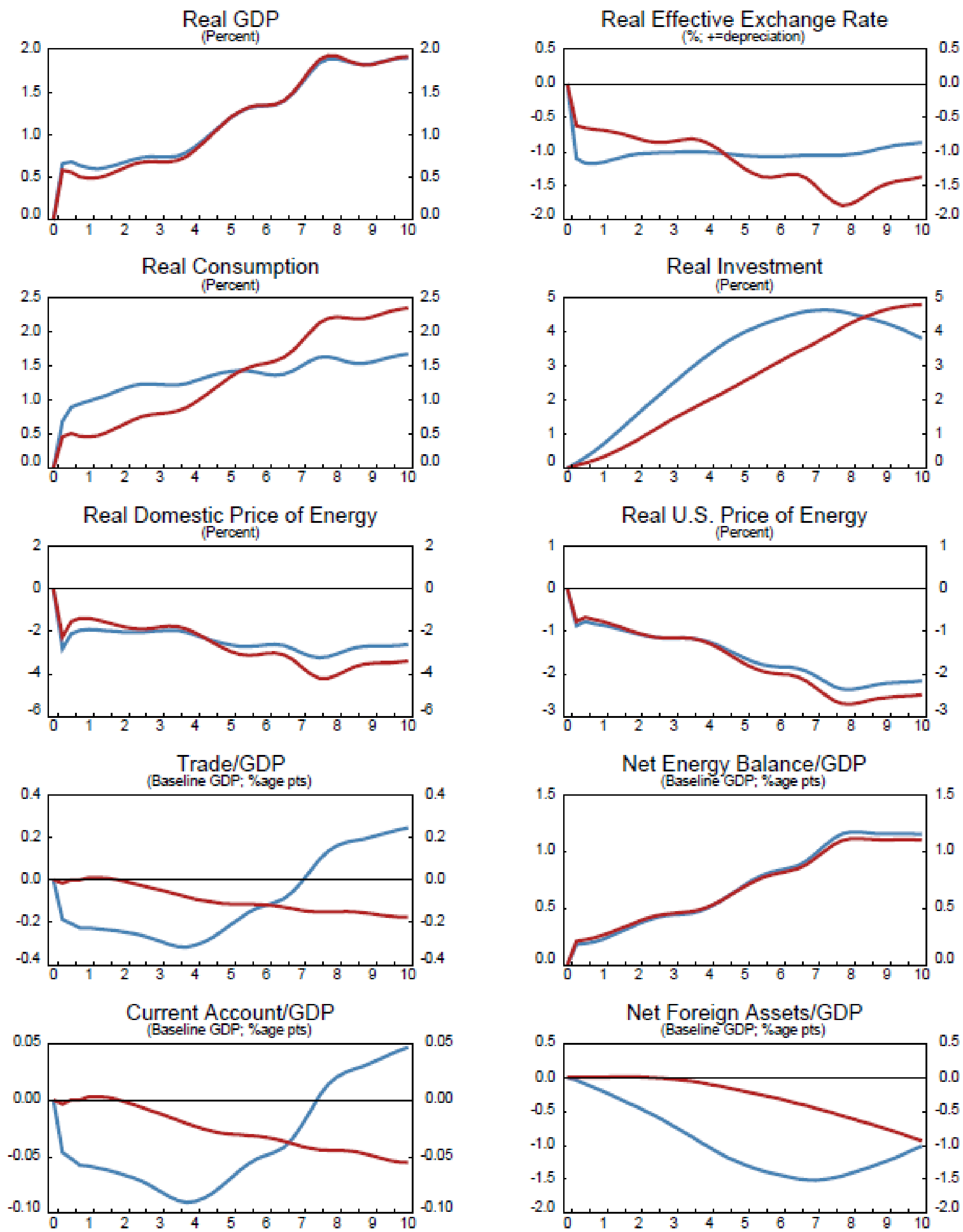
**There are two possible ways in which the expansion in the energy supply could unfold**. First, the path of the future expansion of the Canadian energy supply would be fully anticipated, and understood by all agents, reflected from the first period in their behavior. The other extreme would be if agents did not anticipate the increase in energy supply at all, and would be constantly surprised by the increase in production each period. This would lead to differing outcomes, particularly in Canada's current account balance.

**Figure A1. Permanent Increase in Canadian Energy Supply—Global Market Scenario**

Canada

___ is Anticipated ___ is Unanticipated

*(Deviation from control, unless otherwise stated)*



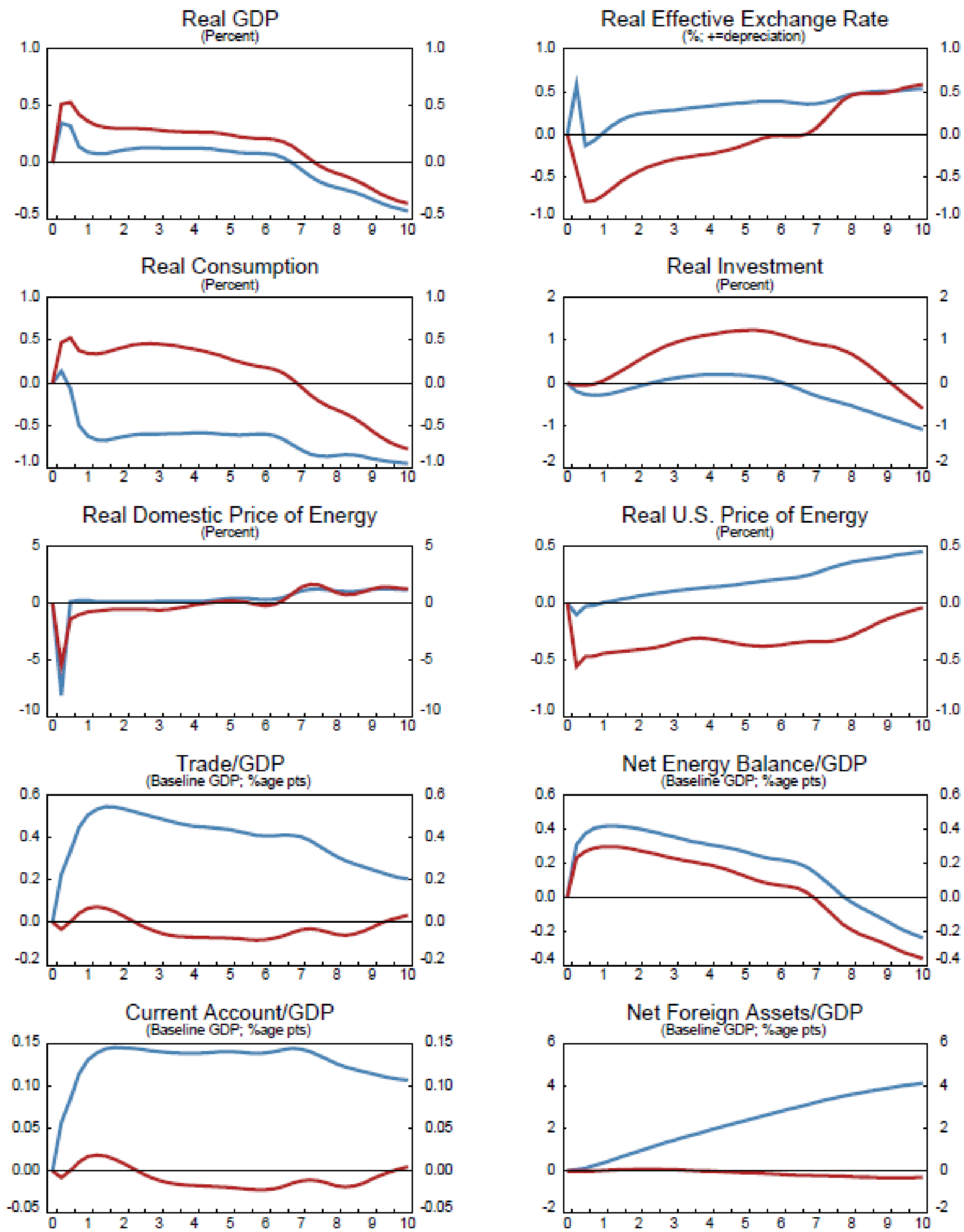
## Figure A2. Segmented Market Scenario

Canada

___ is Anticipated

*(Deviation from control, unless otherwise stated)*

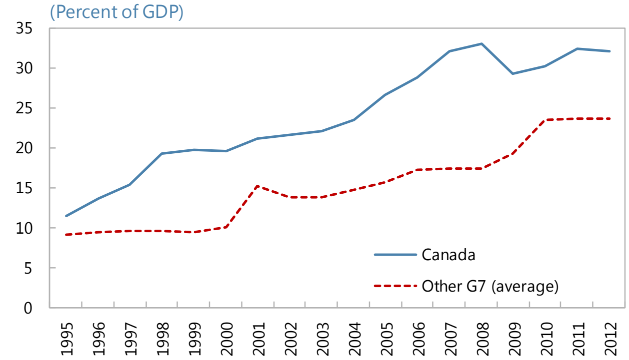
___ is Unanticipated



# IS "DEAD" MONEY ALIVE? A FIRM-LEVEL ANALYSIS OF CANADIAN NON-FINANCIAL LISTED CORPORATIONS CASH HOLDING AND CAPITAL EXPENDITURE BEHAVIOR[1]

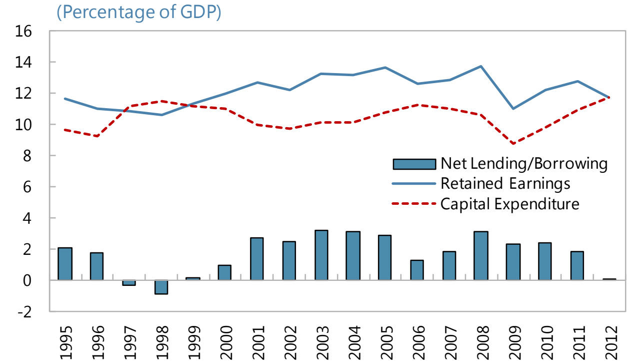
## A. Introduction

**1. The amount of cash held by Canadian non-financial firms has increased rapidly since the early 2000s.** Cash as a share of assets held by non-financial public and private corporations almost doubled between the mid-1990s and 2012.[2] While Canada is not unique in this respect, as the increase in corporate cash holding occurred in many other advanced economies, the increase in corporations' cash holdings in Canada has been the fastest among G7 countries since the mid 2000s (Chart).[3]



Sources: OECD; and IMF staff estimates.

**2. The increase in cash positions raised concerns that Canadian firms may be missing on productive investing possibilities.** The accumulation of cash has coincided with the Canadian non-financial corporate sector becoming a net lender of funds to other sectors of the economy, from being a net borrower. This is because the increase in corporate savings from late 1990s wasn't matched by an equivalent pickup in capital spending (Chart). This trend is not unique to Canada and has occurred in both



Sources: OECD; Haver Analytics.

[1] This SIP is a short version of a forthcoming IMF Working Paper "Cash Holding and Investment Behaviors of Canadian Non-Financial Corporations" by Ivo Krznar (MCM), Tim Mahedy and Julien Reynaud (all WHD).

[2] In this paper, cash is defined as currency and deposits.

[3] Poschmann (2013), however, notes that while Canadian businesses have increased the share of assets they hold as cash, they have simultaneously decreased their share of current assets held in non income-earning forms, such as inventories and accounts receivable.

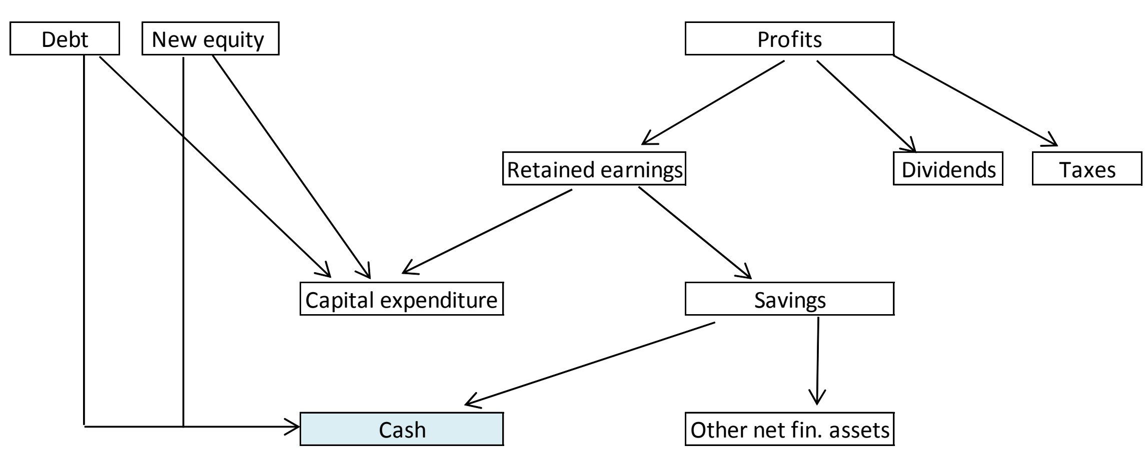
Germany and Japan, however; most G7 countries (UK, US, Italy and France) remain net borrowers as of 2012.

**3. This paper looks at the factors behind the accumulation of cash positions by Canadian non-financial corporations.** In particular, we look at whether this is the result of a deliberate decision by firms to cut their capital expenditure plans in order to increase the liquidity of their balance sheet positions. To do so, we use firm level data and estimate an empirical model of cash holdings as a function of several firms' characteristics.[4] Our results suggest that the increase of cash holdings of Canadian firms reflects greater precautionary demand for liquidity in an increasingly uncertain economic environment, and that firms that have greater holdings of cash are more likely to increase their capital spending in the future.

## B. Why do Firms Hold Cash?

**4. The increase in cash positions can be seen simply as the byproduct of other choices in firms' decision-making process (Figure 1).** With perfect capital markets, firms should be indifferent between financing their capital expenditure through retained earnings or through borrowing, as access to capital markets is not costly. In this case, firms have no reason to manage their cash positions as they change mechanically in line with firms' net profits or as the result of other businesses' decisions. In particular they change based on the size of the dividends to be distributed to the shareholders, the investment in physical capital, the amount of debt to repay, and the accumulation of financial assets (such as equities).

**Figure 1. Corporate Decision Making Tree**




[4] Our study is similar to McVanel, Darcey and Perevalov (2008), although their analysis focuses on the level of the cash-to-asset ratio of Canadian non-financial listed firms.

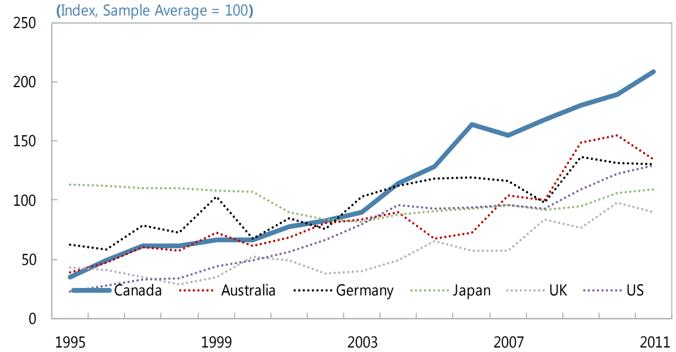
**5. However, greater cash holdings can also be the result of firms' decision to maximize shareholders' wealth.** With imperfect capital market and information asymmetries that make external financing costly, firms may decide to keep their cash holdings at a level that equates its marginal costs and benefits. The benefits derived from the reduced probability of being short of financing if profits fail to meet expectations, and, therefore, being forced to cut investment plans and/or dividend payments or having to raise costly external finance, could be higher than the cost of holding liquidity. Firms may thus increase their holdings of cash if they face a higher level of uncertainty and greater potential future investment needs—as the opportunity costs from having to forgo spending due to a of lack of adequate external funding is higher in these cases.[5]

## C. Data and Descriptive Statistics

**6. In order to assess whether the increase in cash positions reflect changes in the expected benefits and costs of cash holdings, staff uses firm-level data for Canadian listed, non-financial companies**. This study uses data from the Worldscope database covering about 3,500 Canadian non financial publicly listed firms for the period between 1990 and 2012. This gives the following insights:[6]

- *Comparison with other countries:* While the increase in cash holdings by non-financial corporations took place in several advanced economies, the increase in Canada has been much stronger (Chart). This may reflect cross country differences in the industry mix, as some industries tend to hold greater cash positions given their characteristics: for example, firms in sectors that need large infrastructures investments, as in the case of the energy sector, tend to hold more cash (Pinkowitz, Stulz and Williamson, 2012).

**Non-Financial Corporations Cash by Country**
(Index, Sample Average = 100)



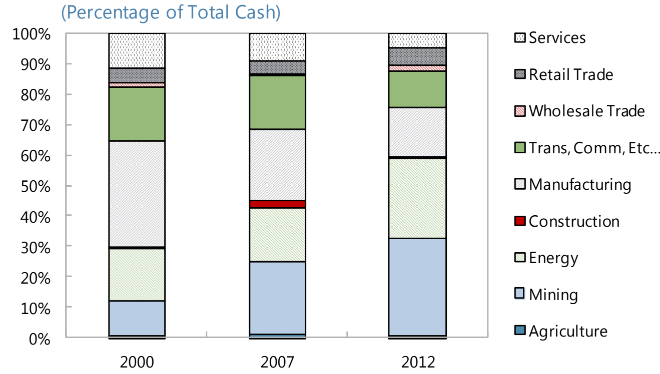

Source: Worldscope Database

[5] For detailed overview of the literature and a summary of empirical studies see Ogundipe, Ogundipe and Ajao (2012).

[6] Overall, listed companies accounted for nearly 40 percent of total firms' assets and 33 percent of total cash holdings according to the latest (2012) National Balance Sheet.

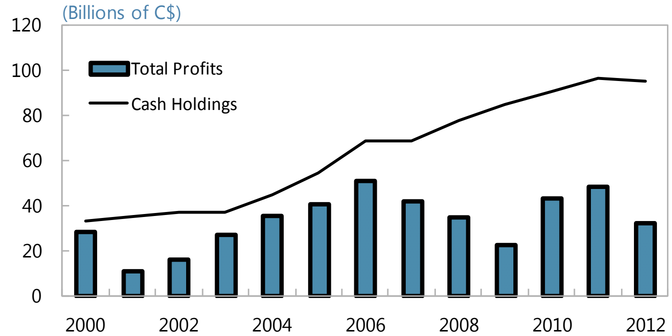
- *Sector:* Indeed, firms in Canada's energy and mining sectors have on average more than doubled their cash holdings since 2005 and accounted for roughly 60 percent of cash held in 2012.[7] The steep rise in cash holdings in both the mining and energy sectors more than compensated for the decline in cash holding of manufacturing firms (Chart).

**Total Cash Holdings by Sector**
(Percentage of Total Cash)




- *Profits:* The increase in cash holdings coincided with an increase in corporate profits, except during the Great Recession (Chart). To a large part, the growth in aggregate profitability in our sample was driven mainly by firms in oil extraction and utilities sectors. At firm level, firms with higher profitability also tended to accumulate greater cash holdings, consistent with interpreting the increase in cash positions as a byproduct of stronger earnings over the last decade.

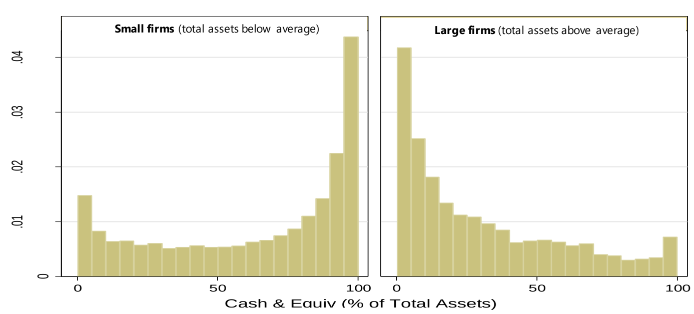
**Corporate Profits and Cash Holdings**
(Billions of C$)




Source: Worldscope Database

- *Size:* Relatively smaller Canadian non-financial firms in our sample tend to hold more cash, as a share of their assets, than large firms (Chart). This is consistent with the hypothesis that smaller firms may have relatively greater cash positions as they find more difficult to access external funding. Yet, the aggregate increase in cash holdings in our sample of Canadian firms has been driven by the 25 largest firms (13 of which are in the energy and mining

**Cash-to-asset Ratio by Firms' Size**
(Number of firms/year by percent of total asset)




Sources: Worldscope; and IMF staff calculations.

[7] The lack of coverage of SMEs implies a bias in sector coverage in favor of good producing sectors, as two-thirds or Canadian SMEs are in service sectors.

sector), as they accounted for nearly 50 percent of cash holdings in our sample in 2012.

- *Capital expenditure:* firms with the greatest increase in their cash positions since early 2000s are also those that have had the largest increase in capital spending. This result may also reflect a sectoral bias: close to 90 percent of the increase in capital spending in the sample is accounted by firms in the energy and mining sectors, which have also seen the largest accumulation of cash. Capital spending has also increased sharply on average for firms in construction sector, while it has fallen in the manufacturing sector.

## D. Why do Canadian Non-Financial Firms Hold More Cash?

**7. We estimate a model of cash holdings for Canadian non-financial firms.** To complement the set of bivariate correlations described in the previous sections we run a multivariate panel regression that relates the change in cash, ΔV, (defined as natural logarithms of the sum of cash and cash equivalents[8]) of Canadian firms on our sample to a series of firms' characteristics.[9] Doing this we also aim at controlling for the sectoral biases in our sample. The regression model is

$$\Delta V_{i,t} = \alpha_i + \alpha_t + \sum_{c=1}^{n} \beta_c \, \Delta Control_{c,i,t} + \varepsilon_{i,t}$$

where *i* represents a firm, and *t* time (year).[10] Among the firms' specific variables in Control we include variables that proxy for different motives for cash holdings: *Market-to-book asset ratio*, *R&D expenditures*, *capital expenditures*, and *company acquisitions* proxy for investment/growth opportunities. *Firm size*, *dividend payments*, *equity issuance,* and *leverage*[11] proxy for financial constraints.[12] *Cash flow volatility*, defined as the rolling standard deviation of cash flow over the period of 5 years, proxies for uncertainty. Two macroeconomic variables were also included: (i) *terms of trade*[13] to control for a main driver of aggregate demand in a small open economy with a vast

[8] Cash and cash equivalents are the most liquid balance sheet assets. Cash equivalents are asset investment securities that are short-term, have high credit quality and are highly liquid.

[9] To avoid survivor bias, both currently active firms and firms that no longer exist due to a bankruptcy or merger/acquisition are included.

[10] As in related studies (for example McVanel and Perevalov, 2008, and Bates, Kahle and Stulz, 2009) we use firm fixed-effects to control for unobserved firms' characteristics. Cash holdings could also increase over time for reasons unrelated to firms' characteristics, such as improvements in technology that affect firms throughout the economy but not uniformly across time. We therefore include year dummies in all our estimations.

[11] Leverage is defined as debt over equity.

[12] On the other, high leverage might imply lower capacity to rise capital suggesting that highly levered firms would hold more cash for precautionary motives.

[13] Terms of trade is defined as the price of exports of goods and services divided by the prices of imports of goods and service, yearly averaged of quarters values, indexed in 2002=100.

resource endowment like Canada, and (ii) the *effective corporate income tax ratio*[14], measured on average by sector, which directly affects profitability.[15]

**8. Our findings suggest that the increase in cash positions in Canada in recent years at least partly reflects greater precautionary demand for cash in an increasingly uncertain economic environment.** Firms that see stronger growth opportunities (increases in market-to-book ratio and spending in R&D) tend to increase their cash holdings (Table 1 Columns 1–5). As they become larger and more leveraged, firms tend to reduce their cash holdings, possibly as they see their financial constraint relaxed. Also, an increase in the volatility of cash flows is associated with larger cash positions. Figure 2 shows that there is a positive and significant relation between cash holdings and the prices of sectors more exposed to boom-bust cycles (oil and gas prices, house prices and gold prices). Since these sectors are subject to large swings in prices and accentuated cyclical fluctuations, Canadian firms may have been induced to accumulate extra cash buffers over the last decade. All this suggests that precautionary motives have played an important role in the decision to hold more cash, in particular over the recent past. Running our model only during the post-Great Recession period shows that an increase in cash holdings can be mainly explained by an increase in cash volatility and market capitalization (Table 1, Column 6). At the same time, including the terms of trade variable in the regression improves its explanatory power, and tax cuts are found to be associated with an increase in cash holdings. This suggests that the increase in cash positions is also the result of better profitability conditions for Canadian corporations following the positive terms of trade shock and lower corporate taxation since mid-2000s (Table 1, Columns 3–5).

**9. Holding more cash today signals more investment in the future.** In the model for cash flows changes, an increase in capital spending is associated with a decline in cash positions, which may reflect the "residual" nature of cash holdings. But when we include the amount of capital expenditures done in the future (in years *t+1*) as an explanatory variable, we find those variables to be statistically significant, and with a positive coefficient, suggesting that firms with higher levels of cash holdings at year *t* tend to increase their investments in physical capital in years *t+1* (Table 1, Column 7). To check whether this result is driven by firms in the energy and mining sector we perform sector-levels regressions, and found that higher cash holdings are systematically associated with higher capital expenditure within each sector (Table 2). Two further tests confirm that greater cash positions may lead to more capital spending. First, a simple pairwise causality test on the average cash holdings and capital expenditures by sectors shows that cash holdings help predict capital expenditures in most sectors (in particular, mining, energy, construction, transportation and

[14] We do not consider repatriation taxes even though they play an important role on level of cash in some countries (e.g. the U.S., see Hartzell, Titman, Twite, 2006 and Hanlon, Maydew, Saavedra, 2013). The reason is that many countries are included in Canada's tax treaty network that exempts dividends repatriated from affiliates located in tax treaty partner country from domestic taxation (see Smart, 2000).

[15] In Canada, interest payments on debt are deductable, providing a tax shield.

utilities and retail trade). Second, a causality test for panel data model show that past cash holdings at the firm level help predict future capital expenditures, both in levels and changes.[16]

## E. Conclusions

**10. The increase in cash position of Canadian non-financial firms over the last decade could reflect the desire to increase the liquidity of balance sheet positions in anticipation of greater capital spending.** Focusing only on listed firms and running a model of changes in cash holdings suggest that greater macroeconomic and business uncertainty may have induced firms to raise the cash buffer at their disposal over the last decade. This is especially the case for firms in the energy and mining sector, which account for the majority of cash accumulation in our sample. Our analysis also shows that firms' high cash balances are typically associated with higher levels of capital expenditure, which bodes well for the acceleration of business investment in the near future.

[16] We use the Dumitrescu-Hurlin (2012) procedure that provides a test statistic based on the individual firms Wald statistics of Granger non causality averaged across the cross-section units.

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## Table 1. Regressions results - Cash and Equivalents

| | (1) Base | (2) Base with Level | (3) Base with Taxes | (4) Base with Terms of Trade | (5) Base with Taxes and Terms of Trade | (6) Base over 2009-12 period | (7) Base with lead in Capital Expenditure |
|---|---|---|---|---|---|---|---|
| Acqusitions | -0.00344** | -0.00297*** | -0.00363* | -0.00344** | -0.00363* | -0.00605** | -0.00214 |
| | (0.00142) | (0.00115) | (0.00202) | (0.00142) | (0.00202) | (0.00306) | (0.00147) |
| Total debt | -0.0163*** | -0.00810*** | -0.0145*** | -0.0163*** | -0.0145*** | -0.0151*** | -0.0155*** |
| | (0.00169) | (0.00137) | (0.00224) | (0.00169) | (0.00224) | (0.00281) | (0.00171) |
| Market capitalization | 0.381*** | 0.249*** | 0.482*** | 0.381*** | 0.482*** | 0.475*** | 0.346*** |
| | (0.011) | (0.00898) | (0.0171) | (0.011) | (0.0171) | (0.0196) | (0.0105) |
| Equity issued | 0.0188*** | 0.0161*** | 0.0168*** | 0.0188*** | 0.0168*** | 0.0186*** | 0.0212*** |
| | (0.00122) | (0.000988) | (0.00164) | (0.00122) | (0.00164) | (0.0019) | (0.0013) |
| Capital expenditure | -0.0292*** | -0.0475*** | -0.0328*** | -0.0292*** | -0.0328*** | -0.0203* | |
| | (0.0069) | (0.0056) | (0.00929) | (0.0069) | (0.00929) | (0.0108) | |
| Dividends | -0.00143 | -0.000587 | -0.00149 | -0.00143 | -0.00149 | 0.00105 | -0.0036 |
| | (0.00298) | (0.00242) | (0.00358) | (0.00298) | (0.00358) | (0.00548) | (0.00333) |
| Cash volatility | 0.00585*** | -0.00292 | 0.00756*** | 0.00585*** | 0.00756*** | 0.0110*** | 0.0072* |
| | (0.00224) | (0.00182) | (0.00247) | (0.002240 | (0.00247) | (0.00367) | (0.00307) |
| R&D to total assets | 0.0100*** | 0.00242 | 0.00909*** | 0.0100*** | 0.00909*** | 0.0112*** | 0.0105*** |
| | (0.00238) | (0.001930 | (0.003220 | (0.00238) | (0.00322) | (0.00338) | (0.00258) |
| Size dummy | 0.0806 | -0.600*** | 0.0015 | 0.0806 | 0.0015 | 0.00767 | 0.1293** |
| | (0.0612) | (0.05010 | (0.0956) | (0.0612) | (0.0956) | (0.159) | (0.06259) |
| Cash | | 0.704*** | | | | | |
| | | (0.00711) | | | | | |
| Taxes | | | -0.0415*** | | -0.0415*** | | |
| | | | (0.0153) | | (0.0153) | | |
| Terms of Trade | | | | 0.0287** | 0.0145*** | | |
| | | | | (0.0134) | (0.00526) | | |
| Capital expenditure *(t+1)* | | | | | | | 0.0649*** |
| | | | | | | | (0.0071) |
| Constant | 0.228** | 0.722*** | 0.05 | 0.285** | -0.0287 | -0.226*** | -0.011 |
| | (0.112) | (0.0912) | (0.0738) | (0.137) | (0.0609) | (0.049) | (0.115) |
| Observations | 22,364 | 22,364 | 12,327 | 22,364 | 12,327 | 9,444 | 22,354 |
| R-squared | 0.118 | 0.421 | 0.134 | 0.118 | 0.134 | 0.153 | 0.119 |
| Number of firms | 3,581 | 3,581 | 2,829 | 3,581 | 2,829 | 2,771 | 3,581 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

## Table 2. Regressions results - Capital Expenditure

| | (1) Capital Expenditure | (2) Capital Expenditure and Terms of Trade | (3) Capital Expenditure in Mining | (4) Capital Expenditure in Energy (Oil) | (5) Capital Expenditure in Energy (Gas) | (6) Capital Expenditure in Manuf. | (7) Capital Expenditure in Utilities | (8) Capital Expenditure in Wholesale | (9) Capital Expenditure in Retail | (10) Capital Expenditure in Services |
|---|---|---|---|---|---|---|---|---|---|---|
| Cash (difference) | -0.185*** | -0.185*** | -0.229*** | -0.159*** | -0.159*** | -0.101*** | -0.0748*** | -0.0393 | -0.0506* | -0.148*** |
| | (0.00659) | (0.00659) | (0.00665) | -0.0138 | -0.0138 | -0.0144 | -0.0241 | -0.0389 | -0.0293 | -0.0213 |
| Cash | 0.338*** | 0.338*** | 0.413*** | 0.263*** | 0.263*** | 0.169*** | 0.168*** | 0.0760* | 0.128*** | 0.306*** |
| | (0.00794) | (0.00794) | (0.00803) | -0.0171 | -0.0171 | -0.0171 | -0.0294 | -0.0456 | -0.0332 | -0.0251 |
| Terms of trade | | 0.0310*** | | | | | | | | |
| | | (0.00311) | | | | | | | | |
| Terms of trade (lag) | | 0.0123*** | | | | | | | | |
| | | (0.00464) | | | | | | | | |
| Gold price | | | 0.886*** | | | | | | | |
| | | | (0.207) | | | | | | | |
| WTI crude oil spot price | | | | 0.175*** | | | | | | |
| | | | | -0.0346 | | | | | | |
| HH natural gas spot price | | | | | 1.180*** | | | | | |
| | | | | | (0.165) | | | | | |
| Constant | -0.106 | -4.547*** | -6.562*** | 0.314 | -3.053*** | 0.249* | 1.500*** | 0.556** | 1.362*** | -0.840** |
| | (0.0934) | (0.695) | (1.525) | (0.281) | (0.735) | (0.13) | (0.208) | (0.272) | (0.208) | (0.334) |
| Observations | 26,345 | 26,345 | 10,038 | 4,974 | 4,974 | 5,013 | 1,719 | 564 | 717 | 2,947 |
| R-squared | 0.122 | 0.122 | 0.191 | 0.155 | 0.155 | 0.043 | 0.105 | 0.103 | 0.149 | 0.090 |
| Number of Firms | 3,760 | 3,760 | 1,554 | 787 | 787 | 598 | 199 | 69 | 80 | 424 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Figure 2. Commodity Prices and the Cash-to-Asset Ratio**